Prepared in cooperation with the Idaho Department of Lands and Midas Gold Idaho, Inc.

Arsenic, Antimony, Mercury, and Water Temperature in Streams near Stibnite Mining Area, Central Idaho, 2011–17

Scientific Investigations Report 2019–5072

U.S. Department of the Interior
U.S. Geological Survey

Cover: East Fork of South Fork Salmon River at Stibnite, Idaho. (Photograph taken by Austin Baldwin, U.S. Geological Survey, August 10, 2016.)

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic yard (yd^3)	0.7646	cubic meter (m^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Mass	
ton per day (ton/d)	0.9072	metric ton per day
ton per year (ton/yr)	0.9072	metric ton per year

Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Volume	
milliliter (mL)	0.033814	ounce, fluid (fl. oz)
liter (L)	0.2642	gallon (gal)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8×°C)+32$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to feed above NAVD 88.

Abbreviations

BCF	bias correction factor
BFI	base-flow index
CCC	criterion continuous concentration, or “chronic” aquatic-life criterion
CMC	criterion maximum concentration, or “acute” aquatic-life criterion
EF1	East Fork of South Fork Salmon River above Meadow Creek, near Stibnite, Idaho
EF2	East Fork of South Fork Salmon River at Stibnite, Idaho
EF3	East Fork of South Fork Salmon River above Sugar Creek, near Stibnite, Idaho
EFSFSR	East Fork of South Fork of the Salmon River
HHB	human-health based criterion
MDAT-CW	maximum daily average water-temperature criterion for cold-water aquatic life
MDAT-SS	maximum daily average water-temperature criterion for salmonid spawning
MDMT-SS	maximum daily maximum water-temperature criterion for salmonid spawning
MSPE	model standard percentage error
MWMT-BT	maximum weekly maximum water-temperature criterion for bull trout habitat
NWQL	National Water Quality Laboratory
QA/QC	quality-assurance/quality-control
QBFI	streamflow weighted by base-flow index
R^2	coefficient of determination
RPD	relative percent difference
SWE	snow-water equivalent
USGS	U.S. Geological Survey

Arsenic, Antimony, Mercury, and Water Temperature in Streams near Stibnite Mining Area, Central Idaho, 2011–17

By Austin K. Baldwin and Alexandra B. Etheridge

Abstract

Mineralization and historical mining of stibnite (antimony sulfide), tungsten, gold, silver, and mercury in the headwaters of the East Fork of the South Fork Salmon River (EFSFSR) near the former town of Stibnite in central Idaho resulted in water-quality impairments related to mercury, antimony, and arsenic. Additionally, mining-related disturbances and wildfires have resulted in a lack of riparian shade in some areas, likely impacting water temperatures. In 2011, the U.S. Geological Survey, in cooperation with Midas Gold Corporation and the Idaho Department of Lands, began a study to characterize the spatial and temporal occurrence of trace metals to the EFSFSR. Five sites on the EFSFSR and its tributaries (Meadow and Sugar Creeks) were sampled about six times annually during 2011–17, during a range of streamflow conditions, for a total of 36–40 samples per location. Continuous water temperature, specific conductance, and streamflow also were measured at each site. The purpose of this report is to update previously reported information related to arsenic, antimony, mercury, and water temperature.

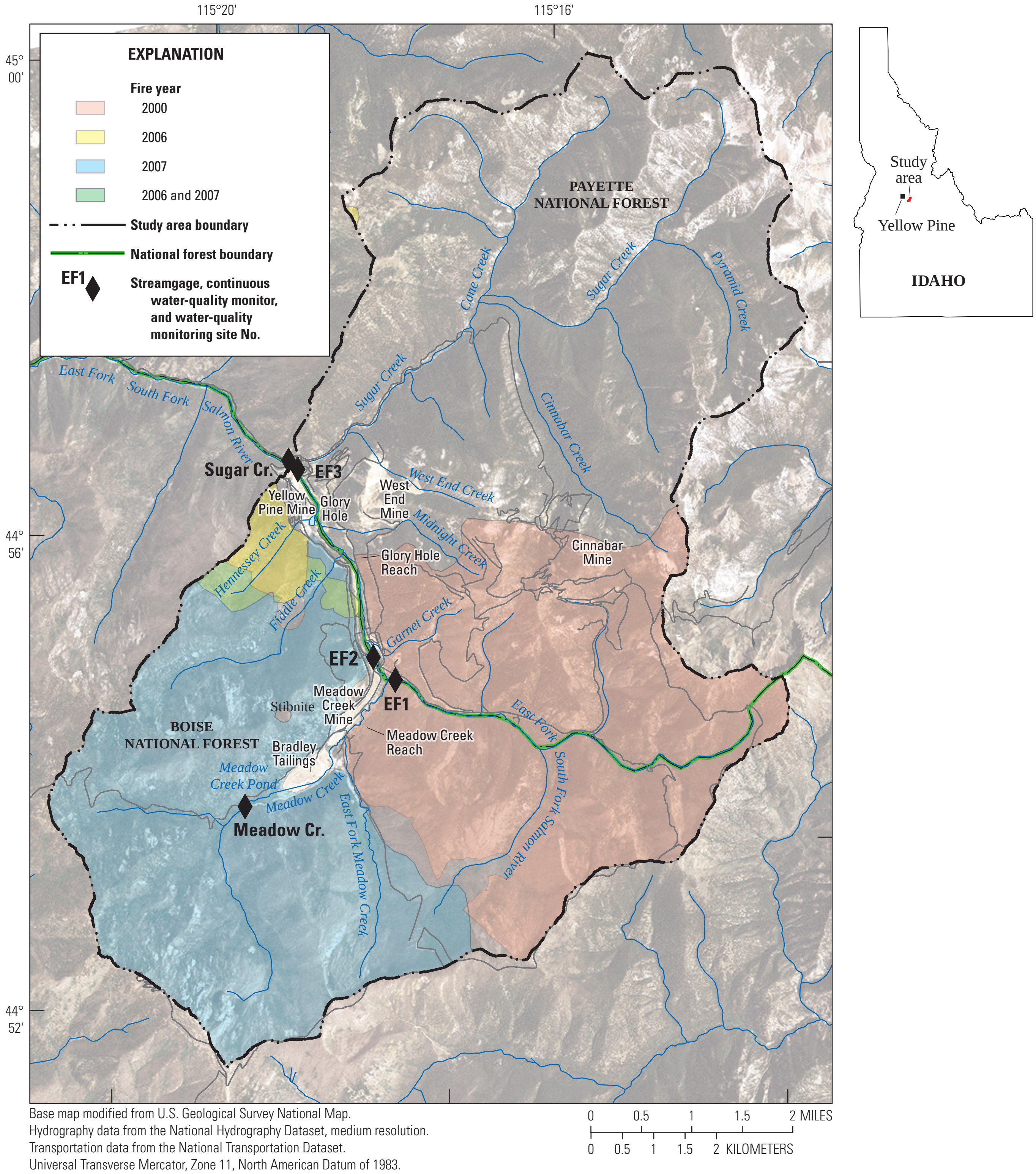
Concentrations of dissolved arsenic and antimony generally increased from upstream to downstream in the EFSFSR. At the upstream site, upstream of the Meadow Creek confluence, dissolved arsenic and antimony concentrations averaged 8.86 and 0.93 micrograms per liter (µg/L), respectively. Downstream, upstream from the Sugar Creek confluence, average dissolved concentrations increased to 56.5 and 27.9 µg/L, respectively. All samples from the downstream EFSFSR site exceeded the human-health based criterion for both dissolved arsenic (10 µg/L) and dissolved antimony (5.6 µg/L). The chronic aquatic life criterion for dissolved arsenic (150 µg/L) was not exceeded (the maximum sample concentration was 108 µg/L), and aquatic life criteria for antimony have not been established. The highest concentrations of both dissolved arsenic and dissolved antimony occurred during low-flow periods (July–March), suggesting the constituents are present in groundwater. In contrast, total mercury concentrations were highest during high-flow periods (April–June) and were particulate-associated, suggesting that mercury is present in surface materials. At Sugar Creek, where the highest total mercury concentrations were measured, 97 percent of samples exceeded the chronic aquatic life criterion (0.012 µg/L) and 11 percent exceeded the acute criterion (2.1 µg/L). At all sites, summertime water temperatures frequently exceeded criteria related to salmonid spawning.

Surrogate models previously developed to estimate continuous concentrations of arsenic, antimony, and mercury were reevaluated and updated, and the importance of explanatory variables on constituent concentrations is discussed. Results from this study can help guide future remediation locations and strategies, and provide a baseline against which future changes can be measured.

Introduction

The Stibnite mining area (study area) is in Boise and Payette National Forests, 14 miles southeast of Yellow Pine, Idaho (fig. 1). The area was intermittently mined for gold, silver, mercury, antimony, arsenic, and tungsten from 1919 to 1997. During World War II, the Stibnite mining area produced 90 percent of the antimony (Klahr, 1987) and the majority of the tungsten (Mitchell, 2000) for the Allied war effort. Mining operations took place at Meadow Creek Mine in the Meadow Creek valley between 1919 and 1938; at Yellow Pine Mine in the area surrounding the Glory Hole (a pit lake, also known as the Yellow Pine Pit) between 1937 and 1952; and at West End Mine in areas near West End Creek and Garnet Creek between 1982 and 1997 (fig. 1). Cinnabar Mine was operated intermittently between 1902 and 1966 in the Cinnabar Creek drainage, which is a tributary to Sugar Creek (fig. 1). Additional mineralized areas that have not yet been mined also contribute to the impairment of water quality in the study area; however, identification and characterization of the unmined mineralized areas was not the focus of this work.

The study area is the headwaters of the East Fork South Fork Salmon River (EFSFSR), which, together with the South Fork Salmon River (SFSR), supports one of the most intact assemblages of native fishes in the Columbia River Basin (U.S. Forest Service, 2017). The EFSFSR is designated critical habitat for Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and westslope cutthroat trout (*O. clarki lewisi*), all of which are listed as threatened, endangered, or sensitive (Idaho Department of Environmental Quality, 2002).



Base map modified from U.S. Geological Survey National Map.
Hydrography data from the National Hydrography Dataset, medium resolution.
Transportation data from the National Transportation Dataset.
Universal Transverse Mercator, Zone 11, North American Datum of 1983.

Figure 1. Streamgaging and water-quality monitoring sites near Stibnite mining area, central Idaho, 2011–17.

Historical mining-related activities have altered stream configuration and habitat in the study area. Mill tailings and spent ore were disposed directly into Meadow Creek (1930 to about 1946) and in impoundments (after about 1946) covering 100 acres of the Meadow Creek valley floor during active mining periods. The Meadow Creek stream channel was diverted around tailings and reconstructed several times to mitigate effects on water-quality from tailings. A hydroelectric dam constructed in the East Fork of Meadow Creek to power mining operations failed in 1965; the release of water transported and redistributed existing tailings and debris in the floodplain further downstream. Waste-rock dumps were generated upstream and downstream of the Glory Hole, and the EFSFSR was diverted around the Glory Hole beginning in 1938. After 1955, the Glory Hole was allowed to fill with water and remain part of the EFSFSR channel. An estimated 3,000 cubic yards of mercury-laden tailings deposited near the Cinnabar Mine on Cinnabar Creek act as a substantial source of mercury in Cinnabar and Sugar Creeks (Trainor, 2003).

These and other alterations of a strongly mineralized area resulted in water-quality impairments with implications for aquatic and human health (Etheridge, 2015). Previous water-quality investigations reported exceedances of chronic freshwater ambient water-quality criteria for arsenic, free cyanide, lead, mercury, silver, and zinc, and elevated concentrations of antimony (Trainor, 1993; URS Corporation, 2000; Etheridge, 2015).

Midas Gold Idaho, Inc., is conducting mineral exploration activities as part of the Stibnite Gold Project to better define the potential of mineral deposits in the Stibnite mining area. The exploration project identified a need to evaluate existing water-quality conditions in the study area and to identify potential source areas to target further reclamation efforts to be completed prior to or incorporated into plans for renewed mining activity. To help characterize water quality conditions, the U.S. Geological Survey (USGS), in cooperation with the Idaho Department of Water Resources (IDWR) and Midas Gold Idaho, Inc. (and later the Idaho Department of Lands), began a water-quality study in the area in 2011. Streamflow, water temperature, and specific conductance were measured continuously at five sites in the study area. Trace element and suspended-sediment concentrations were sampled at the same sites approximately every other month between October 2011 and present.

The USGS published results from the initial study period, October 2011–September 2014 (Etheridge, 2015). That report included concentration summaries of 20 trace elements from 5 sampling sites, each with 20–24 samples. The majority of the sampled trace elements were found to occur at concentrations below aquatic water-quality criteria and human-health based (HHB) criteria. Arsenic, antimony, and mercury were the only trace elements with frequent criteria exceedances. Etheridge (2015) developed surrogate models to continuously estimate concentrations of arsenic, antimony, and mercury using specific conductance, streamflow, and other variables. Using continuous water temperature data, Etheridge showed that water temperature frequently exceeded salmonid and bull trout criteria during the initial study period.

Purpose and Scope

In the current report, additional monitoring data are used to update findings from Etheridge (2015), focusing on arsenic, antimony, mercury, and water temperature. This update is warranted because the study period has increased from 3 to 6 years, and the average number of samples at each site has increased from 22 to 38. The expanded study period includes 2017, a high water year in which mean daily streamflows at the five monitoring sites were 35–47 percent higher than in any previous study year. The expanded dataset representing more years, with more samples, improves our understanding of inter-annual variability, resulting in more relevant and robust characterizations of water quality under varying streamflow conditions. Specific objectives of this report include:

- Evaluate spatial and temporal occurrence of trace metals in the study area (that is, upstream to downstream, by watershed, and relative to streamflow and season);
- Assess exceedances of water-quality criteria;
- Update the original surrogate models and evaluate the importance of different explanatory variables on constituent concentrations.

Description of Study Area

The five monitoring sites discussed in this report are located in the Stibnite mining area in Valley County, central Idaho (fig. 1; table 1**;** described in detail in Etheridge, 2015). Three of the monitoring sites are located on the main-stem EFSFSR, upstream of the confluence with Sugar Creek. A fourth monitoring site is located on Sugar Creek, just upstream of the confluence with the EFSFSR. Within the Sugar Creek basin is the abandoned Cinnabar mercury mine, an area of known mercury contamination (Trainor, 2003). The fifth monitoring site is located on Meadow Creek, upstream of the historical mill tailings and spent ore disposal area. The Meadow Creek site is meant to characterize unmineralized background water-quality conditions, but is not meant to represent the pre-mining water-quality conditions of the entire study area. Even prior to mining, the extensive mineralization of the study area downstream of the Meadow Creek site may have resulted in increased trace metal concentrations in surface waters.

Table 1. Streamgaging and water-quality monitoring sites near the Stibnite mining area, central Idaho, 2012–17.

Abbreviated site name	Site No.	Streamgaging and water-quality monitoring site name
Meadow Cr.	13310850	Meadow Creek near Stibnite, Idaho
EF1	13310800	East Fork of South Fork Salmon River above Meadow Creek, near Stibnite, Idaho
EF2	13311000	East Fork of South Fork Salmon River at Stibnite, Idaho
EF3	13311250	East Fork of South Fork Salmon River above Sugar Creek, near Stibnite, Idaho
Sugar Cr.	13311450	Sugar Creek near Stibnite, Idaho

Study Methods

The methods used in this study were described previously (Etheridge, 2015). Briefly, water-quality and streamflow monitoring began at five sites between autumn 2011 and spring 2012 and is ongoing at the time of this report's publication (table 1; fig. 1). Continuous monitors were used to measure water temperature and specific conductance on a 15-minute interval at each site, operated according to USGS procedures (Wagner and others, 2006). Monitors were typically removed in winter because of limited access and to prevent ice-related damage. Stream stage height was measured at each site on a 15-minute interval throughout the study period and was used to estimate streamflow using standard USGS methods (Rantz and others, 1982).

Approximately six water-quality samples were collected annually at each site on a set interval, representative of a range of streamflow conditions and seasons. Water-quality samples were collected using cross-sectional, depth-integrating methods. Sampling equipment and procedures were consistent with those described in the USGS National Field Manual for the collection of trace metals (U. S. Geological Survey, variously dated). Samples for dissolved analyses were filtered through a pre-rinsed, 0.45-micrometer (µm) pore size, disposable capsule filter. Arsenic and antimony samples were preserved with 2 milliliters of Ultrex® nitric acid. Mercury samples were preserved with 2 mL of Omni-Trace® hydrochloric acid. Samples were shipped to the USGS National Water Quality Laboratory in Denver, Colorado.

Samples were analyzed at the USGS National Water Quality Laboratory using established analytical techniques. Arsenic and antimony concentrations were determined by atomic absorption spectrometry in conjunction with a graphite furnace and inductively coupled plasma-mass spectrometry (Fishman and Friedman, 1989; Fishman, 1993; Hoffman and others, 1996; Garbarino and Struzeski, 1998; Garbarino and others, 2006). Mercury concentrations were determined by atomic fluorescence spectrometry (Garbarino and Damrau, 2001).

Quality-assurance/quality-control (QA/QC) procedures included field blanks and field replicates, which are summarized in tables 2 and 3, respectively. Dissolved antimony was detected in 13.9 percent of field blanks (n=36), with a maximum concentration of 0.11 µg/L, and dissolved arsenic was detected in 8.3 percent of field blanks (n=36), with a maximum concentration of 0.06 µg/L. Total antimony and total arsenic (n=36 each) and dissolved and total mercury (n=24 and 27, respectively) were not detected in field blanks. The field-blank detections of dissolved but not total antimony and arsenic suggest occasional contamination during filtration of the dissolved samples, either from the pump hose or the capsule filter. Relative to environmental concentrations in this study, the detected concentrations of dissolved antimony and arsenic in field blanks are low.

Field replicate pairs of dissolved and total antimony and arsenic had median relative percent differences (RPD) of 0.7–1.55 percent (n=22 each). Field replicate pairs of dissolved and total mercury had median RPDs of 12.6 percent and 27.5 percent, respectively.

Table 2. Summary of results from field blanks from streams near Stibnite mining area, central Idaho, 2011–17.

[**Abbreviation**: µg/L, microgram per liter]

Constituent	Number of blanks	Blanks with detected concentrations (percent)	Maximum detected concentration (µg/L)
Antimony, dissolved	36	13.9	0.11
Antimony, total	36	0	ND
Arsenic, dissolved	36	8.3	0.06
Arsenic, total	36	0	ND
Mercury, dissolved	24	0	ND
Mercury, total	27	0	ND

Table 3. Summary of results from field replicate pairs from streams near Stibnite mining area, central Idaho, 2011–17.

[**RDP**: Relative percent difference, calculated using the absolute value of the difference between the result pair, divided by the mean of the result pair and multiplied by 100]

Constituent	Total replicate pairs	Replicate pairs with detected concentrations in both samples: Number of pairs	Median RPD	Mean RPD	Standard deviation of RPD	Maximum RPD	Number of replicate pairs with detected concentration in only one sample	Number of replicate pairs with no detected concentrations
Antimony, dissolved	22	22	1.20	1.54	1.28	4.3	0	0
Antimony, total	22	22	1.55	2.30	2.16	7.2	0	0
Arsenic, dissolved	22	22	0.70	1.23	1.63	5.2	0	0
Arsenic, total	22	22	1.55	2.63	2.54	8.7	0	0
Mercury, dissolved	14	8	12.6	13.0	10.8	33.3	1	5
Mercury, total	15	12	27.5	40.0	47.4	174	0	3

Summary statistics for constituents with detection frequencies less than 100 percent were computed using adjusted maximum likelihood estimation (Helsel, 2012) using the *censStats* function in the “smwrQW” package in R (R Core Team, 2015; Lorenz, 2018). Relations between constituent concentrations and streamflow were assessed using Spearman correlation with a significance level (*p*-value) of 0.05, computed using the *rcorr* function in the “Hmisc” package in R (Harrell and others, 2015). The percentage of arsenic, antimony, and mercury occurring in the dissolved phase (percent dissolved) was computed for each sample as the dissolved concentration divided by the total concentration, times 100. Percent dissolved summary statistics excluded samples with nondetects, as percent dissolved could not be computed for those samples. In some instances, in samples with virtually all of a given constituent present in the dissolved phase, the dissolved concentration was reported to be higher than the total concentration because of measurement uncertainties. In those instances, the percent dissolved was reported as 100.

Non-QA/QC data collected as part of this study are publicly available from the USGS National Water Information System (U.S. Geological Survey, 2017). QA/QC data are available upon request to the USGS Idaho Water Science Center.

Constituent concentrations and water temperatures were compared to State of Idaho water-quality criteria to assess potential harm to human health or aquatic life (Idaho Department of Environmental Quality, 2014). Criteria are listed in table 4. Criteria for arsenic and antimony are based on dissolved fractions only. Criteria for mercury are based on total mercury. None of the criteria used require corrections based on water hardness (they are not hardness-dependent). Daily average and daily maximum water temperatures were computed from 15-minute data. Exceedances of the maximum weekly maximum water-temperature criterion for bull trout habitat (MWMT-BT) were determined by comparing the criterion value (13 degrees Celsius [°C]) to the 7-day rolling average of maximum water temperatures.

Table 4. State of Idaho water-quality criteria for arsenic, antimony, mercury, and water temperature.

[**Criterion:** HHB, human-health based criterion; CCC, criterion continuous concentration or “chronic” aquatic-life criterion; CMC, criterion maximum concentration or “acute” aquatic life criterion; MDAT-SS, maximum daily average water-temperature criterion for salmonid spawning; MDMT-SS, maximum daily maximum water-temperature criterion for salmonid spawning; MWMT-BT, maximum weekly maximum water-temperature criterion for bull trout habitat; MDAT-CW, maximum daily average water-temperature criterion for coldwater aquatic life. **Criterion value:** Dissolved arsenic, dissolved antimony, and total mercury shown in microgram per liter (µg/L); water temperature shown in degrees Celsius (°C)]

Constituent	Criterion	Criterion value (µg/L and °C)
Dissolved arsenic	HHB	10
	CCC	150
Dissolved antimony	HHB	5.6
Total mercury	CCC	0.012
	CMC	2.1
Water temperature	MDAT-SS	9
	MDMT-SS	13
	MWMT-BT	13
	MDAT-CW	19

Surrogate Regression Models for Estimating Constituent Concentrations

Surrogate regression models can provide real-time estimates of concentrations for constituents of regulatory interest. Multiple linear regression models were developed using continuously monitored specific conductance, streamflow, hydrologic indices, and time/season variables (surrogates, collectively) to estimate continuous concentrations of dissolved arsenic, dissolved antimony, and total mercury at the five monitoring sites. Surrogate models were developed using stepwise linear regression analysis as described in Wood and Etheridge (2011). Stepwise linear regression involves testing a number of explanatory variables to determine which are the best predictors of measured concentrations.

Unlike Wood and Etheridge (2011), instantaneous values of water-quality parameters were paired with values obtained from discrete sample analytical results, rather than daily values. Predictor variables were assessed for their significance (using a *p*-value of less than 0.05) in estimating the constituent of interest, and the variance inflation factor (VIF) was used with a maximum threshold of 4 to detect multicollinearity (problematic correlation between variables) as additional predictor variables were assessed in the regression model. The lowest Mallows' Cp and predicted residual error sum of squares (PRESS) statistic were used to identify models for further exploration. Finally, residuals analysis was used to identify that a plot of residuals versus observed values were homoscedastic, and that residuals plotted against each predictor variable, including time, were randomly distributed. The adjusted coefficient of determination (R^2_{adj}) and mean square prediction error were also used to expess the overall ability of the final model to explain the variability in observed sample results and with what degree of error.

Regression models were evaluated using the USGS R statistical programming packages "smwrQW" (Lorenz, 2018), "smwrStats," "DVstats," and "dataRetrieval" (Hirsch and De Cicco, 2015), all of which are provided in the public domain at U.S. Geological Survey (variously dated). Particularly, regression assumptions and methods used in R packages are described in detail in Mallows (1973), Miller (1990), and Helsel and Hirsch (2002). Methods used for regression estimation of left-censored (non-detected) mercury results in two of the models are further described in Cohn (1988), Breen (1996), and Helsel (2012). Specifically, left-censored results for mercury were re-expressed in models using the Adjusted Maximum Likelihood Estimation method.

The functional form of the surrogate models is:

$$lnC = I + a(SC) + b(\ln SC) + c(Q) + d(\mathrm{SWE}) + e(\mathrm{BFI}) + f[\text{square root}(\mathrm{QBFI})] + g[\text{square root}(\mathrm{Qrange})] + h[\sin(2\pi \mathrm{T})] + i[\cos(2\pi \mathrm{T})] + j(\mathrm{T}) \tag{1}$$

where

ln is the natural logarithm;
C is the constituent concentration in µg/L;
I is the regression intercept;
SC is specific conductance in microsiemens per centimeter at 25 °C;
Q is the sampled streamflow in cubic feet per second;
SWE is the snow water equivalent;
BFI is the base flow index;
$QBFI$ is the streamflow divided by the BFI;
$Qrange$ is the ratio of daily range in streamflow to mean daily streamflow;
T is decimal time expressed as a year with the decimal representing the day of that year as a fraction, for example December 31, 2011, is 2011.999, Janauy 1, 2012, is 2012.001;
$sin(2\pi T)$ and $cos(2\pi T)$ are periodic time functions that describe seasonal variability;
$a,...j$ are the regression coefficients that remain constant over time.

Surrogate models were calibrated using results from discrete samples and concurrent streamflow and water-quality parameters. During the winter when in-situ water-quality sondes were removed, discrete measurements of water-quality parameters were collected along with discrete samples.

Three streamflow indices were assessed for their potential as explanatory variables in regression models for total mercury. These were the base flow index (BFI), the sampled streamflow divided by the BFI ("QBFI"), and the ratio of daily range in streamflow to mean daily streamflow ("Qrange"). These indices were not routinely assessed as explanatory variables for dissolved arsenic and antimony because the dissolved fraction of arsenic and antimony is the dominant form found in the study area and dissolved arsenic and antimony loading and transport is well-explained by instream changes in specific conductance.

The method for computing BFI is described in Gustard and others (1992) and incorporated into the "DVstats" R package cited above. A BFI closer to 1 indicates a larger percentage of streamflow derived from baseflow (groundwater) as opposed to snowmelt or rainfall runoff (surface water). In some regression models, BFI was used to weight streamflow by dividing the sampled streamflow by the BFI for "QBFI." QBFI computed using a very low BFI is indicative of a large runoff event and results in a larger weighted streamflow using this weighting technique. Any "Qrange" close to 1 indicates a larger range in streamflow relative to the mean daily streamflow and is useful for estimating system response to short-duration summer storms. In some cases, QBFI and Qrange were transformed by taking the square root to improve linear fit with the response variable.

In addition to BFI, QBFI, and Qrange, snow-water equivalent (SWE) was assessed as an explanatory variable for estimating dissolved antimony concentration because of the timing of peak antimony concentrations (discussed further in section, “Results”). SWE was obtained in inches as a daily time-series from the Natural Resources Conservation Service Deadwood Summit Snow Telemetry site (site number 439, Natural Resources Conservation Service, 2018); all values were adjusted by +0.1 to eliminate zeros and negatives in preparation for data transformation.

Results

The majority of arsenic occurred in the dissolved phase, from an average of 82 percent dissolved at Meadow Creek to 96 percent dissolved at EF1, suggesting a groundwater source. Arsenic concentrations generally increased from upstream to downstream along the main stem of the EFSFSR (table 5**;** fig. 2*A*). Dissolved arsenic concentrations averaged 8.86 µg/L at EF1 and increased to 56.5 µg/L at EF3. The lowest arsenic concentrations were measured at Meadow Creek, upstream of the historical Bradley tailings (mean 1.03 µg/L, dissolved). The highest concentrations of arsenic typically occurred during low-flow periods (July–March), indicating a groundwater source (figs. 3*A* and 4*A*). Dissolved arsenic and streamflow were significantly inversely related at all sites, with Spearman correlation coefficients between -0.70 at EF2 to -0.91 at EF1 (table 6).

Like arsenic, concentrations of antimony typically increased from upstream to downstream along the main stem of the EFSFSR (table 5; fig. 2*B*). Dissolved antimony concentrations averaged 0.930 µg/L at EF1 and increased to 27.9 µg/L at EF3. Antimony concentrations were lowest at Meadow Creek (mean 0.320 µg/L, dissolved). As with arsenic, antimony primarily occurred in the dissolved phase (site means of 94–100 percent dissolved), and concentrations were lowest during high flow periods (fig. 3*B*), suggesting a groundwater source. Concentrations of dissolved antimony were significantly inversely related to streamflow at EF1, EF3, and Sugar, but were not significantly related at Meadow Creek or EF2 (table 6). Unlike arsenic, peak antimony concentrations were generally observed during the first flush of spring snowmelt on the rising limb of the hydrograph (fig. 4*B*) rather than during low flow conditions. This first flush phenomenon has been observed at other mine sites and has been attributed to the dissolution of soluble salts and the flushing out of waters that were concentrated by evaporation (Nordstrom, 2009). The observance of this phenomenon with dissolved antimony but not dissolved arsenic may be related to differences in adsorption behavior with minerals and (or) organic matter in the soil (Dousova and others, 2015).

Mercury concentrations were consistently highest at Sugar Creek, where the average total mercury concentration was 1.19 µg/L (table 5; fig. 2*C*). Mercury concentrations were lowest at Meadow Creek, where it was typically not detected. In contrast to arsenic and antimony, mercury primarily occurred in the particulate phase, especially at Sugar Creek, where particulate mercury averaged 82 percent of total mercury (EF1, EF2, and EF3 averaged 52–63 percent particulate). The association with particles indicates that the mercury is coming from erosion and (or) resuspension of surface material, rather than groundwater. Also in contrast to dissolved arsenic and antimony, total mercury concentrations were highest during high-flow periods (April–June; figs. 3*C* and 4*C*), another indicator of an erosion/surface material source. Total mercury concentrations were significantly positively related to streamflow at EF1, EF2, EF3, and Sugar Creek, with Spearman correlation coefficients between 0.64 and 0.84 (table 6).

Exceedances of Water-Quality Criteria

Exceedances of water-quality criteria for arsenic, antimony, and (or) mercury were frequent at all sampling sites except in the unmineralized Meadow Creek site, where only one exceedance was observed. Samples from sites EF1, EF2, EF3, and Sugar Creek regularly exceeded the HHB criterion for dissolved arsenic (10 µg/L), with exceedance frequencies as high as 98 and 100 percent at EF2 and EF3, respectively (fig 2*A*). The chronic aquatic life criterion for dissolved arsenic (150 µg/L) was not exceeded at any site (the maximum sample concentration was 108 µg/L).

Exceedances of the HHB criterion for dissolved antimony (5.6 µg/L) were common at EF2 and EF3, with exceedance frequencies of 75 and 100 percent, respectively (fig 2*B*). An aquatic life criterion for antimony has not been established.

The mercury chronic aquatic life criterion (0.012 µg/L) was exceeded in at least one sample at all sites, with exceedance frequencies ranging from 4 percent at Meadow Creek to 97 percent at Sugar Creek (fig. 2*C*). The acute aquatic life criterion (2.1 µg/L) was only exceeded at Sugar Creek, with a frequency of 11 percent.

At all sites, on the basis of continuous data, summer water temperatures frequently exceeded water temperature criteria related to salmonid spawning and (or) bull trout (fig. 5). Exceedances occurred June–September, but were most common in July and August. Sites EF1 and Meadow Creek had the fewest days with temperature exceedances, with a maximum of 15 percent of days per month exceeding the maximum daily maximum water-temperature criterion for salmonid spawning (MDMT-SS, 13 °C) and the MWMT-BT (13 °C). The maximum daily average water-temperature criterion for salmonid spawning (MDAT-SS, 9 °C), a criterion more sensitive than the MDMT-SS or MWMT-BT, was exceeded up to 83 percent of days at Meadow Creek and up to 59 percent of days at EF1.

Table 5. Summary of concentrations of select constituents from five monitoring locations in the Stibnite mining area, central Idaho, 2011–17.

[Summary statistics for constituents with detection frequency less than 100 percent were computed using the censStats function in the "smwrQW" package in R. All concentrations in microgram per liter. Site abbreviations are defined in table 1 and site locations are shown in figure 1. **Abbreviation**: NA, not applicable]

Constituent	Number of samples	Detection frequency (percent)	Mean	Standard deviation	Median	Maximum
Meadow Creek						
Arsenic, dissolved	38	100	1.03	0.268	0.900	1.50
Arsenic, total	38	100	1.57	1.71	1.25	11.3
Antimony, dissolved	35	100	0.320	0.098	0.290	0.570
Antimony, total	38	100	0.340	0.195	0.260	1.32
Mercury, dissolved	23	0	NA	NA	NA	NA
Mercury, total	24	8	0.002	0.007	0.000	0.014
EF1						
Arsenic, dissolved	36	100	8.86	2.94	9.55	12.8
Arsenic, total	36	100	9.18	2.69	9.70	13.4
Antimony, dissolved	36	100	0.930	0.361	0.910	1.86
Antimony, total	36	97	0.928	0.343	0.900	1.72
Mercury, dissolved	22	41	0.005	0.001	0.005	0.010
Mercury, total	23	87	0.012	0.011	0.007	0.051
EF2						
Arsenic, dissolved	40	100	23.7	9.83	24.4	52.6
Arsenic, total	40	100	25.7	10.3	26.2	59.2
Antimony, dissolved	39	100	10.9	10.6	7.39	50.0
Antimony, total	39	100	11.6	11.2	8.13	57.6
Mercury, dissolved	28	11	0.004	0.001	0.004	0.006
Mercury, total	30	60	0.017	0.039	0.006	0.304
EF3						
Arsenic, dissolved	39	100	56.5	28.6	57.2	108
Arsenic, total	39	100	63.4	35.5	62.9	150
Antimony, dissolved	38	100	27.9	15.0	26.8	71.9
Antimony, total	38	100	27.9	14.7	25.3	72.8
Mercury, dissolved	31	16	0.004	0.001	0.003	0.007
Mercury, total	32	50	0.008	0.009	0.005	0.037
Sugar Creek						
Arsenic, dissolved	38	100	12.1	5.31	10.85	31.1
Arsenic, total	38	100	14.5	6.56	14.1	35.1
Antimony, dissolved	37	100	3.35	2.84	2.25	12.9
Antimony, total	37	100	3.41	2.68	2.70	11.7
Mercury, dissolved	35	94	0.014	0.011	0.010	0.302
Mercury, total	36	100	1.19	4.45	0.070	26.3

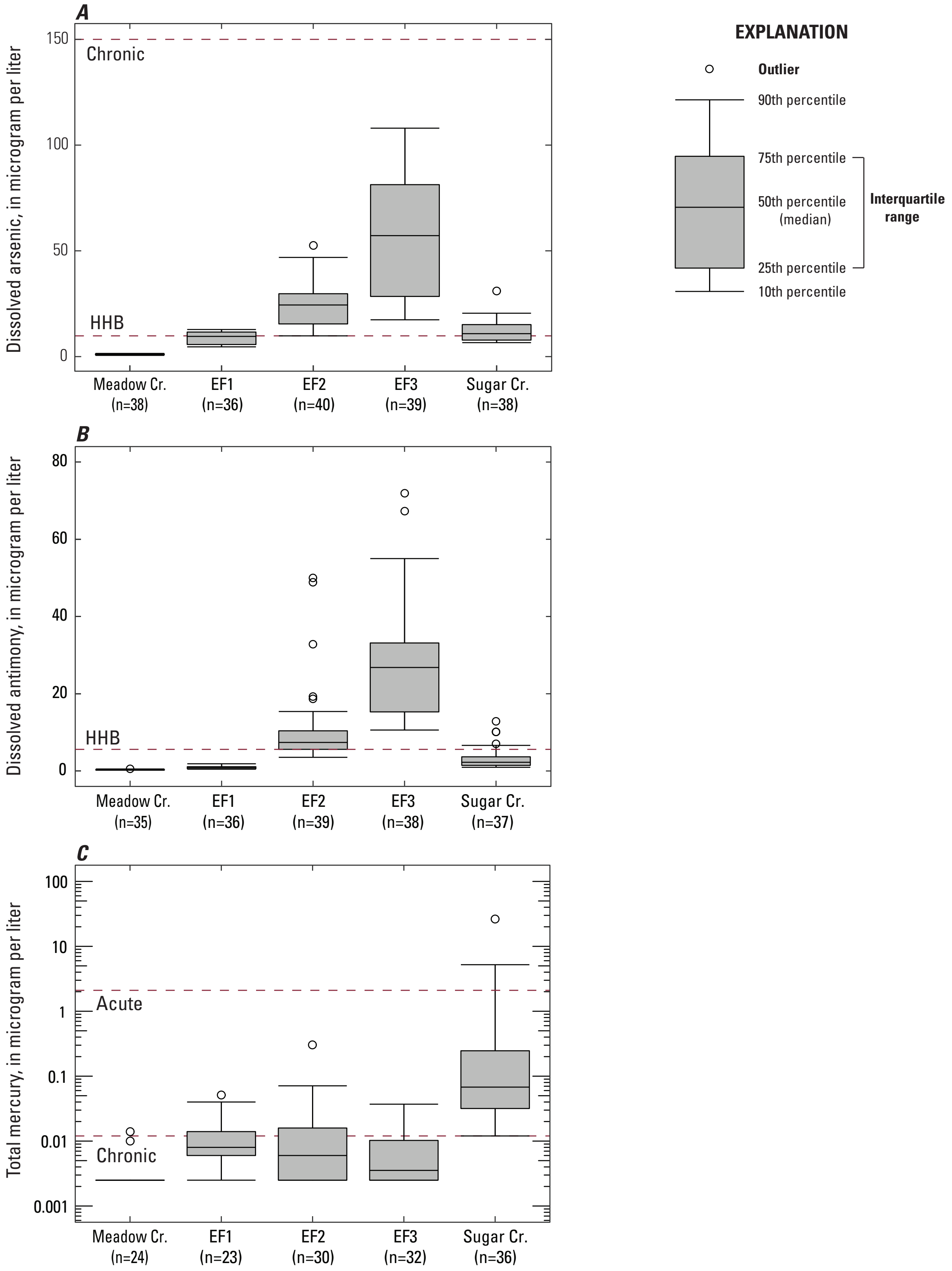


Figure 2. Concentrations of dissolved arsenic (*A*), dissolved antimony (*B*), and total mercury (*C*) relative to water-quality criteria at five monitoring sites in the Stibnite mining area, central Idaho, 2011–17. Concentrations below the reporting level are plotted at half the reporting level for visualization purposes. Site names and locations are shown in table 1 and figure 1, respectively. Water-quality criteria are defined in table 4. HHB, human-health based criterion.

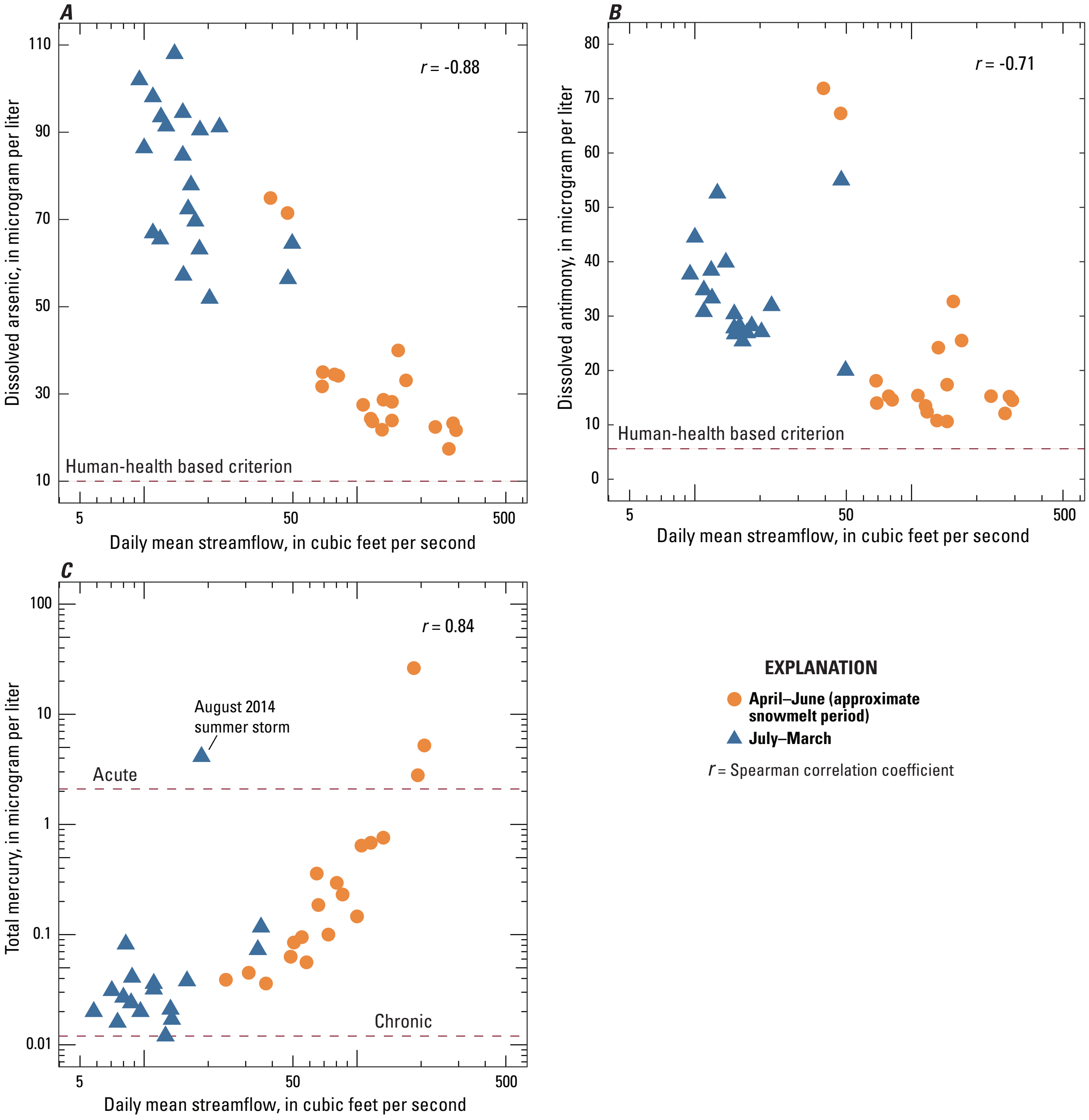


Figure 3. Concentration versus daily mean streamflow for dissolved arsenic at EF3 (*A*), dissolved antimony at EF3 (*B*), and total mercury at Sugar Creek (*C*), 2011–17. Concentrations below the reporting level are plotted at half the reporting level. Site names and locations are shown in table 1 and figure 1, respectively. Water-quality criteria are defined in table 4. HHB, human-health based criterion.

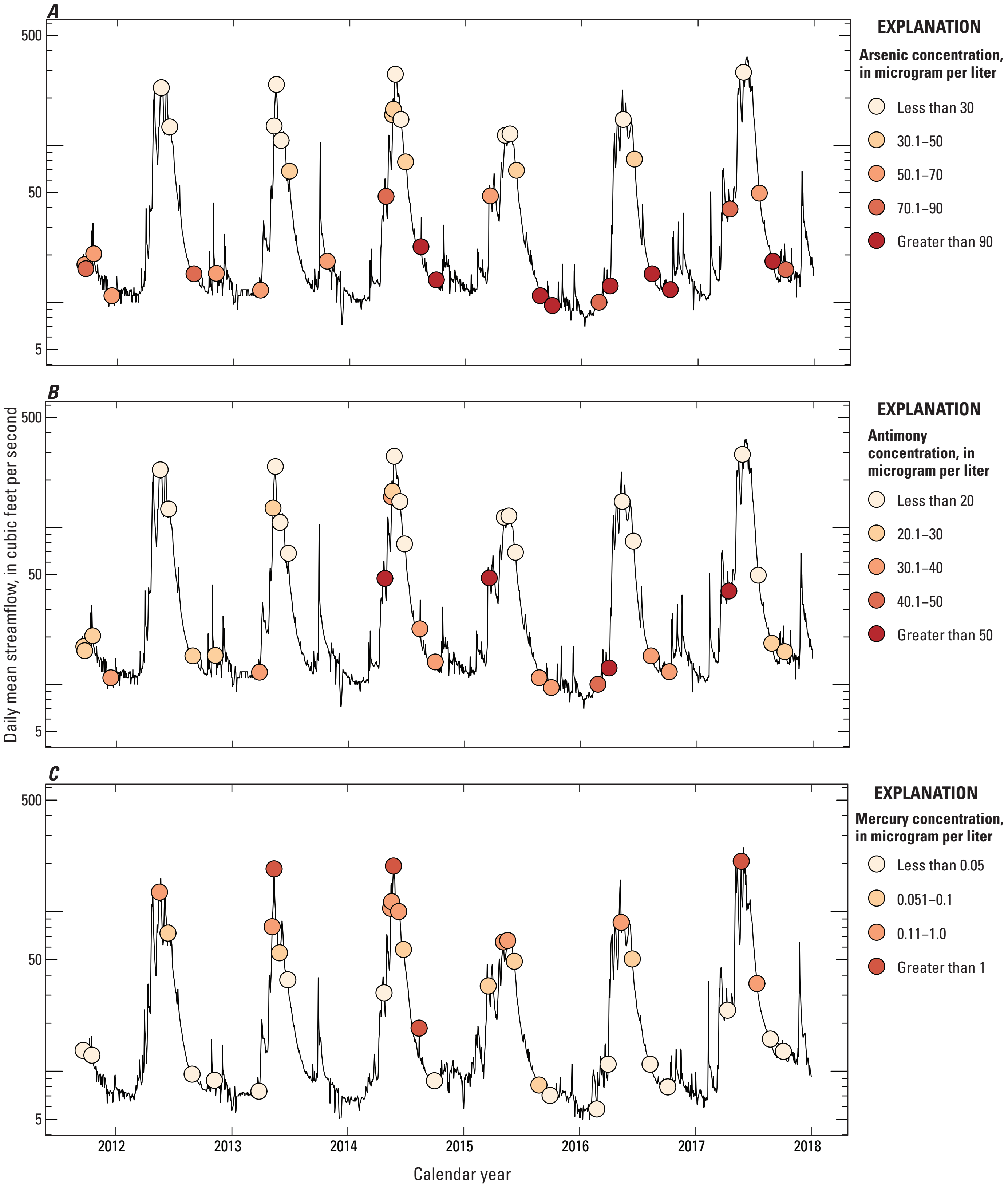


Figure 4. Daily mean streamflow, sample timing, and concentration of dissolved arsenic at EF3 (*A*), dissolved antimony at EF3 (*B*), and total mercury at Sugar Creek (*C*), 2011–17. Site names and locations are shown in table 1 and figure 1, respectively. Water-quality criteria are defined in table 4.

Table 6. Statistically significant ($p < 0.05$) Spearman correlation coefficients between streamflow and constituent concentrations at each site.

[Positive coefficients indicate a direct (positive) relationship. Negative coefficients indicate an inverse relationship. Site names and locations are shown in table 1 and figure 1, respectively. **Abbreviations:** NS, not significant.]

	Arsenic		Antimony		Mercury	
	Dissolved	Total	Dissolved	Total	Dissolved	Total
Meadow Cr.	-0.88	NS	NS	NS	NS	NS
EF1	-0.91	-0.86	-0.69	-0.69	0.63	0.79
EF2	-0.70	-0.57	NS	NS	NS	0.64
EF3	-0.88	-0.85	-0.71	-0.69	0.47	0.69
Sugar Cr.	-0.85	-0.51	-0.88	-0.81	0.73	0.84

Water temperature criteria exceedances were much more frequent at EF2 than at EF1 (fig. 5), likely because mining disturbances and forest fires (fig. 1) have left much of Meadow Creek without shade. The MDMT-SS, MDAT-SS, and MWMT-BT were exceeded up to 83, 94, and 82 percent of days, respectively, at EF2, and up to 59, 100, and 59 percent of days, respectively, at EF3. The MDAT-CW was not exceeded at any site during the study period.

Surrogate Regression Models

Surrogate regression models that use input variables from real-time in-stream sensors can be used to assess changes in stream quality in near-real-time. Surrogate models also can be used to estimate temporal variability in constituent concentration and load over any desired time frame of interest, from hours to years. The population of samples used to compute regression estimates of constituents of interest is larger and more varied than the sample population used in Etheridge (2015). Because of this more varied dataset, coefficients for explanatory variables changed in many cases. Changes to model coefficients do not necessarily indicate changes in drivers of constituent transport, nor do they indicate a change in the conclusion that continuously measured in-stream specific conductance and streamflow are good explanatory surrogates that can be used to estimate constituent concentrations in near real time. As more conditions are sampled, surrogate model validation and assessment for changes in explanatory variable coefficients is recommended practice (Rasmussen and others, 2009). Changes in explanatory variable coefficients during model recalibration efforts reflect the fact that the population of samples used to calibrate models is more varied. For example, specific conductance remains positively correlated and significant in linear or log space in all the dissolved arsenic and antimony models, and streamflow remains positively correlated with total mercury concentrations, but the coefficients and (or) transformations may have been changed to improve model fit with a more diverse population of calibration samples (table 7). In some cases, explanatory variables previously used to fit models for seasonal change were no longer significant or were replaced with a more suitable explanatory variable to capture a seasonal component of constituent loading and transport, such as SWE (table 7). However, because the updated models are based on a larger and more varied dataset, they are considered to better reflect the interactions between constituent concentrations and explanatory variables compared to the original models.

Generally, surrogate regression models for dissolved arsenic, dissolved antimony, and total mercury at EF3 and Sugar Creek are the most useful models for ongoing monitoring and assessment of trends in constituent concentration and loads because together these two sites represent water-quality conditions leaving the study area. As such, models from these two sites can be used to estimate total mercury, dissolved arsenic, and dissolved antimony loading to points downstream. Model archive summaries are provided in the appendix.

Meadow Creek

The updated surrogate regression model for dissolved arsenic in Meadow Creek agrees with the conclusion of the original model that arsenic is derived from groundwater upstream of the monitoring site. Etheridge (2015) described how increases in streamflow due to rainfall or snowmelt runoff coincided with decreases in dissolved arsenic and specific conductance. Streamflow remains negatively correlated with dissolved arsenic at Meadow Creek and elsewhere (table 6; fig. 3*A*), but was not included in the Meadow Creek regression model because specific conductance was a better predictor, and the model did not appreciably improve with the inclusion of streamflow.

In contrast to arsenic, regression analysis using a larger sample population indicated that dissolved antimony concentrations are not significantly related to changes in streamflow or specific conductance in Meadow Creek (tables 6 and 7). In the absence of explanatory variables, a regression model for dissolved antimony at Meadow Creek cannot be published.

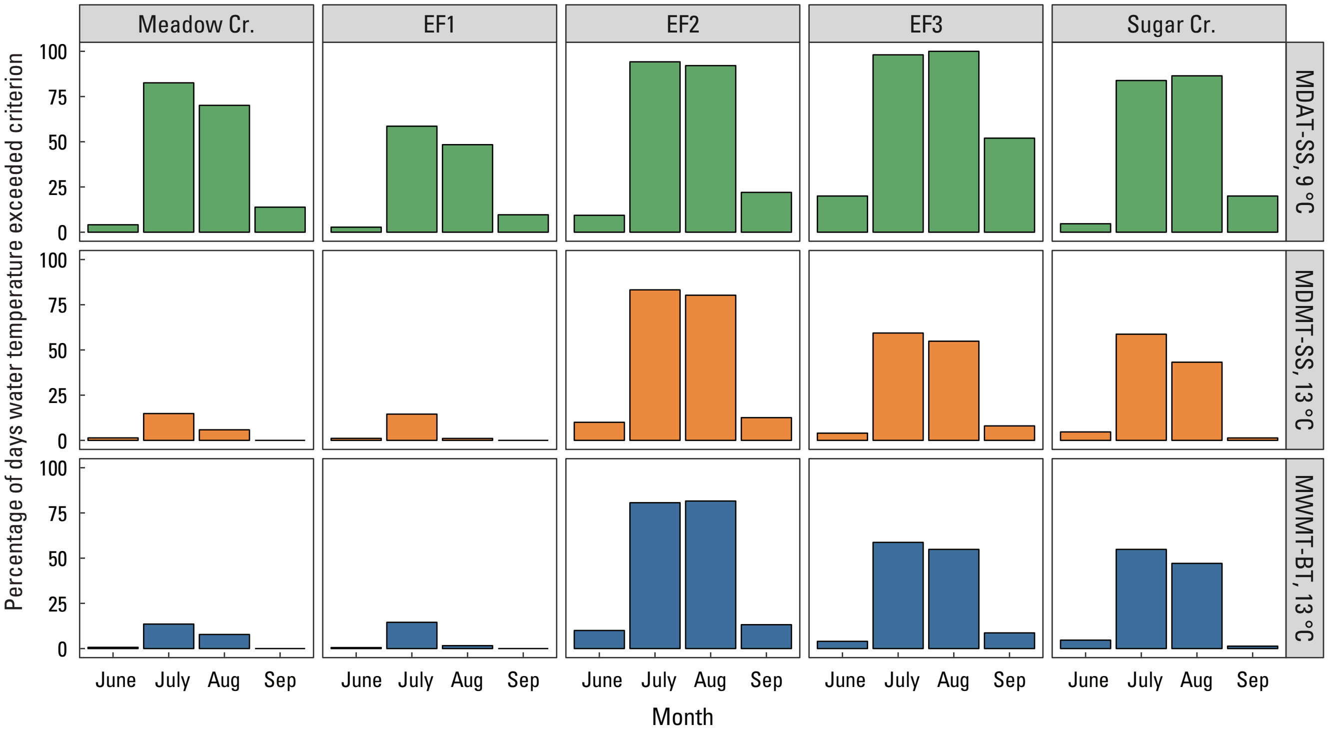


Figure 5. Percentage of days that water temperature exceeded criteria at five monitoring sites in the Stibnite mining area, central Idaho, June–September, 2011–17. Site names and locations are shown in table 1 and figure 1, respectively. Water-temperature criteria are defined in table 4. [Aug, August; Sep, September]

Table 7. Regression coefficients and model diagnostics for surrogate models used to estimate concentrations of selected constituents at monitoring sites in the Stibnite mining area, central Idaho, 2011–17.

[Site names and locations are shown in table 1 and figure 1, respectively. Each regression model was calibrated using the available data collected at each site for water years 2012–17. The regression equation is $\ln C = I + a\,(SC) + b\,(lnSC) + c\,(Q) + d\,(SWE) + e\,(BFI) + f$ [square root$(QBFI)] + g$ [square root$(Qrange)] + h\,[\sin(2\pi T)] + i\,[\cos(2\pi T)] + j(T)$, Where ln is the natural logarithm transformation; C is the constituent concentration, in micrograms per liter; I is the regression intercept; SC is specific conductance in millisiemens per centimeter; Q is the sampled streamflow, in cubic feet per second; SWE is the snow water equivalent; T is decimal time expressed as a year with the decimal representing the day of that year as a fraction; QBFI, Qrange, and BFI are terms describing streamflow variability; square root is the square root transformation; and a, b, c, d, e, f, g, h, i, and j are regression coefficients that remain constant over time. R^2 (coefficient of determination), represents the amount of variance explained by the model in percent. **Abbreviations**: BCF, bias correction factor; MSPE, model standard percentage error; –, no regression coefficient]

Constituent	number *N*	intercept *I*	SC *a*	lnSC *b*	Q *c*	SWE *d*	BFI *e*	QBFI *f*	Qrange *g*	sin *h*	cos *i*	decime *j*	BCF	MSPE (percent)	Surrogate concentration model adjusted R^2
Meadow Creek															
Arsenic, dissolved	37	0.252	0.014	–	–	–	–	–	–	–	–	–	NA	9.64	87
Antimony, dissolved	34	Model discontinued, no significant relation with continuously measured parameters													
EF1															
Arsenic, dissolved	35	-2.937	–	1.241	–	–	–	–	–	–	–	–	1.01	10.3	92
Antimony, dissolved	35	-5.544	–	1.279	–	0.013	–	–	–	–	–	–	1.01	17.0	81
Mercury, total	22	-5.228	–	–	0.022	–	–	–	–	–	–	–	1.07	49.1	75
EF2															
Arsenic, dissolved	38	-1.364	–	1.049	–	–	–	–	–	–	–	–	1.03	24.5	69
Antimony, dissolved	38	-1.970	–	0.855	–	0.030	–	–	–	–	–	–	1.07	36.3	71
Mercury, total	29	-5.089	–	–	–	0.066	-1.430	–	–	-0.638	-0.703	–	1.26	97.6	67
EF3															
Arsenic, dissolved	37	-275	74.71	–	–	–	–	–	–	-5.33	-10.93	–	na	17.8	88
Antimony, dissolved	37	-2.477	–	1.249	–	0.013	–	–	–	–	–	–	1.01	16.9	89
Mercury, total	31	-4.089	–	–	0.004	–	-1.622	–	–	–	–	–	1.08	50.1	67
Sugar Creek															
Arsenic, dissolved	36	108	0.012	–	–	–	–	–	–	–	–	-0.053	1.01	14.3	88
Antimony, dissolved	36	301	–	1.725	–	–	–	–	–	0.113	0.323	-0.153	1.01	17.3	94
Mercury, total	35	-354	–	–	–	–	–	0.179	4.368	–	–	0.173	1.37	78.5	85

East Fork of South Fork Salmon River Above Meadow Creek (EF1)

With the addition of 15 new samples, seasonality terms became insignificant as explanatory variables for dissolved arsenic concentration at EF1. The dissolved antimony model for EF1 remained the most similar to the originally published model, but explained less of the variation captured in the sample population used to calibrate the model. The dissolved antimony and arsenic surrogate regression models for EF1 are useful in real time to assess changes in baseline conditions in the study area.

The total mercury model developed for EF1 showed that streamflow alone is a good surrogate for estimating total mercury concentrations (table 7). There are not yet enough calibration samples to warrant additional explanatory variables in the EF1 total mercury surrogate regression model so only streamflow was used as an explanatory variable. Three out of 22 sample results for total mercury at EF1 were left-censored (13.6 percent). Additional model calibration samples and (or) a sample population containing less than 5 percent left-censored (Theresa Rasmussen, USGS Surrogates Workgroup, personal communication) total mercury results are needed before a linear regression model is used to estimate total mercury at EF1 in near real time, thus a model archive summary is not included in the appendix for the EF1 total mercury model.

East Fork of South Fork Salmon River at Stibnite (EF2)

Relations between continuously measured specific conductance and dissolved arsenic and antimony remained significant at EF2 with the addition of new samples. Surrogate regression models at EF2 accounted for less of the sampled variability in dissolved arsenic and antimony concentrations compared to surrogate regression models at other streamgages in the study area. Seasonality variables were no longer significant in either regression model at EF2. SWE was a significant explanatory variable in the dissolved antimony regression model because the highest dissolved antimony concentrations in EF2 were observed soon after snowpack began to melt, rather than at low flow (fig. 4*B*). SWE and unmeasured streamflow (streamflow at EF2 minus streamflow at EF1 minus streamflow at Meadow Creek) were evaluated as explanatory variables to improve the dissolved arsenic model fit at EF2, but were ultimately not included in in the model because they resulted in non-normally distributed model residuals, violating an assumption of linear regression.

A total mercury surrogate regression model was developed for EF2 using 29 samples (table 7). The total mercury surrogate regression model for EF2 is not summarized in a model archive (appendix) because more samples should be collected before it is used to estimate total mercury concentrations in near-real-time with computed and (or) telemeterd explanatory variables from the streamgage. Out of 29 total mercury results, 11 (38 percent) were left-censored. Additional model calibration samples and (or) a sample population containing less than 5 percent left-censored total mercury results are needed before a linear regression model is used to estimate total mercury at EF2 in near real time. Streamflow and two hydrologic indices are positively correlated to mercury concentrations at EF2 (table 7). Although Sugar Creek contributes approximately 98 percent of the mercury load transported downstream of the study area (Etheridge, 2015), the EFSFSR is also a contributor of mercury upstream and downstream of the Glory Hole. Holloway and others (2017) suggested that the historical Fern mine was a source of mercury to the EFSFSR, attributable to increased stream sediment mercury concentrations at EF1.

The total mercury sample collected on April 11, 2017, represents the highest total mercury concentration (0.304 μg/L) sampled at EF2 (fig. 2*C*). This sample is an outlier because it corresponds to a relatively low streamflow of 30.4 ft^3/s. The sample was collected during a brief period of relatively warm weather, which triggered a period of snowmelt before cooler weather returned (Natural Resources Conservation Service, 2018; University of Utah, 2018). Because mercury transport may occur as snowmelt initiates, SWE was particularly useful as an explanatory variable to fit the model to the 0.304 μg/L outlier. BFI was also a significant negative correlate to mercury concentrations at EF2 (table 7). The surrogate regression model for mercury at EF2 may improve with additional samples collected during brief increases of snowmelt runoff, early in the snowmelt runoff season, and during summer storms.

East Fork of South Fork Salmon River Above Sugar Creek (EF3)

Surrogate regression models remained relevant and useful for estimating real-time concentrations of dissolved arsenic and antimony at EF3. Like EF2, SWE was positively correlated with dissolved antimony at EF3.

The total mercury surrogate regression model at EF3 was improved with the addition of 16 new samples. Although the total mercury surrogate regression model at EF3 explained less of the variability in sampled total mercury than its predecessor, it achieves a 50.1 percent model standard percentage error around a detection limit of 0.005 μg/L. Out of 31 total mercury results at EF3, 15 (48 percent) are left-censored. The total mercury surrogate regression model for EF3 is not summarized in a model archive (appendix) because more samples and (or) a sample population containing less than 5 percent left-censored total mercury results are needed before a linear regression model is used to estimate total mercury concentrations in near-real-time with computed and (or) telemeterd explanatory variables from the streamgage.

Sugar Creek

Decimal time was a significant explanatory variable in all surrogate regression models for Sugar Creek, indicating trend significance in constituent transport in Sugar Creek. Regression models developed for Sugar Creek during stepwise regression analysis exhibited a trend in residuals plotted against time unless decimal time was included as an explanatory variable in the regression equation. A negative coefficient for decimal time indicated a decreasing trend in concentrations of dissolved arsenic and antimony in Sugar Creek, though a nonparametric Mann-Kendall test for temporal trend in dissolved arsenic and antimony was insignificant. A positive coefficient for decimal time indicated an increasing trend in total mercury concentrations in Sugar Creek, and again, a nonparametric Mann-Kendall test for temporal trend in total mercury was insignificant. In each case where decimal time was used as an explanatory variable, it removed bias in residuals over time. Use of decimal time as an explanatory variable in each case also resolved violations of regression assumptions such as the assumption that residuals are homescedastic and normally distributed. In all three cases, decimal time should be verified or removed as an explanatory variable in any future iterations of each model, especially when there are enough samples to subset the calibration dataset and validate models with hold-out samples.

Dissolved arsenic and antimony model standard percentage errors improved at Sugar Creek with 15–16 additional samples collected since 2015. Together with regression models at EF3, the surrogate regression models at Sugar Creek can be used to estimate concentration and flux of dissolved arsenic and antimony transported downstream of the study area with a high degree of statistical significance and quantifiable uncertainty in the form of real-time prediction intervals (U.S. Geological Survey, 2018). Overall statistical significance of each regression model is assessed using the model standard percentage error (table 7) and was assessed during stepwise regression using an F-statistic and associated p-value, the PREdiction Error Sum of Squares (PRESS) statistic, and k-fold cross-validation (Fushiki, 2011) (appendix).

The total mercury model at Sugar Creek was improved with the addition of 16 more samples since 2015. The sample population for both the previously published and the revised total mercury models included a summer storm sample from August 14, 2014 (Etheridge, 2015). With a concentration of 4.13 µg/L and a corresponding streamflow of 24.2 ft^3/s, the August 14, 2014, sample remains an outlier (fig. 3*C*). Including the outlier in the regression model results in non-normally distributed residuals, a basic violation of regression model assumptions. The model currently includes results from one summer storm to use in assessing residuals distribution. Removing the summer storm sample outlier from August 14, 2014, improves the model, but limits its ability to provide reasonable estimates of mercury concentration or flux during summer storms. Summer storms may account for relatively large mass flux of mercury out of the study area, so the summer storm sample was kept in the calibration dataset.

Mercury transport in the study area is positively correlated to streamflow events regardless of their seasonal timing (fig. 4C). Streamflow and (or) hydrologic indices derived from continuous streamflow were significant as predictors of total mercury concentration at EF1, EF2, EF3, and Sugar Creek (table 7). Two hydrologic index terms were used with decimal time as explanatory variables in the revised total mercury model for Sugar Creek. The first index term used BFI to weight streamflow by dividing streamflow by BFI (table 7; QBFI). The most significant improvement of total mercury model fit came with the addition of a hydrologic index computed using the ratio of mean daily streamflow to daily range in streamflow (table 7; Qrange). This results in a Qrange index close to or greater than 1 for any suddden increase in streamflow such as a summer storm or any surge of snowmelt runoff.

Continuous precipitation data could improve models used to estimate mercury concentrations at Sugar Creek and elsewhere, especially during localized summer storms and brief periods of warm weather as snowmelt runoff season begins. These data are currently collected at a site near the Stibnite air strip but large gaps in the time-series precluded their inclusion in the models.

Summary

The Stibnite mining area, in the headwaters of the EFSFSR, was intermittently mined for most of the 20th century. Results from this study show that, decades after mining ceased, water quality in the area continues to be impaired. Concentrations of dissolved arsenic and antimony generally increased from upstream to downstream in the EFSFSR. Based on the majority of arsenic and antimony occurring in the dissolved phase, and inverse relationships with streamflow at most sites, the primary route of arsenic and antimony to surface waters is likely from groundwater. Mercury, in contrast, was directly related to streamflow and was associated with particulates, suggesting erosion of surface materials to be the primary route to surface waters. Mercury concentrations were highest in Sugar Creek.

Arsenic and antimony concentrations regularly exceeded human-health based criteria, and mercury concentrations frequently exceeded the chronic aquatic life criterion at some sites. Water temperatures, potentially affected by a combination of mining disturbances, loss of shade from forest fires, and (or) climate change, commonly exceeded salmonid spawning and bull trout criteria.

The additional 3 years of monitoring since the initial study report (Etheridge, 2015) improved our understanding of inter-annual variability, resulting in more relevant characterizations of water quality under varying streamflow conditions. A number of the surrogate models changed with the inclusion of the additional monitoring data. Because they represent a greater diversity of environmental conditions, the revised surrogate models should be more robust than the initial models. Streamflow, specific conductance, SWE, and hydrologic indices derived from streamflow were all important explanatory variables in surrogate regression models.

Future changes in the EFSFSR watershed are likely. These changes may be related to additional mining and (or) remediation, forest fires and (or) regrowth of fire-impacted areas, or climate change. All of these factors have the potential to impact water quality. Given the importance of the EFSFSR (and the SFSR downstream) as critical habitat for Chinook salmon, steelhead, bull trout, and westslope cutthroat trout, the remediation of the Stibnite mining area is a priority for many government and non-government organizations. Results from this study can inform future remediation and monitoring efforts by identifying the stream reaches with the highest contaminant concentations and water temperatures, identifying contaminant pathways into the surface water (groundwater versus erosion/surface material), prioritizing contaminants based on water quality criteria exceedances, and providing valuable baselines against which future changes may be measured.

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Appendix. Surrogate Regression Model Archive Summaries

Appendix can be accessed at https://doi.org/10.3133/sir20195072.

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FISH and FISHERIES WILEY

ORIGINAL ARTICLE

Effects of artificial light at night on fishes: A synthesis with future research priorities

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Abstract

Nearly all organisms rely on natural fluctuations of light as cues for synchronizing physiological processes and behavioural actions associated with foraging, growth, sleep and rest, reproduction, and migration. Consequently, although artificial lighting sources have provided a plethora of benefits for humans, they can lead to disruptions for wild organisms. With one quarter of the human population living within 100 km of coastlines, there is great potential for artificial light at night (ALAN) to influence the physiology, behaviour and fitness of fishes. Through a review of the literature (n = 584 publications focused on the effects of ALAN on individual organisms or ecosystems), we illustrate that most papers have concentrated on terrestrial species (59%) compared with aquatic species (20%) or a mixed approach (21%). Fishes have been underrepresented in comparison with many other taxa such as birds, insects and mammals, representing the focus of less than 8% of taxa-specific publications. While the number of publications per year focusing on fishes has generally been increasing since the mid-2000s, there has been a downturn in publication rate in the last few years. To understand where research related to ALAN in fishes has been focused, we partitioned studies into categories and found that publications have mostly concerned behaviour (41.0%), abundance and community structure (24.4%), and physiology (22.8%), while the longer-term effects on fitness (6.9%) are lacking. We synthesize the research completed in fishes and outline future priorities that will help ascertain the short- and long-term consequences of this relatively novel stressor for fish health and persistence.

KEYWORDS
artificial light at night, behaviour, community structure, fitness, light pollution, physiology

1 | INTRODUCTION

The benefit of artificial lighting for humans has led to an increase in the duration, distribution and brightness of light at night, as well as the quality of light emitted as the colour spectrum is explored (Smith, 2009). It is estimated that the extent of the Earth's artificially lit landscape has been increasing by 2.2% each year, with the level of brightening in already-lit areas increasing at this same rate (Kyba et al., 2017). Until just 100 years ago, the sun, stars and moon were the only significant sources of light present in the biosphere. Natural variations in these light sources provide plants and animals with a reliable cue for daily and seasonal physiological responses, the regulation of reproduction, migratory timing, leaf-out and loss and many other biological activities and behaviours (Gaston et al., 2013; Longcore, 2010). Indeed, virtually all organisms have developed an internal circadian rhythm (i.e. biological clock) that allows them to anticipate the shift from day to night and perform necessary actions accordingly (Stevens et al., 2013).

The widespread increase in artificial light at night (ALAN) has caused a diversity of organisms to experience a new anthropogenic stressor, the consequences of which are not yet fully understood (Zapata et al., 2019). However, research has been accumulating that indicates even relatively low levels of light can disrupt normal physiology and behaviour (Ouyang et al., 2018). For example, newly hatched sea turtles have an innate response to orient in the direction of the greatest light to make it safely to the sea, which traditionally has been the moon's glow, but in many coastal areas is being replaced by artificial lighting on land (Tuxbury & Salmon, 2005). In birds, the timing of egg laying in females and the mating songs produced by males are affected by streetlights as they unintentionally mimic changes in day length (Kempenaers et al., 2010). Additionally, many birds depend heavily on the night sky since both directional and temporal cues are used to guide them during migration, which can be disrupted by artificial light (Cabrera-Cruz et al., 2018). In nocturnal species, such as bats, ALAN may displace individuals from inhabiting certain areas, making them more vulnerable to predation (Stone et al., 2012). A recent meta-analysis illustrated that exposure to ALAN has broad implications across species, showing marked changes to the onset of daily activity for diurnal species, disruption to hormone levels and alterations to life history traits (e.g. number of offspring; Sanders et al. 2021).

Although the impact of ALAN on terrestrial taxa has garnered a fair degree of attention, there is comparatively less research on aquatic ecosystems (Davies et al., 2014; Zapata et al., 2019). Considering that more than 25% of the Earth's population lives within 100 km of a marine or freshwater coastline, aquatic ecosystems can be highly susceptible to the effects of ALAN (Small & Nicholls, 2003). Sources of direct lighting on coastlines range from temporary lighting, which includes ships and light fisheries, to more permanent sources of light, which include home lights, resort lights, residence lights, streetlights found in towns, cities, harbours and docks, and a multitude of other fixtures (Davies et al., 2014). The light that is emitted by these sources can expand out into the waters as the scattered light emitted is reflected by the clouds, further altering the lightscape as “skyglow” (Davies et al., 2014). The intensity of lighting can range from approximately 10–60 lux for common streetlight fixtures to 100–300 lux for stadium-level floodlighting and indoor lighting (Gaston et al., 2012; Rich & Longcore, 2006; Sanders et al. 2021). As a result, shallow waters in urban and suburban locations can often experience light intensities at night that vary from 0.03 to 2.5 lux (e.g. due to skyglow; Perkin et al., 2014) up to 150–200 lux in more strongly lit areas such as harbours (Bolton et al., 2017). In comparison, full moonlight on a clear night gives an illumination level of 0.1–0.3 lux and on a cloudy night radiates just 0.00003–0.0001 lux (Rich & Longcore, 2006). Although the effects of ALAN may be more visually obvious in terrestrial environments, both marine and freshwater aquatic ecosystems should be further explored given they are also readily exposed (Davies et al., 2014; Perkin et al., 2011).

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With more than 35,000 species (WWF, 2021), fishes represent the largest and most diverse group of vertebrates (Ravi & Venkatesh, 2008). Most species rely on visual cues for some combination of prey localization and capture, avoidance of predators, mate finding and reproductive activities, recognition of conspecifics, habitat selection, navigation and utilizing refugia (Hammerschlag et al., 2017). Considering that the attenuation of light through the water column is relatively low, fish visual systems have evolved to optimize light use in their respective ecosystems (Bowmaker, 1995). Water acts as a monochromator (i.e. it transmits a narrower band of wavelengths than are present at input) and maximum transmission of light occurs at approximately 460 nm (blue light); however, this value can change depending on the purity of the water (Bowmaker, 1995). For example, turbidity causes a shift in the spectrum towards red light, around 600 nm, due to greater absorption of shorter (bluer) wavelengths of light (Bowmaker, 1995). The sensitivity of rods and cones to specific wavelengths of light is determined by the presence of visual pigments, and those of fishes have some of the largest ranges of wavelength sensitivity of all vertebrates, with peak sensitivities from 350 nm (near ultraviolet) to 635 nm (far red; Bowmaker, 1995). The retinae of fishes are also unique in comparison with other vertebrates in that they can continue to grow over the lifetime of the fish through the addition of new neurons or stretching of existing tissue (Fernald, 1988). These adaptations in visual systems highlight the importance of light reception in fishes overall, and the potential for light of different intensities or spectral qualities to have different consequences depending on the underlying environmental conditions, the fishes being affected and their stage of development.

Fishes also possess light-detecting cells that are not involved in vision but instead gather information for a variety of neural systems, including allowing entrainment of circadian rhythms (i.e. ensuring biological clocks remain synchronized with real-world time; Gerkema et al., 2000). This aspect of light detection is essential for ensuring appropriate daily changes in behaviour and physiology related to locomotion, activity and rest, and foraging (Kopperud & Grace, 2017) and is dependent on the light–dark cycle (Menaker 1969). Along with daily rhythms, light-regulated biological clocks are also necessary for seasonal changes, such as the timing of reproduction (Maitra et al., 2006). As a result, changes to the light environment such as the amount of light available, its quality and the timing at which it occurs further have the potential to profoundly alter the behaviour, physiology, health and fitness of fishes through disruption of circadian and circannual processes.

Human impacts on aquatic ecosystems and fish populations are well documented in both freshwater habitats (e.g. pollution, invasive species, habitat alteration; Barbarossa et al., 2021; Dudgeon et al., 2006; Reid et al., 2019) and estuarine and coastal marine habitats (e.g. pollution, overexploitation, habitat alteration; Crain et al., 2009; Kennish, 2002). Human activity tends to be concentrated in areas that surround (e.g. streams, rivers, small lakes, estuaries) or are adjacent to (e.g. littoral areas of large lakes, coastal areas of oceans) shorelines. Globally, freshwater and marine fishes are experiencing marked declines due to human activity (Arthington et al., 2016; Gordon et al., 2018), including populations that regularly use nearshore habitats or enter them at key life-history stages. For example, pollock (*Pollachius virens*, Gadidae) have declined from inshore habitats on the coasts of Atlantic Canada, and the management and protection of these ecosystems are important to maintaining their potential to supply historically depleted adult stocks (McCain et al., 2016). Many populations of river herring (*Alosa pseudoharengus*, Clupeidae and *Alosa aestivalis*, Clupeidae, collectively), which are anadromous and rely on coastal streams for spawning and rearing, have reached historic lows in population size and are in need of a full ecosystem approach to restoration (Hare et al., 2021). Similar patterns have been observed in the Hudson River estuary (New York, USA), where striped bass (*Morone saxatilis*, Moronidae) are showing declining abundances and the American shad (*Alosa sapidissima*, Clupeidae) population is at an all-time low (Nack et al., 2019). Given the declining population trends in many fishes living in nearshore areas and their dependence on vision for day-to-day activities, developing a more holistic understanding of threats such as ALAN should be beneficial to managing commercially, recreationally and culturally valuable fisheries as well as targeting conservation efforts for imperiled populations.

Using a structured search of the primary literature, we quantitatively determine the extent to which researchers have explored the environmental issue of ALAN in fishes, in comparison with other taxa. We quantify whether ALAN research in fishes has been increasing over time and which categories of research (behaviour, physiology, community structure, morphology and fitness) have been most commonly investigated. Along with a summary of the status of the literature, we provide suggestions for expanding the research conducted in fishes, with special attention to documenting conservation implications. By identifying current gaps in the literature, this synthesis provides a roadmap to further our understanding of how the emerging stressor of ALAN is affecting a group of species of great commercial, recreational and cultural importance.

2 | TRENDS IN ALAN RESEARCH

To form a database of ALAN publications, we conducted a search in the global search engine Web of Science (Core Collection) on 18 September 2019 using the following key terms: “unnatural light”; “artificial light at night”; “night-time light”; “light pollution”; “artificial light”; “outdoor light”; “night sky pollution”; “global light emissions”; “artificially lit habitats”; “artificially lit environment”; “street light”; “artificial illumination”; “artificial glow”; “anthropogenic light”; “artificial night light”; ALAN. We further refined the search by excluding Web of Science categories that were unrelated to wildlife biology (e.g. applied physics, political science and oncology). Our full search string with all exclusions can be found in the Supporting Information (Part 1; Table S1). We completed an additional search with the same terms and exclusions on 29 January 2021 that was limited to the date range of “September 2019 – present” to update the database. In the first search, we obtained 3,549 publications which we then manually coded to form a database that only pertained to the biological effects of any form of artificial light (i.e. focused on plants, animals or whole ecosystems, or reviews of any combination of these). The second search yielded 670 papers that were manually coded by CLM. We acknowledge that we used a single search engine to obtain our results, and we therefore could have missed papers on ALAN that were published in highly specialized or local journals, articles that were not in English and/or publications that would be considered grey literature (e.g. government reports, theses; Mongeon & Paul-Hus, 2016). In the Life Sciences, we anticipate this could lead to a loss of up to 7%–8% of journal articles (Vieira & Gomes, 2009). However, we do not anticipate that certain taxonomic groups would be more likely to be excluded in the Web of Science Core Collection based on the search engine's journal coverage compared with others (e.g. Scopus). Further, our analysis did not require the comparison of the literature across disciplines or languages. As a result, we are confident that our results still provide a robust snapshot of the current state of the research on ALAN in fishes and in comparison with other taxa.

All publications considered to fall within our criteria of pertaining to the biological effects of artificial light were further categorized. We recorded (1) taxa of focus (or multi-taxa if the paper pertained to more than one major taxonomic group; or non-taxonomic if the publication reviewed overall effects of artificial light on entire ecosystems or from a global perspective); (2) whether the paper focused on aquatic or terrestrial ecosystems/species or both; (3) whether the paper dealt with artificial light in the context of pollution or other contexts (e.g. lighting in aquaculture facilities, the use of light for attraction in fisheries, light for commercial growth of plants). If a publication pertained to fishes (whether independently or as part of a multi-taxa approach, and in any setting—wild, laboratory or aquaculture), we further recorded: (4) species studied; (5) whether the study was completed in an aquaculture setting; (6) the focus/foci of the research (behaviour, physiology, fitness, morphology, community structure). Fitness was considered to be an organism's ability to survive and/or produce offspring. Although the effect of light on fish growth, behaviour and reproduction has also been studied in the context of improving aquaculture production (see review by Ruchin, 2021), we focus our review on publications specifically designed to study light pollution as they will have greater applicability to the light levels and ecological conditions experienced by wild fishes.

After manually removing papers that did not pertain to the effects of light on living organisms, we retained a database of 957 publications. We determined that 584 of these specifically discussed artificial light at night as a stressor (i.e. as light pollution), while the remaining papers covered other related topics such as normal function or ecology under natural light–dark cycles or the use of artificial lighting in industry (e.g. aquaculture facilities, greenhouses) or for behavioural guidance. Of the 584 ALAN papers, 60 took a non-taxonomic approach in that they discussed global, full ecosystem, or large-scale effects on biodiversity, most of them being reviews or meta-analyses. The publications with a taxonomic focus on light pollution (*n* = 524) covered a variety of taxa including birds (29%), insects (17%), mammals (17%), reptiles (9%), fishes (8%), other invertebrates (7%), multiple taxa (often bats and insects; 5%), plants (4%), amphibians (3%) and other organisms (algae, fungi, microorganisms; 1%; Figure 1). Studies on terrestrial organisms (59%) were more common compared with aquatic (20%) or mixed systems (21%).

Of the five taxonomic groups with greater than 40 publications pertaining to ALAN, birds, mammals, insects and reptiles have shown a general trend of increasing numbers of publications over time, although there are fluctuations from year to year in the total number of papers (Figure 2a). Mammals, insects and reptiles have shown a flatter climb in publication rate compared with birds (Figure 2b). Further, fishes have shown a decline in the number of papers published each year since 2016 (Figure 2a), having only reached a maximum of 6 publications in a single year.

The 8% (*n* = 41) of total publications focusing on fishes (Table S1) covered a number of major research topics (Figures 3 and 4) including behaviour (41.0%), abundance and community structure (24.4%), physiology (22.8%), fitness (6.9%) and morphology (4.9%).

3 | BEHAVIOUR

3.1 | Swimming activity

Swimming activity represented the most common metric investigated of the potential effects of ALAN on behaviour. Swimming is important to fulfilling many biological needs in fishes, such as acquiring food, avoiding predators, mating and/or caring for offspring and making seasonal migrations (Beamish, 1978). As a result, any ALAN-induced changes to general activity level are expected to have consequences for fish survival and/or reproduction, either directly through disruption of an associated behaviour or through changes in energy expenditure that then place limitations on the resources

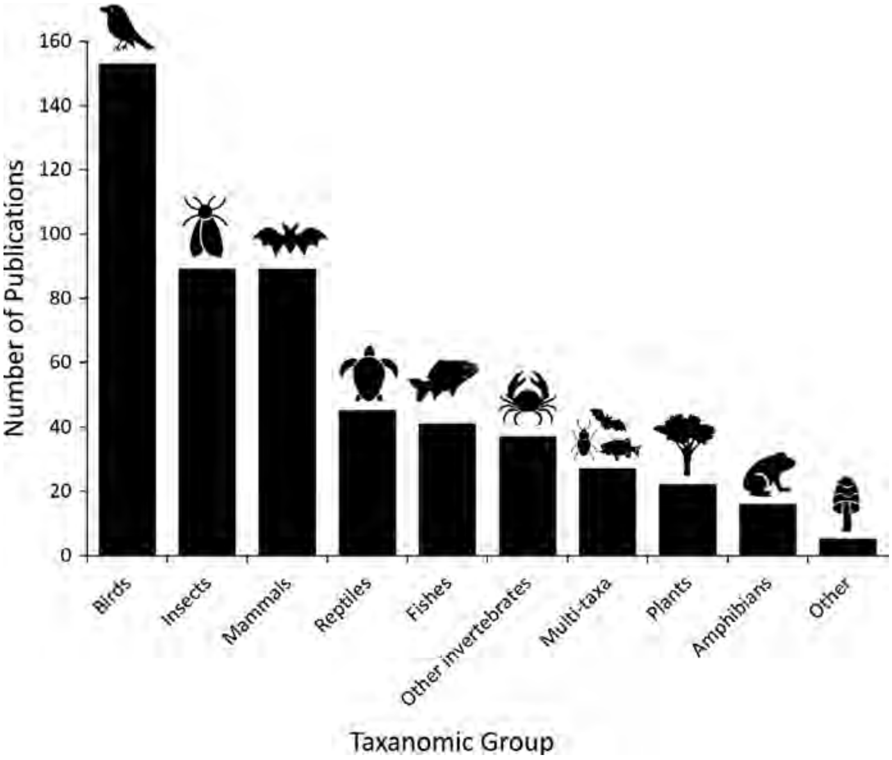
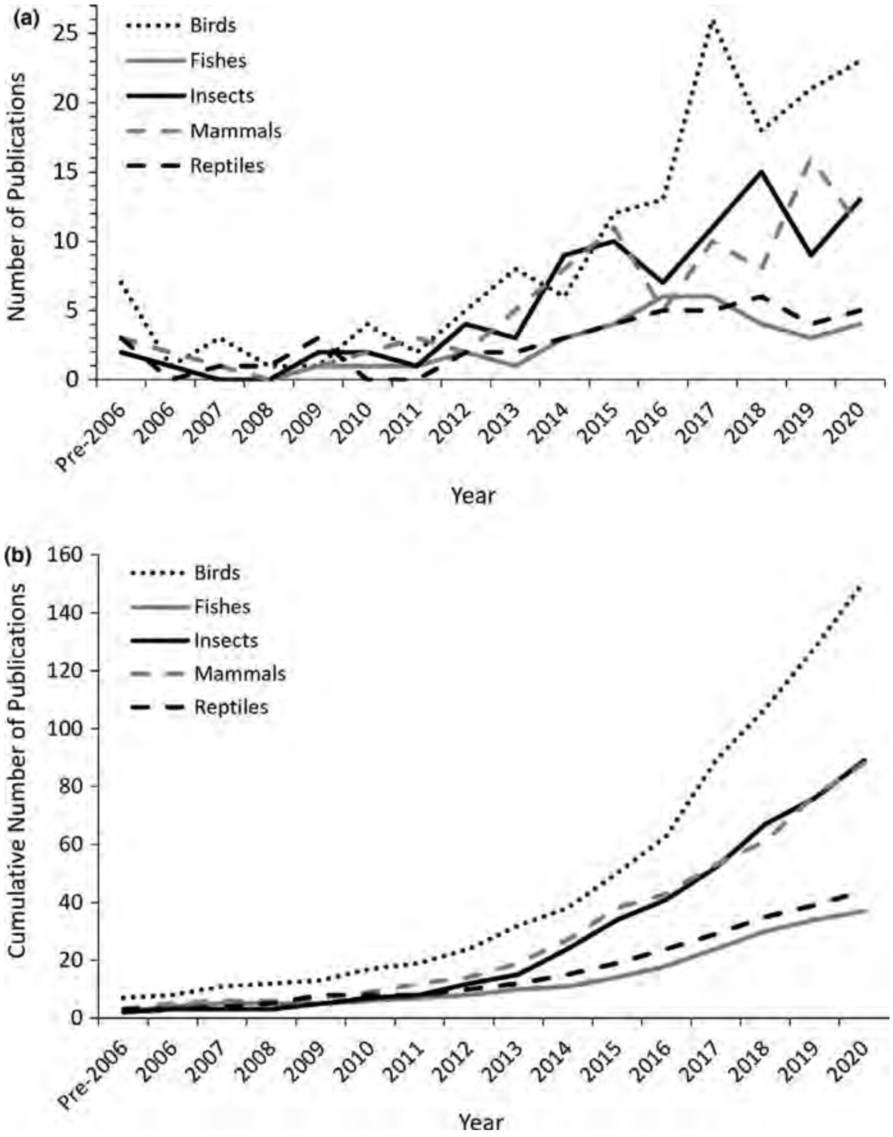


FIGURE 1 Number of publications in the primary literature focused on artificial light at night divided by major taxonomic group (1965–2021)

FIGURE 2 (a) Number of publications and (b) cumulative number of publications by year focused on artificial light at night in the five taxonomic groups with the largest total number of publications



available for reproduction or maintenance activities. Using accelerometer biologgers, Foster et al. (2016) found that nest-guarding male smallmouth bass (*Micropterus dolomieu*, Centrarchidae) exposed to two different types of ALAN in their natural habitat—low intensity dock-lighting (median 2.6 lux) and higher intensity simulated traffic lights (median 40.4 lux)—increased their total activity level in comparison with controls living in unaltered habitats. Fish experiencing the intermittent (traffic) lighting treatment showed the greatest increase in activity levels and the largest fluctuations in activity level between night and day, with implications for energy budgets during this crucial stage of reproduction (Foster et al., 2016). Indeed, there is some evidence that increases in swimming activity associated with light pollution could lead to increased energetic demand. Following a 10-day period of ALAN (70 lux) exposure, overall activity of wild-caught rockfish (*Girella laevifrons*, Kyphosidae) increased, with fish exposed to light showing greater activity across their entire 24-hr cycle compared with control fish (Pulgar et al., 2019). Further, while control fish showed peak activity levels at mid-day coinciding with expected change in the tide, light-exposed fish lost this circadian and circatidal pattern (Pulgar et al., 2019). Given that the increased activity in light-exposed fish was also paired with higher oxygen consumption (see Section 4.0 on Physiology below), these results further illustrate that ALAN has the potential to increase the energetic cost of living (Pulgar et al., 2019) with potential for carryover consequences to fitness.

To our knowledge, only two studies have documented the influence of ALAN on the activity of fish within communities in natural waterways, finding noticeable differences compared with unlit reaches or times. Bolton et al. (2017) reported that the installation of LED lighting in a wharf led to fishes being more active on lit nights compared with normal night-time conditions, as determined by analysis of underwater sonar footage (DIDSON). Becker et al. (2013) similarly investigated the activity of fish in a lit estuary using the same technology, finding that large fish worked to maintain their position in the lit area, a potentially energetically costly activity due to the swimming requirements necessary to compete with the current flows. These results further reinforce the potential for ALAN to alter the energetic budgets of a variety of fish species, with consequences for the functioning of entire communities if predator–prey relationships, reproduction, recruitment or species distribution is affected (Zapata et al., 2019).

We also have only limited information on how swimming activity may respond to different wavelengths of light. Lin et al. (2021) exposed the cyprinid *Ptychobarbus kaznakovi*, Cyprinidae to red, yellow, green and blue light of various illuminance levels (15–120 lux) and found that swimming activity was higher in the lit areas of arenas across all wavelengths in comparison with dark areas; however, the greatest increases were seen under yellow and red light. These results indicate that wavelength may be an important consideration for lighting along waterways and that there may also be potential applications for excluding or guiding fish as part of recovery efforts (Lin et al., 2021). There is also some evidence that different types of standard lighting sources could have various impacts on fish swimming behaviour, but whether these effects are related to the spectral quality of light still requires investigation. For example, swimming speed of juvenile rudd (*Scardinius erythrophthalmus*, Cyprinidae) was higher under halogen light (5.4 lux) compared with high pressure sodium (8.2 lux), while not differing from metal halide (7.1 lux), perhaps due to visual conditions/visibility (Tałanda et al., 2018). Therefore, the type of light source over a waterway could have consequences for the level of disruption to fish behaviour and it will be necessary to conduct more research to understand how the spectral characteristics of different light sources (particularly LEDs which are more energy-efficient and offer unlimited opportunities for tailoring spectral quality) may change the responses of different fish species.

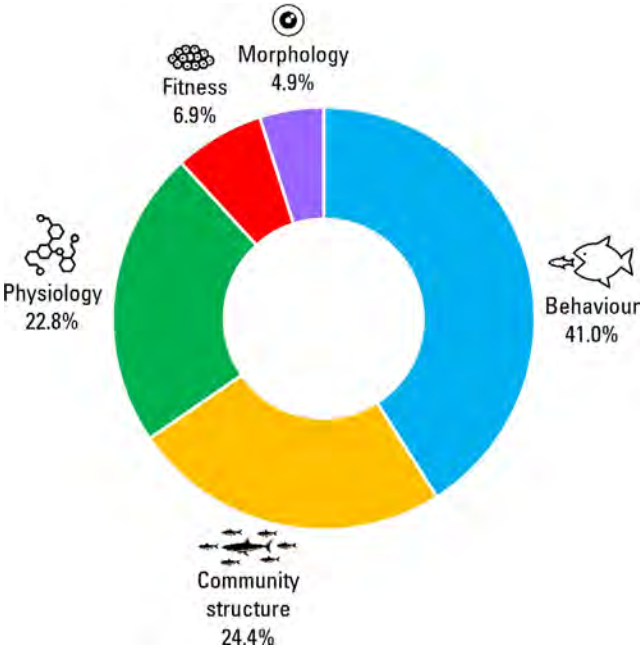


FIGURE 3 Proportion of major research topics covered in publications on the effects of artificial light at night on fishes (*n* = 41)

Finally, there are examples where ALAN did not influence the activity of the fish under investigation. For example, Trinidadian guppies (*Poecilia reticulata*, Poeciliidae) experiencing 10 weeks of ALAN (either bright at 5,000 lux or dim at 0.5 lux) did not show differences in activity level compared with fish kept on a normal light-dark cycle (Kurvers et al., 2018). In addition, juvenile bonefish (*Albula vulpes*, Albulidae) exposed to eight hours of simulated constant streetlighting (48 lux) or intermittent car headlights (80 lux) overnight showed no subsequent differences in overall activity, number of freeze events or burst swimming events compared with controls (Szekeres et al., 2017). The overall complement of studies on activity level has investigated a range of brightness levels and it is currently unclear whether there is a minimum threshold where behaviour may be affected, or how a species' life history, daily pattern of activity, developmental stage or habitat type may influence their behavioural sensitivity to ALAN. However, given that light-intensity thresholds for physiological effects appear to exist (see Section 4.0), it is feasible that behavioural thresholds will also be evident, and that they may be low (e.g. near 1 lux; Sanders et al., 2021). Based on patterns

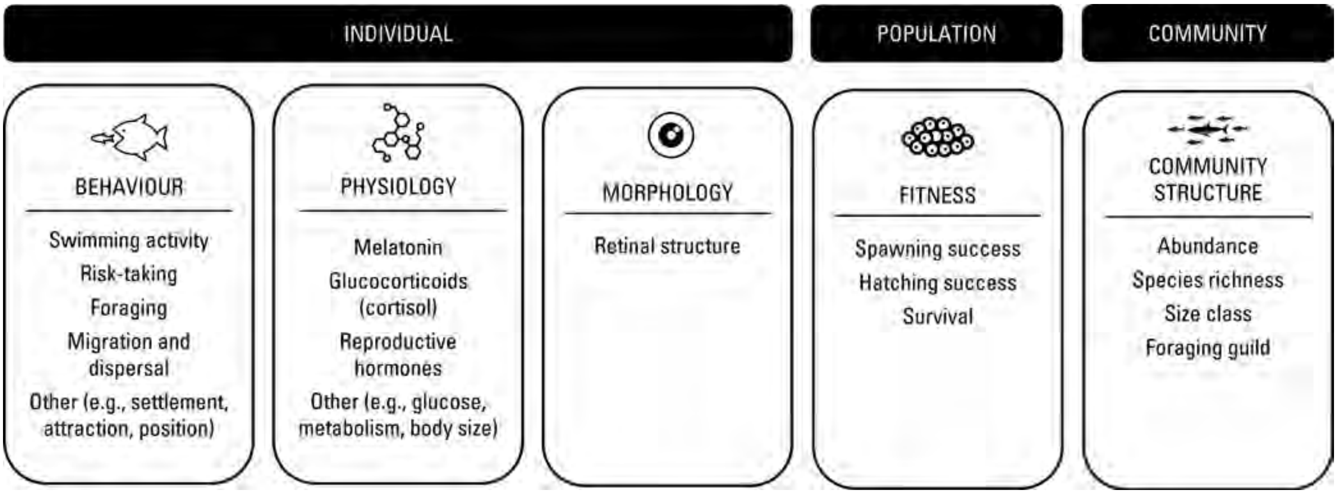


FIGURE 4 Summary of the major research topics investigated in artificial light at night publications focused on fishes, including subtopics within each major category

documented across species in a recent meta-analysis (Sanders et al., 2021), species or life stages with lower mobility to find refuge, lower behavioural flexibility and/or a nocturnal activity pattern could experience greater negative consequences. There is a pressing need for studies that simultaneously document behavioural changes and the associated consequences for energy expenditure, as well as the downstream influence of those changes on fitness.

3.2 | Foraging

Many species of fishes show diel rhythms of feeding activity (Helfman, 1993). Thus, ALAN can induce changes in foraging by either providing more or improved feeding opportunities (e.g. by increasing attraction of prey to light or improving forager vision) or increasing the risk of predation during feeding. For example, using a visual foraging model (VFM) based on experimentally determined reaction distance and capture success under various light levels, Mazur and Beauchamp (2006) showed that a nocturnal piscivore (cutthroat trout; *Oncorhynchus clarkii*, Salmonidae) experiencing urban light pollution (1–20 lux) gained greater access to vertically migrating prey fishes. Low-level ALAN in the laboratory also increased the consumption of invertebrate prey (gammarids) by Eurasian (also known as European) perch (*Perca fluviatilis*, Percidae) compared with dark nights, with fish being similarly effective predators during illuminated nights (2 lux) as they were in dusk conditions (10 lux; Czarnecka et al., 2019). Interestingly, the inclusion of woody debris did not provide an effective refuge for invertebrate prey under illumination, only under darkness, indicating that habitat complexity may not always mitigate the influence of ALAN on prey communities (Czarnecka et al., 2019). In a more natural setting, Tabor et al. (2004) investigated the ability of cottids (*Cottus* spp., Cottidae) to prey on sockeye salmon (*Oncorhynchus nerka*, Salmonidae) fry under four light intensities in artificial streams. As light intensity increased, cottids preyed on a larger number of fry, likely because fewer fry were emigrating from the lit areas. While cottids consumed approximately 5% of fry in dark conditions, 45% of fry were consumed in the brightest light conditions (5.4 lux). Further, Nelson et al. (2021) found that predation risk of Chinook salmon smolts in the wild increased with increasing ALAN intensity (0–70 lux at the surface), but only 3–5 hr after sunset. ALAN therefore has the potential to alter predator-prey dynamics to favour visual predators, increase predation on small-bodied species and therefore potentially lead to downstream changes in abundance of certain species.

In a community context, Bolton et al. (2017) showed that adding ALAN to a wharf led to greater predation of sessile invertebrates by fishes compared with dark nights, with levels of predation similar to those observed in daytime. In turn, the assemblage of sessile invertebrates changed under ALAN, indicating that this stressor has the potential to cause cascading effects through ecosystems. Bolton et al. (2017) also found evidence that fish were beginning to forage earlier on lit nights. More work is needed to determine whether acquisition of extra food resources can compensate for potential losses to rest and recovery that could result from extending total foraging time, for example through the measurement of body condition (Bolton et al., 2017). Other potential mismatches between evasiveness of prey and visual conditions for predators under ALAN could further accentuate alterations to predator-prey dynamics. Tałanda et al. (2018) measured the reaction distance of juvenile rudd as well as the evasiveness of their prey, *Daphnia*, under various light sources. While *Daphnia* were able to reliably gain information on the predation threat posed by fish under halogen lights (likely due to the spectrum being similar to that of sunlight), evasiveness was lower under metal halides, resulting in less capacity to escape predation. These types of disruptions to predator–prey interaction can have downstream consequences for entire ecosystems, for example if prey items are important for water quality and algae control (Tałanda et al., 2018).

Larger-scale *in situ* experiments will be necessary to account for full assemblages of predators and prey to determine how ecosystem functioning and water resource management may be impacted by various forms of ALAN (Tałanda et al., 2018). *In situ* experiments, or more complex laboratory designs, will also allow researchers to measure the behaviour of foraging individuals that are under their own predation pressure by piscivores, leading to a clearer picture of how ALAN will influence predator-prey dynamics in natural systems. Many studies investigated behavioural responses to short-duration ALAN, while aquatic systems are often facing ongoing changes to the lit environment. As a result, longitudinal studies that monitor how behaviour may change under longer-term light pollution will be helpful to understanding any persistent behavioural effects (Czarnecka et al., 2019). Finally, although ALAN may appear to create a benefit to some species by increasing access to prey, there is still potential that physiology and reproduction are simultaneously being altered (see sections below). Species, populations or individuals able to flexibly adjust their foraging activity to take advantage of opportunistic increases in prey under ALAN would be predicted to benefit from increased light intensity, with prey species facing increased risk of predation with increasing brightness. However, whether the benefits outweigh potential costs still requires investigation, in particular by observing fish over their full-day cycle (i.e. diel changes in foraging and energy intake) and across seasons.

3.3 | Movement, migration and dispersal

Migration and dispersal are important aspects of the life cycle of many fishes as it allows for territory establishment and exploration of temporally productive areas that increase fitness (Lennox et al., 2016). Often, natural lighting acts as a cue to initiate migratory behaviour and artificial lights can therefore disrupt this process (Lennox et al., 2016). For example, wild Atlantic salmon (*Salmo salar*, Salmonidae) smolts exposed to street lighting (14 lux) migrated from their natal stream at random times, compared with those under natural conditions which timed their migration with sunset (Riley et al., 2012). Riley et al. (2015) further experimentally documented that the dispersal of Atlantic salmon fry was delayed by 1.4 to 2.2 days under streetlight intensities as low as 1 lux (up to 8 lux) in the laboratory and similar results were unsurprisingly found under higher light intensities of 12 lux (Riley et al., 2013). In addition, the timing of dispersal is altered under lit conditions, with the mean time of fry dispersal taking place 5.5 hr after dusk under 1 lux, compared with 4 hr under dark control conditions (Riley et al., 2015). The distribution of dispersal times was also wider under 1 lux compared with darkness, with significantly more fish dispersing during daylight hours (Riley et al., 2015). Tabor et al. (2004) were also able to delay the migration of sockeye salmon fry in an 8-m section of shoreline through the installation of low-level light sources (0.1 lux). The subsequent removal of ALAN caused the fry to leave the shoreline (Tabor et al., 2004). As dispersal is a critical life stage leading to establishment and defence of territories, disruption of its timing could have implications for survival, particularly if nocturnal dispersal no longer affords protection from predators or if altered timing leads to a reduction in available energy reserves (Riley et al., 2013, 2015).

3.4 | Risk-taking behaviour

Behavioural traits associated with personality, such as risk-taking (or boldness), have been linked to survival and reproductive success in natural environments in fishes (e.g. Biro et al., 2003; Wilson et al., 2010). As a result, any effects of ALAN on the ability of fish to assess risk could result in altered predation outcomes or disruptions to energy balance, with potential fitness consequences. However, research on this category of behavioural response is limited. Becker et al. (2013) found that small fish showed a greater tendency to form schools on lit nights in an estuary, and this behaviour was viewed as an anti-predatory response to increased risk under ALAN. In a captive choice environment, zebrafish (*Danio rerio*, Cyprinidae) were not deterred by bright light (1000–1500 lux) but spent less time close to a crossing tube and more time in the upper layer of the tank in dimmer light (300–750 lux), which was interpreted as a sign of lower anxiety and lower perceived predation risk in lower light levels (Sabet et al., 2016). Further, Trinidadian guppies exposed to 10 weeks of ALAN (bright light: 5000 lux; dim light: 0.5 lux) emerged quicker from their refuge compared with control fish, with the brightest treatment leading to the greatest reduction in emergence time (Kurvers et al., 2018). Fish exposed to bright light also spent less time near walls and more time in the open compared with control fish (Kurvers et al., 2018). Both of these traits would likely increase risk and individuals may have increased their activity at night under ALAN, thereby taking on metabolic costs that would need to be replenished during daytime (i.e. if fish were hungrier and therefore took on greater risk to forage; Kurvers et al., 2018). Although this study suggests that diurnal behaviour following ALAN exposure can be disrupted, future studies should investigate a greater range of brightness levels to determine whether levels more closely resembling those found near coastlines could alter risk-associated behaviours. Further, documenting behavioural responses across the day and in relation to a hierarchy of lux levels will reveal if there is a dose-dependent relationship.

3.5 | Other behavioural responses

Apart from the more common behaviours discussed above, there were a number of additional studies that investigated responses to ALAN based on other aspects of behaviour. For example, Berge et al. (2020) found that fish and microzooplankton communities showed a near-instantaneous response to ALAN from a ship down to 200 m in depth and up to 200 m away, changing position in the water column via alterations to swimming behaviour in response. Given how little understanding we have of transient sources of light pollution, such as those associated with fishing or other vessels, this study indicates that this source of ALAN could have consequences for entire communities, at least for a short duration. ALAN may also affect other large-scale group behaviours within a single species. Bogue (*Boops boops*, Sparidae) were observed forming massive nocturnal juvenile shoals (biomass exceeding 1 ton at peak) in the shallow littoral zone; however, these were only recorded in anthropogenically modified habitats (both structural modifications and presence of light pollution; Georgiadis et al., 2014). Through visual observations of shoal micro-distributions between lit and shaded areas, Mavraki et al. (2016) determined that shoals favoured darker regions. As a result, the fish may be attracted on the large scale to lit, protected bays but then hide in shaded locations at the local scale, likely for predator avoidance. Finally, O'Connor et al. (2019) allowed convict surgeonfish (*Acanthurus triostegus*, Acanthuridae) to make a settlement choice in the laboratory between darkness and lit habitat (LED, 250 lux), with larvae showing a significant preference for dark habitat. Exposure to lower-level ALAN (20–25 lux) also caused larvae to make a quicker choice in response to visual stimulus (conspecific or heterospecific fish) compared with control larvae (O'Connor et al., 2019). While these individual investigations do not allow broad conclusions to be made, they still provide information on how ALAN can potentially alter behaviour in general and open avenues for future study of phototaxis at various life stages, whether ALAN can mask lunar cues important to reproduction and/or settlement (O'Connor et al., 2019), and how transient forms of ALAN influence fish species.

4 | PHYSIOLOGY

4.1 | Melatonin

Fish possess a light-sensitive organ called the pineal gland that produces and releases melatonin in response to varying light levels (Ekstrzm & Meissl, 1997). Melatonin is considered the key driver of biological rhythms that synchronize physiological processes with behavioural actions such as shoaling, locomotor activity, feeding or vertical migration (Brüning et al., 2018). Disruption of circadian rhythm and the loss of melatonin patterns can further interrupt reproduction, resulting in significant fitness implications. Levels of melatonin oscillate following photoperiodical changes with release being suppressed by light; levels are high during the night and low during the day (Brüning et al., 2018).

Almost all studies in fishes have shown a decrease in the production of melatonin when fish are exposed to ALAN. Khan et al. (2018) demonstrated the depression and loss of overall rhythmicity of melatonin in zebrafish serum, whole brain, retina and ovary in response to continuous light (300 lux) of relatively short duration (1 week) as well as over longer periods of one month and one year, in comparison with normal light–dark conditions (12-h light, 12-h dark). Further, some species show different responses depending on the spectrum of light tested. For instance, common roach (*Rutilus rutilus*, Cyprinidae) showed equivalent melatonin depression across three colours of light (blue, red, green) as well as to white light (Brüning, Hölker, et al., 2018), while in European perch, melatonin levels were least suppressed under blue light (Brüning et al., 2016). The magnitude of this suppression is expected to be biologically relevant (i.e. night-time levels are suppressed below natural daytime levels, and there is often an associated loss of overall rhythm in melatonin secretion; Brüning et al., 2016). A decrease in melatonin levels has been observed during exposure to levels of light as low as 1 lux and increasing the lux level has little to no effect (Brüning et al., 2015, 2016; Brüning, Hölker, et al., 2018). As a result, there is likely a threshold level of ALAN near 1 lux that can alter circadian rhythm by causing melatonin suppression in some fishes, and this light level is similar to that experienced below walkway lighting in aquatic environments (Brüning et al., 2016). Even lower light intensities, such as those associated with skyglow (0.01–0.1 lux), have been found to suppress night-time melatonin levels after periods as short as 10 days in Eurasian perch in captivity (Kupprat et al., 2020).

In a more natural experiment where European perch and roach were held in net cages within drainage channels, light levels of 15 lux at the surface produced by streetlights did not lead to differences in melatonin levels compared with fish experiencing natural light conditions (half-moon; up to 0.02 lux; Brüning, Kloas, et al., 2018). The authors outline that changes to melatonin rhythm could have been masked by individual differences, differences in sampling times between cages or due to low levels of light from the moon (Brüning, Kloas, et al., 2018). Given the other findings on these species and others in captivity, it is clear that more wild studies are needed. Such investigations should be performed in areas with similar abiotic and biotic properties between control and lit environments to ensure that the effect of ALAN can be disentangled from the effects of other conditions. Overall, the limited data available in fishes suggests that even low levels of light pollution may affect the circadian rhythm and melatonin release, particularly for freshwater fishes.

4.2 | Cortisol

The glucocorticoid hormone cortisol is a commonly measured indicator of stress in fish, and it influences several processes such as growth, osmotic regulation, immunological function and energy metabolism (Mommsen et al., 1999). In many species, cortisol also exhibits a circadian rhythm (Sánchez-Vázquez et al., 2019). If ALAN represents an unexpected stressor or energetic challenge, cortisol levels could be expected to differ in comparison with controls; however, the results of studies investigating this question in fishes have been mixed. Despite the changes to melatonin levels described above across light regimes (1, 10 and 100 lux) for European perch, Brüning et al. (2015) found no evidence that ALAN led to differences in overall cortisol levels or rhythm (with a peak occurring in the morning). Likewise, in a study on juvenile bonefish, Szekeres et al. (2017) found that whole-body cortisol showed no significant response to ALAN relative to controls. However, glucose was elevated 8 hr after exposure to both of two types of light pollution: constant streetlighting (48 lux) and intermittent car headlights (80 lux). Fish under the constant streetlight treatment also experienced higher levels of blood glucose than those under intermittent lighting (illuminated for 1 min every 10 min). This rise in glucose is similar in magnitude to what is experienced in adults during catch-and-release angling, and likely indicates that there was indeed a rise in cortisol, but it was transient and therefore not captured by sampling 8 hours post-treatment (Szekeres et al., 2017).

In contrast to the above investigations, Newman et al. (2015) did document elevated cortisol levels in dispersing Atlantic salmon fry exposed to ALAN (1–8 lux). However, this pattern was only found to be marginally significant when sampling water from flow-through incubators over a period of 1 month (analysis of Polar Organic Chemical Integrated Samplers from a full population of fish in each incubator). Water cortisol concentrations of individual fry sampled from containers (after 30 min) did not show differences between light-exposed and control treatments (Newman et al., 2015). As a result, ALAN may not be interpreted as a stressor for dispersing fry, or individuals may have become acclimated to the light levels. The authors were unable to test whether length of exposure or age influenced cortisol levels of individual fry, but further investigations with larger sample sizes could clarify these questions and be pertinent to managers (Newman et al., 2015).

In all cases, experiments were completed in a laboratory setting that lacks many environmental and ecological inputs, such as refuges, predators and prey (Brüning et al., 2015). It is therefore unclear whether the addition of ALAN to a more natural setting, or over longer periods of time, may lead to alterations in cortisol secretion. The release of cortisol may be transient, meaning more studies sampling fish at other intervals (e.g. minutes to 1–2 hr) following interaction with artificially lit environments are necessary to fully understand the influence of ALAN on stress physiology (Szekeres et al., 2017).

4.3 | Reproductive hormones

Gametogenesis is dictated by a cascade of hormones with gonadotropin-releasing hormone (GnRH) stimulating release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) from the pituitary, and thereby leading to the production of sex steroids (Brüning, Kloas, et al., 2018). This hormone cascade is controlled by daily fluctuations in photoperiod, along with other factors such as temperature, and can therefore be hypothesized to be affected by ALAN (Brüning, Kloas, et al., 2018). Brüning et al. (2016) found that mRNA expression of luteinizing hormone and follicle-stimulating hormone was suppressed by white light levels as low as 1 lux in female European perch. Conversely, there were no differences in gonadotropin expression in male perch exposed to ALAN in comparison with control fish, perhaps due to the timing of the reproductive cycle and maturation of gonads occurring earlier in males than females. Other wavelengths of light (blue, green, red) did not influence the mRNA expression of gonadotropins in either sex; however, the authors speculate that the timing of this part of the experiment likely occurred too early in the season and thus the reproductive cycle had not yet begun. Brüning, Hölker, et al. (2018) similarly did not find that either white or coloured light impacted the mRNA expression of gonadotropins in roach in a laboratory setting, again potentially due to a time of year effect on the reproductive axis (i.e. the study was completed outside of a photolabile period for this fish species). These findings highlight the importance of considering seasonality, among other contexts, when interpreting the effect of anthropogenic change on physiology. Indeed, in a follow-up study in a natural setting, Brüning, Kloas, et al. (2018) found a reduction in both mRNA expression of gonadotropins (luteinizing hormone and follicle-stimulating hormone) and circulating sex hormones (17β-oestradiol and 11-ketotestosterone) in European perch and roach under streetlighting (13.3–16.5 lux at the surface).

Although the research into the effect of ALAN on the reproductive hormone axis of fishes is limited, the available evidence indicates that light pollution has potential to disrupt hormonal rhythms, particularly if species exhibit a photolabile period associated with onset of gonadogenesis, with downstream consequences for fitness and population dynamics (Brüning, Kloas, et al., 2018). The work thus far has only been completed in two freshwater species, illustrating the vast potential for understanding how this emerging stressor influences reproductive physiology in natural settings across species, seasons, habitat types and geographic areas.

4.4 | Other physiological traits

Additional investigations into the physiological effects of ALAN have included a variety of metrics. For example, Pulgar et al. (2019) exposed juvenile wild-caught rockfish to the same level of ALAN commonly found in its coastal intertidal habitats (~70 lux). After 10 days, fish displayed higher oxygen consumption compared with controls, likely as a result of higher activity levels. This potential change in overall energetic balance can increase the metabolic cost of living and could lead to changes in mass over longer exposure periods (Pulgar et al., 2019). Indeed, Atlantic salmon fry exposed to simulated streetlighting (12 lux) were smaller at dispersal compared with control fish under a natural light–dark cycle (Riley et al., 2013). ALAN has also been shown to lead to desynchronization of a number of clock-associated genes over timespans of weeks to months and to upregulation of genes that ultimately lead to tumorigenesis, with the confirmation of ovarian tumour formation through histology in wild-caught zebrafish after one year of exposure (300 lux; Khan et al., 2018).

Overall, research on the physiological consequences of ALAN for fishes has been limited to a small subset of traits in a few species. Given the vast toolbox of physiological measurements available to assess stress, immune and energetic responses to anthropogenic change (Madliger et al., 2018), there is much greater potential to document whether and how fish cope with this stressor. As with behaviour, physiological monitoring has the power to provide information on the mechanism underlying threats and therefore imparts the ability to design better-targeted solutions. Greater scope in physiological monitoring (both the number and type of metrics) will broaden our understanding of the time periods (e.g. time of night, season or life stage), environmental conditions, and species that will be most affected by ALAN, and therefore how to best put mitigation strategies in place.

5 | ABUNDANCE AND COMMUNITY STRUCTURE

Because ALAN can alter the availability and distribution of resources, influence risk landscapes by changing predatory–prey interactions and interfere with dispersal and movement patterns, there is potential for the restructuring of community composition (Zapata et al., 2019). Such changes could include differences in relative abundance of particular species, species richness and diversity, and the spatial distribution of taxa in light-polluted compared with dark environments (Zapata et al., 2019). Research on these types of ALAN-induced effects have been relatively limited; we found only 12 publications related to abundance and/or community composition in fishes, many of which focused on predator–prey interactions. In some cases, the sources of ALAN were quite bright in comparison with non-lit environments. Keenan et al. (2007) investigated the lit environment near offshore petroleum platforms in the Gulf of Mexico and recorded 10–1,000 times more light (based on irradiance profiles) present near platforms in comparison with control sites in open water. They then modelled the 3-D light field and estimated that platforms could represent enhanced foraging environments, providing both sufficient light to visually locate and capture prey and by attracting positively phototaxic prey for species such as Atlantic herring (*Clupea harangus*, Clupeidae), damselfishes (Pomacentridae) and Japanese scad (*Decapterus maraudsi*, Carangidae). In a field study, when quantifying the actual abundances of fish near artificial lighting systems on oil platforms using baited remote underwater video, Barker and Cowan (2017) found that more fish were observed near-lit platforms, but fish were leaving surface waters during the night, possibly due to increased predation pressure caused by artificial lighting. Likely, artificial lighting was decreasing the relative safety many fish experience under darkness by increasing the visibility of prey from predators below (Barker & Cowan, 2017). Other sources of bright, localized light, such as what would be associated with intensive salmon aquaculture, have also been shown to drastically change species composition and abundance within illuminated areas. Using purse seine surveys, McConnell et al. (2010) observed greater than 100 times more Pacific herring (*Clupea pallasi*, Clupeidae) in an artificially lit area created to mimic an aquaculture facility (15–36,000 lux depending on distance from the source light), along with greater abundance of threespine stickleback (*Gasterosteus aculeatus*, Gasterosteidae), Pacific sand lance (*Ammodytes hexapterus*, Ammodytidae), soft sculpin (*Psychrolutes sigalutes*, Cottidae) and larval great sculpin (*Myoxocephalus polyacanthocephalus*, Cottidae) compared with nights where the area was not illuminated. These types of light sources therefore not only have the potential to change natural predator–prey relationships, but also may increase the interactions between wild and farmed fishes, with implications for disease transmission (McConnell et al., 2010).

Dimmer sources of light in aquatic environments have also been found to influence community dynamics. For example, while Nelson et al. (2021) found that predator densities were not related to ALAN 1–3 hr after sunset, the density of piscivorous fishes was greater with ALAN 3–5 hr after sunset. Becker et al. (2013) determined there was a size-dependent response to artificial light in an estuary near a floating restaurant, with increased abundance of small shoaling fish (<100 mm) when the area was lit. As a response to increased foraging opportunities, large predatory fish (>500 mm) also increased in abundance in the illuminated area. By creating more optimal conditions for visual predators, these light-related changes have the potential to lead to unnatural top-down regulation of fish populations (Becker et al., 2013). Bolton et al. (2017) found similar results where predation risk was amplified for marine species exposed to a newly installed source of ALAN (~160 lux) under a wharf. Overall, ALAN increased the abundance of small- and medium-sized fish. While the abundance of predatory fish was lower under ALAN, they showed more predatory behaviour in comparison with darkness (Bolton et al., 2017). As an anti-predator response, many shoaling fish formed large aggregations, which highlighted that they were aware of their increased vulnerability to predation when entering the area of artificial light (Becker et al., 2013; Bolton et al., 2017). As outlined above, given that darkness acts as a refuge for many prey species and allows them to perform important activities such as rest, spawning and foraging, ALAN is likely decreasing the ability of fish to accomplish these important behaviours as they must expend more energy actively protecting themselves from predation (Bolton et al., 2017).

The response to ALAN may also be graded, with greater changes in abundance as the brightness of the light increases. Tabor et al. (2017) found that the addition of light led to greater abundances of subyearling salmonids (Chinook salmon *Oncorhynchus tshawytscha*, Salmonidae; Coho salmon *Oncorhynchus kisutch*, Salmonidae; and Sockeye salmon *Oncorhynchus nerka*, Salmonidae; combined), with the greatest number of fish caught in light treatments of 50 lux, an intermediate number at 5 lux and the fewest under darkness. Such nocturnal phototaxic behaviour could lead to higher predation risk for young salmonids (Tabor et al., 2017). Still, other communities may be less susceptible to the effects of ALAN. For example, Martin et al. (2021) installed a submersible light (leading to brightness of 75.700 μE m^{-2} s^{-1} immediately under the light) in seagrass habitat in Florida, USA. While they recorded that the community structure of fishes differed between day and night, they observed no changes in patterns due to ALAN. Future study is necessary to determine whether this was due to the short duration of light (30 hr). Similarly, Perkin et al. (2014) installed streetlights in forested streams of coastal British Columbia, Canada, and found that the abundance and growth rate of cutthroat trout did not differ between lit (0.81 lux) and control reaches (<0.00167 lux), even though drift of aquatic invertebrates was 50% less in lit compared with dark areas. Again, the authors suggest that future research should determine whether longer-term exposure to light (i.e. months to years) or its presence in other seasons leads to different results before concluding that ALAN does not influence stream ecosystems.

The relative paucity of research available on this topic has likely partially stemmed from the difficulty in observing fish communities at night in darkness (i.e. to obtain control conditions) without creating artefacts (Hammerschlag et al., 2017). Direct sampling has obviously contributed important information, though it is important to acknowledge that alternative capture techniques can lead to bias in the size and age of fishes sampled. The availability of acoustic camera technology (e.g. DIDSON) has the potential to allow further data collection on how ALAN influences abundance and behaviour of fishes simultaneously (Martin et al., 2021). In addition, all the studies to date in fishes have dealt with a single source of light, and it will be informative to determine how multiple sources of light and dispersed light such as skyglow may impact coastal community structure (Becker et al., 2013). More studies are also warranted that compare not just lit communities to dark controls, but also to daytime conditions to begin separating the influence of ALAN from the structural aspects of urban environments (Becker et al., 2013). Finally, the effect of different levels of structural diversity, and therefore potential refuges from light, will be necessary in fully understanding how ALAN affects various habitats (Perkin et al., 2014).

6 | FITNESS

There has been limited research on the fitness-related effects of ALAN for fishes, likely partly due to the logistical difficulties of studying reproduction in the field. However, there is an expectation that light-induced changes in behaviour and physiology (see above) could, in turn, influence survival (e.g. through increased predation risk) or ability to reproduce (e.g. by altering parental behaviours, interfering with egg hatching). In some cases, the effects of ALAN on reproduction have been clearly documented. For example, Fobert et al. (2019) found that exposure of common clownfish (*Amphiprion ocellaris*, Pomacentridae) to low levels of ALAN similar to light-polluted near-shore areas (26.5 lux surface; 10–15 lux bottom) did not influence frequency of spawning or fertilization success. However, eggs incubated in ALAN conditions did not hatch, compared with 86% hatching success in controls (Fobert et al., 2019), illustrating a detrimental impact of light pollution on reproductive success. Possibly, ALAN masks a darkness cue that is integral for hatching to occur (Fobert et al., 2019). In contrast, Brüning et al. (2011) found more mixed and species-specific results for the effect of ALAN on hatching, although the light regime of 3,500 lux is arguably less biologically relevant. For roach and bleak (*Alburnus alburnus*, Cyprinidae), time to 50% hatch was longer under constant illumination compared with controls, whereas chub (*Leuciscus cephalus*, Cyprinidae) hatching was accelerated. Continuous light conditions also extended the full hatching period (time to 100% hatched) in Eurasian perch and roach (Brüning et al., 2011). The ecological relevance of delayed hatch requires further investigation; while earlier hatched larvae may have access to greater food resources and gain advantages for growth (e.g. Durham & Wilde, 2005; Phillips et al., 1995), they are also often smaller at hatch and can experience higher mortality (e.g. Raventós & Macpherson, 2005; Simonin et al., 2016). Despite the brightness of the light used in this experiment, Brüning et al. (2011) showed that ALAN can interrupt potential cues associated with hatching, likely through alteration of the signals sent to the pineal gland and retina, which, in turn, control a hatching enzyme that determines time to hatch (Helvik & Walther, 1992).

Research investigating the effect of ALAN on survival is also very limited. O'Connor et al. (2019) found that wild-caught convict surgeonfish larvae under ecologically relevant ALAN (20–25 lux) for 10 days had higher growth rates and attained greater body masses, but experienced higher post-settlement mortality rates than controls (26% and 4%, respectively). In addition, in a predator–prey trial using a pair of nocturnal predators (clearfin lionfish, *Pterois radiata*, Scorpaenidae), larvae that had been exposed to the 10-day ALAN treatment experienced higher predation rates than control fish, in some trials as high as 9:1 (O'Connor et al., 2019). In a different fitness-related investigation, Riley et al. (2013) exposed Atlantic salmon fry to broad-spectrum streetlight conditions in a laboratory setting and recorded no difference in survival prior to dispersal compared with controls. The authors did, however, outline that the period between emergence of fry and establishment of feeding territories is critical to wild salmonid population dynamics. The authors documented a 3-day delay in fry dispersal under ALAN conditions (see Behaviour Section 3.0), which could have strong implications for fitness in the wild, indicating the need for such *in situ* experiments (Riley et al., 2013).

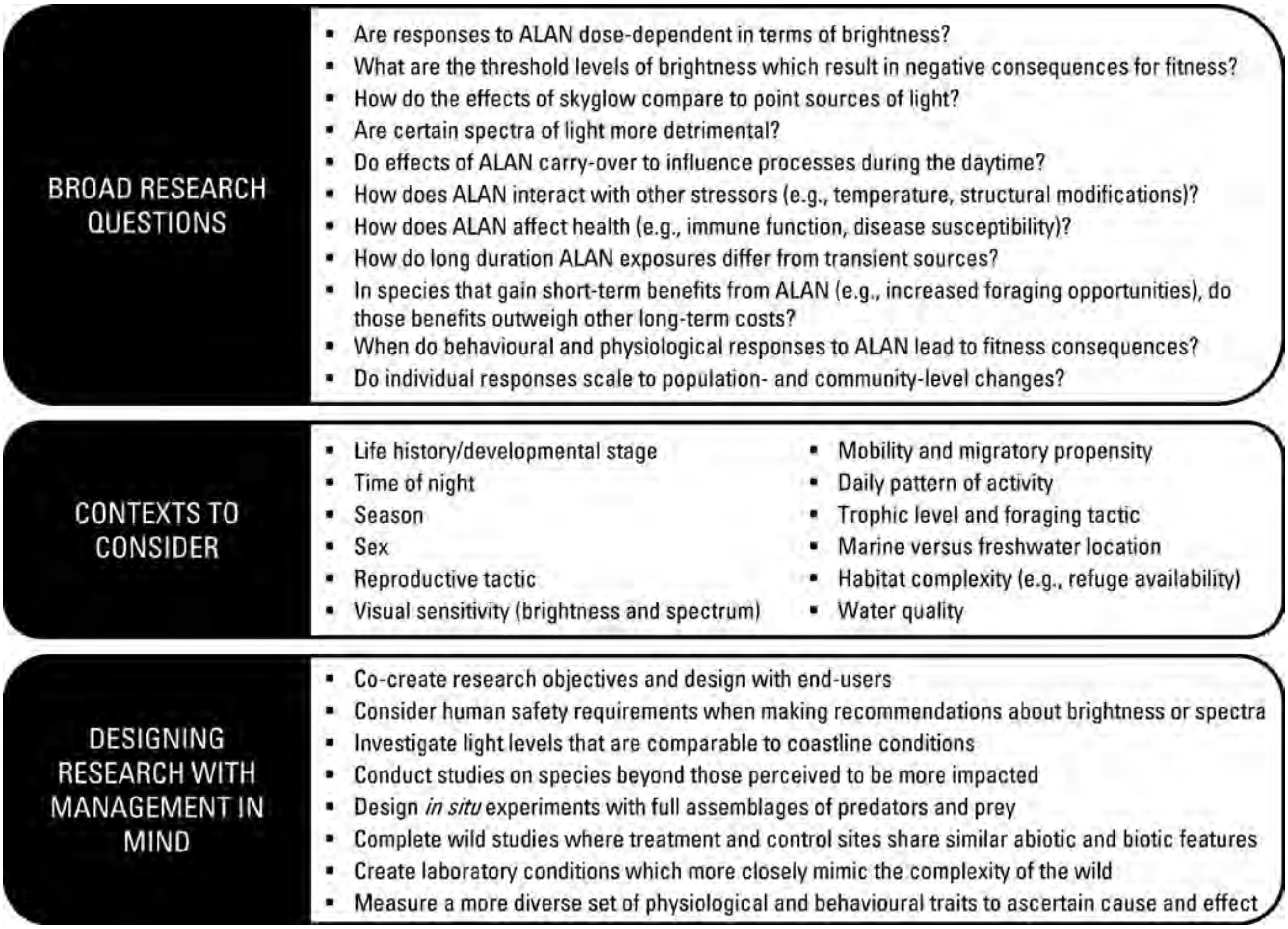
While some studies have therefore documented an effect of ALAN on fish survival and reproductive success, the impact this could impart on population or community dynamics is not yet known. In some species that disperse long distances, the effects could be particularly far-reaching by influencing recruitment dynamics. There is a need to better understand habitat selection during settlement, as some larvae may be attracted to lit areas, as well as post-settlement survival in habitats of varying brightness (Fobert et al., 2019). It is evident that ALAN may influence species differently based on life history, but the exact mechanisms remain unclear. For example, it may be expected that pelagic spawners whose eggs are carried offshore or species with eggs that hatch during the day may be less impacted; however, ALAN could cause signal-masking and induce hatch at the wrong time of day or night, disrupting optimal timing that may be essential for survival of embryos and/or larvae (Fobert et al., 2019). Future research that takes place in the field is essential to include potential costs (e.g. predation risk) and benefits (e.g. access to prey resources) to fully understand the consequences of ALAN for wild populations (Fobert et al., 2019).

7 | MORPHOLOGY

The effect of ALAN on morphology appears to be the topic least explored in fishes. Grace and Taylor (2017) documented developmental changes in the retinas of elopomorph fish in concert with changes in average light environment, with dramatic divergence among taxa that leads to specialized visual capacities. The authors detail that further work is necessary to determine whether the ability to change retinal structure over development will impart a capacity for resilience under scenarios of light pollution, or whether ALAN will instead be detrimental for individuals that must move between dark- and light-polluted locations (Grace & Taylor, 2017). At a finer scale, Kopperud and Grace (2017) measured retinomotor movement in juvenile Atlantic tarpon (*Megalops atlanticus*, Megalopidae) in relation to light–dark cycles. Constant light levels abolished the normal pattern of retinomotor movements in both cones and rods, indicating that light exposure at unexpected times may disrupt vision and therefore predator avoidance and ability to capture prey (Kopperud & Grace, 2017). This limited evidence suggests that there are implications for ALAN to alter retinal development and function, and there would be great benefit in studying such effects under the levels of light often found in coastal environments.

8 | RECOMMENDATIONS AND CONCLUSIONS

We found a total of 41 publications (published as of January 2021) investigating the consequences of ALAN on behaviour, physiology, abundance and community structure, fitness, and morphology in fishes. Based on our synthesis, Figure 5 provides a summary of research gaps, and biotic and abiotic contexts that are important to consider when studying the effects of ALAN on fishes, and suggestions for improving the management applications of ALAN research. Clearly, ALAN can induce physiological and behavioural changes at relatively low intensities (e.g. 1 lux), but we are still lacking information on the consequences of these effects for fitness and higher levels of organization (i.e. ecosystem effects). The threshold values of brightness that impact behaviour, physiology and performance may also differ between species, and these should be compared



BROAD RESEARCH QUESTIONS

- Are responses to ALAN dose-dependent in terms of brightness?
- What are the threshold levels of brightness which result in negative consequences for fitness?
- How do the effects of skyglow compare to point sources of light?
- Are certain spectra of light more detrimental?
- Do effects of ALAN carry-over to influence processes during the daytime?
- How does ALAN interact with other stressors (e.g., temperature, structural modifications)?
- How does ALAN affect health (e.g., immune function, disease susceptibility)?
- How do long duration ALAN exposures differ from transient sources?
- In species that gain short-term benefits from ALAN (e.g., increased foraging opportunities), do those benefits outweigh other long-term costs?
- When do behavioural and physiological responses to ALAN lead to fitness consequences?
- Do individual responses scale to population- and community-level changes?

CONTEXTS TO CONSIDER

- Life history/developmental stage
- Time of night
- Season
- Sex
- Reproductive tactic
- Visual sensitivity (brightness and spectrum)
- Mobility and migratory propensity
- Daily pattern of activity
- Trophic level and foraging tactic
- Marine versus freshwater location
- Habitat complexity (e.g., refuge availability)
- Water quality

DESIGNING RESEARCH WITH MANAGEMENT IN MIND

- Co-create research objectives and design with end-users
- Consider human safety requirements when making recommendations about brightness or spectra
- Investigate light levels that are comparable to coastline conditions
- Conduct studies on species beyond those perceived to be more impacted
- Design *in situ* experiments with full assemblages of predators and prey
- Complete wild studies where treatment and control sites share similar abiotic and biotic features
- Create laboratory conditions which more closely mimic the complexity of the wild
- Measure a more diverse set of physiological and behavioural traits to ascertain cause and effect

FIGURE 5 Summary of future research questions, contexts that should be considered or directly investigated when conducting ALAN research in fishes, and suggestions for how to generate research with stronger management applications

with light conditions quantified in a greater diversity of underwater areas to make stronger predictions of ALAN's influence on aquatic environments (Kurvers et al., 2018; O'Connor et al., 2019). Working towards a community ecology approach that considers the interactions between species and trait distributions will be necessary to understand effects of ALAN on broader ecosystem functions (Sanders & Gaston, 2018).

Ultimately, it is difficult to make long-term conclusions from the information presented herein, as most studies have been conducted in short-term artificial environments. To determine the effects of ALAN on fishes within the constraints of competition, predation and resource limitation, adequately conceptualizing the complexity of natural settings is required. As such, further work in the wild (including use of large mesocosms) or more natural laboratory settings will be necessary. *In situ* studies will be particularly important for quantifying how ALAN can generate both potential benefits (e.g. increased access to resources) and costs (e.g. predation; Fobert et al., 2019). A number of technologies are increasing the potential to collect data in wild settings including DIDSON cameras and predation event recorders, as well as acoustic telemetry (e.g. bridge lighting has been shown to attract free-swimming acoustically tagged Chinook salmon smolts; Celedonia et al., 2011). The vast diversity of life-history strategies found across fishes requires examination of how ALAN could differentially impact species or developmental stages due to visual sensitivity, habitat complexity, water quality, marine versus freshwater environments, foraging tactic, personality type, nocturnal versus diurnal lifestyle, life stage and other factors. It will also be beneficial to conduct studies in more natural settings to determine the additive effects of ALAN coinciding with other natural and anthropogenic stressors, such as changing temperature regimes, structural modifications to shorelines, nutrient inputs and chemical stressors (Perkin et al., 2011, 2014). Further, much of the research in fishes has investigated direct lighting sources; however, skyglow poses a more widespread and persistent threat. Although research on skyglow is increasing (e.g. The LakeLab Experiment, Leibniz-Institute of Freshwater Ecology and Inland Fisheries), continued information on how it affects fishes will be necessary for well-informed conservation planning.

Conservation efforts concerning ALAN in other taxonomic groups with larger research bases demonstrate that effective management strategies can indeed be developed. For instance, research on sea turtles has resulted in laws passed in Florida coastal areas to restrict lighting placement adjacent to nests (Salmon, 2003). Reducing the intensity of ALAN at existing illuminated structures also represents a feasible management strategy. For example, new low intensity LEDs were installed on the Sundial Bridge in Redding, California (USA) to reduce the perceived negative effects of ALAN on migrating juvenile salmon (Hacker, 2019). It may be possible to eliminate overall input of light into heavily affected systems by preventing the amount directed into the sky (e.g. by using covered lights or other shielding), by shortening periods of lighting (e.g. through time limits or motion sensors) (Czarnecka et al., 2019; Gaston et al., 2013; Nelson et al., 2021), using dimmers (McNaughton et al., 2021), or by employing LEDs that tailor spectral quality (Becker et al., 2013). As more research amasses across taxa, the potential for solutions that balance considerations of human safety in built landscapes with the well-being of wildlife (Longcore et al., 2018) should only increase.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are publicly available on Zenodo: https://doi.org/10.5281/zenodo.5780239.

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SUPPORTING INFORMATION

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COMPARATIVE RISKS OF HAZARDOUS MATERIALS AND NON-HAZARDOUS MATERIALS TRUCK SHIPMENT ACCIDENTS/INCIDENTS

Final Report

Prepared for
Federal Motor Carrier Safety Administration

March 2001

Battelle
. . . Putting Technology To Work
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COMPARATIVE RISKS OF HAZARDOUS MATERIALS AND NON-HAZARDOUS MATERIALS TRUCK SHIPMENT ACCIDENTS/INCIDENTS

Executive Summary

This project was designed to assist the U.S. Department of Transportation (USDOT) in achieving their strategic goal of reducing the rate and severity of transportation fatalities and injuries in hazardous materials (HM) transportation and of reducing the dollar loss from high-consequence, transportation accidents. The purpose of this project is to assess the additional risks posed by HM transportation when compared to non-hazardous shipments. The results will also be used to assist the Federal Motor Carrier Safety Administration (FMCSA) in identifying high risk motor carriers.

The project has been divided in three phases.

- The initial portion of the first phase characterized for one year the shipment impacts of Class 3 shipments and assessed the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. The feasibility study results were published in the *Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Non-hazardous Materials Movements,* June 1999.

- The second part of the first phase characterized the one-year shipment impacts of Class 2.1 and Class 8 and provided a preliminary estimate of the impacts of non-HM shipments. Two white papers, *Potential for Integrating Hazmat Transportation Risk Assessment into Safestat* and *Incorporating Severe Class 3 and Class 2.1 Accidents into the Truck Transportation Risk Assessment* were produced by the project in 1999.

- The project's second phase was the actual comparative risk assessment between HM and non-HM truck shipments. To obtain the overall HM risk, the study calculated the risk associated with each class/division of hazardous material. With the completion of the second phase of the project, the risk associated with the shipment of any class/division of HM can be compared to the risk associated with other classes/divisions as well as to the shipment of non-HM materials.

- The third phase of the project focused on a possible application of the HM risk results. Specifically, the study assessed how HM risk information is currently being used in the SafeStat program to identify potentially unsafe HM carriers. With these results in hand, the assessment then focused on how the HM risk information obtained during the first two phases of the study could be applied to the SafeStat algorithm to better identify "high risk" HM carriers.

- For comparative purposes, the risk assigned was applied to 12 HM categories, consisting of classes and divisions or groups of divisions as follows:

- Class 1: Divisions 1.1, 1.2, 1.3 — all have the potential for mass detonation
- Class 1: Divisions 1.4, 1.5, 1.6 — characteristics make mass detonation unlikely
- Class 2: Division 2.1 — Flammable gases
- Class 2: Division 2.2 — Non-flammable gases
- Class 2: Division 2.3 — Poisonous gases
- Class 3: Flammable liquids (and combustible liquids)
- Class 4: Division 4.1, 4.2, 4.3— Flammable solids; spontaneously combustible materials and dangerous when wet materials
- Class 5: Division 5.1, 5.2 — Oxidizers and organic peroxides
- Class 6: Division 6.1, 6.2— Toxic (poison) materials and infectious substances
- Class 7: Radioactive materials
- Class 8: Corrosive materials
- Class 9: Miscellaneous dangerous goods.

Adding non-HM transport brought the total number of categories of materials being assessed to 13.

This report analyzes events involving the transportation of hazardous material that may or may not result in the release of hazardous material to the environment. These events are defined as accidents and incidents. An accident is defined here as an event that occurs when the vehicle transporting the goods is involved in a collision. Any accident involving the shipment of HM would be considered as a HM accident regardless of whether any of the material was spilled or was exposed to the atmosphere. Similarly, a non-HM shipment accident would be considered as a non-HM shipment accident even if fuel from the tractor spilled during an accident. An event that occurs when the vehicle transporting the goods spills some of the HM cargo but is not involved in a collision is termed an enroute incident. An event resulting in the spill or release of HM material during loading or unloading is defined as a loading/unloading incident.

An initial step in developing a risk assessment is to estimate reliably the number of accidents and incidents across a defined period of time. For the first phase, estimates were developed for Class 3, Division 2.1, and Class 8 truck shipment incidents and accidents for a representative year. The Hazardous Materials Information System (HMIS) database served as the baseline database. The HMIS represents the only national database of hazardous materials, highway transportation incidents with details of the material, packaging and consequences involved. To be more complete, the data found in the HMIS were supplemented with data from other federal and state databases. The most important of these was the Motor Carrier Management Information System (MCMIS) accident database that provides accident information for both spill and no-spill accidents. The study determined underreporting rates for Class 3, Division 2.1, and Class 8 accidents and incidents by examining the same accident in several databases. These underreporting factors were then applied to the other HM categories to develop accident and incident likelihoods for an annual portrait.

A key portion of this assessment was the consideration of the impacts of high consequence/low frequency accidents. First, these severe accidents were identified through an examination of the historical record during the past fifty years. Next, the study obtained the likelihood of occurrence by estimating the fraction of the accidents represented by the accident sequence that would, based on the historical record, likely to be severe. Thus, a total likelihood of accidents for the portrait year was developed for all of the HM categories.

The average annual enroute HM accident frequency was estimated to be 2,484 accidents. The release accidents are estimated at 768. Average annual enroute leak incidents totaled 1,455 and loading/unloading incidents totaled 10,746.

Class 3 shipments account for about 64 percent of the enroute accidents with releases and about 52 percent of the non-release accidents. Class 3 shipments along with categories 2.1, 2.2, 5.1, 5.2, 8, and 9, represent about 94 percent of all enroute accidents with releases and about 93 percent of all enroute non-release accidents.

Classes 3 and 8 alone are involved in about 77 percent of all of the enroute leaks in the year. For loading and unloading incidents, these two classes were involved in about 84 percent of all incidents.

To derive an estimate of the economic impact of incidents/accidents for the annual portrait, the following impact categories were considered:

- Injuries and Deaths
- Cleanup Costs
- Property Damage
- Evacuation
- Product Loss
- Traffic Incident Delay
- Environmental Damage.

The study reviewed several sources of information to establish reasonable estimates of the economic impacts of each consequence. A literature review was conducted, as was an evaluation of the utility of the federal and state databases. Impact estimates not readily available from the above sources, such as incident delay, were modeled. Finally, all impacts were converted to dollars to permit comparison and to compile total impact cost.

The HMIS proved to be an important source of impact costs for product loss, cleanup costs, and property damage. Injuries and deaths were valued to be the amount the USDOT would be willing to spend to avoid an injury or death. This averaged out to be $200,000 to avoid an injury and $2,800,000 to avoid a fatality.

Traffic incident delay was established as the total number of people delayed at an incident or accident multiplied by $15 per hour. The size of an average spill and the value placed on environmental contamination as determined by an average of 30 legal settlements constituted an estimate of environmental damage.

Total HM annual impacts for the portrait year are estimated at about $1.2 billion. Enroute accidents with total impacts of just over $1 billion account for about 89 percent of the total impacts. Accidents with a release of HM with impacts of $416 million account for a total of about 40 percent of the enroute accident impacts. Within the release accident category, accidents with a fire and accidents with an explosion have total impacts of $139 million or about 34 percent of the total cost of enroute release accidents. The consequences of these accidents are important because they make up only about 12 percent of the total number of enroute release accidents. Non-release accidents make up about 60 percent of the total enroute accident impacts in the annual portrait.

Leaks enroute at $72 million account for an additional six percent and loading/unloading incidents at $53.5 million accounts for about five percent of the impacts.

Class 3 represents 56 percent of all of the impacts, while categories 8, 2.1, 2.2, and 9 represent 13 percent, 9 percent, 6 percent, and 7 percent respectively. These five categories alone account for approximately 91 percent of the estimated annual impacts for HM shipments. No other category accounts for more than three percent of the total impacts.

Injuries and fatalities dominated the impact costs. For both release and non-release accidents combined, injuries represent about 40 percent of the impact costs. Fatalities represent about 40 percent of all impact costs for enroute accidents. Thus, injuries and fatalities together account for about 80 percent of the impact cost. Incident delay for both release and non-release enroute accidents add up to about nine percent of the total cost. Carrier, property damage, and product loss together represent about eight percent of the total. Clean up, environmental damage, and evacuations account for the remaining three percent of impacts.

Non-HM shipments experienced an estimated 126,880 accidents in the portrait year. After compensating for underreporting, there were an estimated 5,009 fatalities and 109,779 injuries. These injuries and fatalities result in impact costs of about $43 billion. All but $7 billion of that cost results from injuries and fatalities.

All release and non-release enroute accidents for all of the HM categories for the annual portrait year have an average value of about $414,000 per accident, while non-HM accidents averaged about $340,000 per accident. This difference is magnified when non-HM accident impacts are compared with HM release impacts. In the annual portrait year, the average cost per HM accident release is about $536,000. The average impact cost of a release accident with a fire or one with an explosion compared to the average cost of a non-HM accident shows an even greater contrast.

The non-HM accident rate of 0.73 per million vehicle miles is more than double the average HM accident rate of 0.32 per million vehicle miles. This comparison is based on estimated mileage figures from the 1997 Commodity Flow Survey (CFS). As stated above, the annual economic impact of non-HM truck accidents is over $43 billion, considerably higher than for HM truck incidents. Although due primarily to a much larger volume of transport activity, the estimated non-HM truck accident rate is also reflected in the impact cost per vehicle-mile.

Hazardous material shipments make up between four and eight percent of all shipments. Given this small percentage, the cost of non-HM accidents clearly dominates the cost of HM accidents. Although the average cost of an accident is higher for HM, these higher costs are not nearly enough to overcome the large disparity in shipment volume between HM and non-HM shipments by truck.

Taking these observations into consideration, one should view the results of this risk assessment in the context of establishing a general estimate or bound on the financial impact of this problem rather than a precise valuation. This project represents a systematic attempt to benchmark the financial implications of the problem based on the best available data. We anticipate that meaningful research and policy inferences can be derived for risk management purposes.

The SafeStat algorithm was evaluated to determine the appropriate inclusion of the risk of hazardous materials shipments in the FMCSA carrier selection process. Potential changes in how

HM is used in the algorithm were the focus of this effort. At the present time, about 1.6 percent of the bulk HM carriers are identified as potentially unsafe carriers and are therefore subjected to a compliance review. However, the risk assessment results show that the cost associated with the transport of bulk HM by truck represents over two percent of the total truck accident risk. Thus, the current SafeStat algorithm under represents bulk HM carriers. Several alternative scenarios for increasing this percentage were subsequently defined and evaluated. Based on these results, the recommendations formulated state that all bulk HM carriers with a D score should undergo a compliance review. In addition, the scoring algorithm should be changed for bulk HM carriers to include all ACSEA scores greater than 70. Finally, the accident weighting for HM accidents should be expanded to include both spill and non-spill accidents. Currently, SafeStat uses only HM spill accidents in the accident weighting.

The HM risk assessment results presented in this study made extensive use of DOT, Census Bureau and State supported databases. While these results would not be possible without the availability of these databases, limitations of the study can in part be linked to their deficiencies. The study concludes with recommendations, such as investigating ways to cross-reference the TIFA, MCMIS, and HMIS databases and determining the causes of HM accidents. These would enable FMSCA to improve its safety performance monitoring capabilities. The benefit of such improvements would be a reduction in the expense associated with maintaining the databases and in the availability of additional information, such as causal factors, that could be used to develop programs to improve the safety of both HM and non-HM truck transport.

1.0 Introduction

1.1 Purpose and Organization

The United States Department of Transportation's (U.S. DOT) 1997 Draft Strategic Plan recognizes safety as its most important strategic goal and commits to promoting the public health and safety by working towards the elimination of transportation related deaths, injuries, and property damage. This project was designed to assist DOT in achieving this strategic goal by reducing the rate and severity of transportation fatalities and injuries in hazardous materials transportation and the dollar loss from high-consequence transportation accidents. Additionally, the FMCSA 2000-2001 Hazardous Materials Program Plan stresses the identification of high risk carriers for compliance reviews as a primary strategy for the reduction of hazardous materials incidents. The information developed in this project will be directed toward that strategy.

The long-term purpose of this project is to assess the additional risks posed by hazardous materials (HM) highway truck shipments when compared to non-hazardous materials (non-HM) highway truck shipments. Specifically, the project focuses on benchmarking the risk associated with HM highway transportation as compared to the transportation of non-HM. A second purpose of the project is to develop a transportation risk assessment model that will enable the Federal Motor Carrier Safety Administration (FMCSA) to identify programs that can result in the greatest improvement in safety. Additionally, the FMSCA must be able to break down the HM risk assessment into hazard classes so that experts can compare the costs associated with accidents/ incidents for each class. The distinction among hazard classes is based on the regulatory hazard classification system that includes nine classes with divisions contained in the Code of Federal Regulations (CFR) part 172.101 (49CFR Part 172).

The project was divided into three phases.

- The initial portion of Phase I characterized the shipment impacts for one year of Class 3 HM shipments and assessed the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. Class 3 materials were selected because of their relative importance among HM shipments in volume and their potential for injury and damage during an accident. The characterization of the one-year of impacts of Class 3 HM shipments is contained in this report. The assessment of the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments is contained in the *Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements*, April 1999.

  The second portion of Phase I characterized the shipment impacts for one year of Class 2.1 and Class 8 shipments as well as a preliminary annual portrait of non-HM shipments. These characterizations are also contained in this report.

  The project's first phase also produced the two white papers: *Potential for Integrating Hazmat Transportation Risk Assessment into SafeStat* and *The Identification of High Consequence Low Frequency Class 3 Hazmat Transportation Accidents.* The papers were produced in late 1999.

- Phase II of the project produced the actual comparative risk assessment between HM and non-HM truck shipments. The overall HM risk depends on the risk associated with each class/ division of hazardous material. They are calculated for this report. Thus, with the completion of Phase II of the project, the risk associated with the shipment of any class/division of HM can be compared to the risk associated with other classes/divisions as well as to the shipment of non-HM materials.

- Phase III of this project uses the information developed for the first two phases and analyzes the SafeStat algorithm to determine the appropriate inclusion of the risk of hazardous materials in the FMCSA carrier selection process.

1.2 Hazardous Materials Transportation

A hazardous material shipment is cargo that is part or all hazardous material according to the Code of Federal Regulations (49CFR). An incident involving the shipment of HM is defined in 49 CFR parts 171.15 and 171.16 and includes criteria for non-spill accidents. In the CFR, hazardous materials are separated into the following classes (49CFR Part 171):

- Class 1 — Explosives
- Class 2 — Gases
- Class 3 — Flammable liquids (and combustible liquids)
- Class 4 — Flammable solids; spontaneously combustible materials and dangerous when wet materials
- Class 5 — Oxidizers and organic peroxides
- Class 6 — Toxic (poison) materials and infectious substances
- Class 7 — Radioactive materials
- Class 8 — Corrosive materials
- Class 9 — Miscellaneous dangerous goods.

The majority of classes are segmented into divisions. For purposes of comparing risks, this analysis employed a finer categorization of hazardous materials. Specifically, risks were developed for the following classes and divisions or groups of divisions of HM. These are called categories in the report.

- Class 1: Divisions 1.1, 1.2, 1.3 - all have the potential for mass detonating
- Class 1: Divisions 1.4, 1.5, 1.6 - characteristics make mass detonation extremely unlikely
- Class 2: Division 2.1 - Flammable Gases
- Class 2: Division 2.2 - Non-flammable Gases
- Class 2: Division 2.3 - Poisonous Gases
- Class 3
- Class 4: Division 4.1, 4.2, 4.3
- Class 5: Division 5.1, 5.2
- Class 6: Division 6.1, 6.2
- Class 7
- Class 8
- Class 9

This risk assessment considered a total of 12 different categories of hazardous materials. Adding non-HM transport brings the total number of categories of materials assessed to 13.

1.3 Hazardous Material Flow

An essential element of the annual characterization of HM shipments is a description of traffic flows. An estimate of transportation flows for all truck traffic and for all hazardous materials can be derived from several sources.

One source is the 1993 Commodity Flow Survey (CFS) (U.S. Department of Commerce, 1996). The (CFS) is a component of the quinquennial Census of Transportation that is designed to sample the economic activity of the transportation of goods by mode of transportation. The 1993 Commodity Flow Survey provides an estimate of ton-miles for all commodities shipped and an approximate estimate of the percentage of HM shipments of this total volume. The report shows that all commodities were shipped an estimated 869,536,000,000 ton-miles in 1993 with hazardous materials comprising about 74,410,000,000 ton miles of this total. Hazardous materials represent about 8.5 percent of the total ton-miles. Unfortunately, the data for calculating the percentage of the HM allocated to the various HM classes is limited, so the 1993 Commodity Flow study does not provide a reasonable number in this regard. In addition, average shipment tonnages are not available for calculating the mileage.

The 1997 CFS (U.S. Department of Commerce, 2000) is a more recent source of data. The report shows that all commodities shipped by truck comprised an estimated 1,023,506,000,000 ton miles in 1997, with hazardous materials comprising about 74,939,000,000 ton miles of this total. This represents about 7 percent of the total truck ton mileage. Utilizing average tonnage values per shipment supplied by the Census Bureau and assuming an average of about two shipments per truckload, the ton mileage for all truck shipments in 1997 can be converted into an estimated 182,132,216,586 vehicle miles. HM shipments constitute approximately 7,763,282,762 vehicle miles, or approximately 5 percent of the total mileage. The data clearly indicate that HM shipments, although on average heavier than non-HM shipments, tend to travel shorter distances. This is especially true for Class 3 shipments that involve gasoline and fuel oil.

Another source for vehicle miles traveled is the Federal Highway Administration's (FHWA) Highway Statistics for 1996, which provides annual vehicle miles for 1996. The total for all combination and single unit trucks is 182,756,000,000 miles (U.S. DOT, 1997b). During the first phase of the project, the study utilized the National Fleet Safety Survey for 1996 to estimate the percentage of HM (Star Mountain Inc., 1997). For 1996, using a weighted average, 7.2 percent of all trucks surveyed carried HM. To calculate the percentage of Class 3 materials carried by truck for 1996, five regional HM commodity flow surveys were used. Based on the five surveys, the project team estimated that 52 percent of HM vehicles carried flammable liquids. Appendix A provides additional information from these flow studies.

The Research and Special Program Administration's (RSPA) Office of Hazardous Materials Safety in their 1998 study "Hazardous Materials Shipments" (US DOT, 1998) provided an estimate for the number of daily shipments of hazardous materials and the number of tons shipped. This study, based on a number of sources, estimates that all hazardous material truck shipments accounted for about 769,000 shipments per day and about 1.4 billion tons shipped annually. Petroleum products, which comprise the major part of the Class 3 shipments, accounted for an estimated 314,000 of these daily shipments and about 1.04 billion annual tons shipped. Chemical and allied products accounted for about 445,000 daily shipments and “other” for about 10,000 daily shipments. The RSPA study found that although only 43 percent of all HM tonnage is transported by truck, this accounts for approximately 94 percent of all the individual shipments transported by truck.

2.0 Study Methodology

This section describes the methodology used for this report. Crucial portions of the methodology include the

- review, selection and analysis of available data sources;
- estimation of the number of hazardous material and non hazardous material accidents and incidents for the annual portrait; and
- measurement of impacts from these accidents and incidents.

2.1 Accident and Incident Data Sources

In this report, an incident is defined as an event involving the transportation of hazardous material that results in an unanticipated cost to the shipper, carrier or any other party. An accident is an incident that occurs when the vehicle transporting the goods is involved in a collision. The study included HM accidents with a release, HM accidents with no release, loading/unloading with release, and enroute leaks not caused by a vehicular accident. Non-spill accidents warranted consideration in this study because severe consequences (e.g., injuries and fatalities) can still occur. In addition, law enforcement and fire protection officials often treat any HM accident as a potential spill even if no release of material is apparent.

An initial step in developing a risk assessment is estimating the number of accidents and incidents reliably for a defined period of time. In the initial part of Phase I, an estimate of accidents and incidents was developed for Class 3 truck shipments for the annual portrait. The estimate focused on the Hazardous Materials Information System (HMIS) database and utilized several sources of data to adjust the incidents and accidents reported in the HMIS. The adjustment was made in an effort to reflect the actual number of incidents and accidents in a one-year period. During the second part of Phase I, the methodology developed for Class 3 was applied to two additional classes/divisions of HM: Division 2.1 - Flammable Gases and Class 8 - Corrosives.

Findings during Phase I affected the Phase II risk assessment work. Data analysis revealed that the impacts from fires and explosions represented a series of impacts that should be separately assessed whenever the data could support such a breakout. Another finding was the necessity of using more than one year of accident data for the other 11 classes/divisions of HM, if similar accident statistics were to be realized. For the analyses of Division 2.1 and Class 8 transport, initially three years of data were used. Eventually, over nine years of data were used to obtain the statistics for all 12 categories of HM.

As the studies began to focus on the categories with less shipping exposure, some techniques adjusting for underreporting had to change as well. Rather than look at several databases and determine the amount of underreporting directly, the underreporting was estimated using factors obtained from the detailed look at the first three categories of hazardous material, Classes 3 and 8 and Division 2.1. Even if time and money permitted using the accident reporting comparisons for the other categories of hazardous material, it would have not been possible because only the HMIS data covered the entire nine-year study period. For most of the other databases, only one or two years of data were obtainable. The following sections describe the databases used in this effort.

Data identified and reviewed during initial research efforts associated with FMCSA's hazardous materials risk assessment study were from multiple sources and categories with varying detail. Sources of data reviewed consisted of federal and state databases as well as research studies and analytical reports. The categories reviewed were numerator data, characterized as hazardous materials accidents/incidents or general commodity highway crashes, and denominator data, consisting of the flow or movement of hazardous materials and general commodities.

The data assembled and reviewed may be categorized as generally being from a federal or state database with input in some instances by local authorities or private companies. The federal databases are collected and maintained by multiple administrations within the U.S. DOT as well as the Commerce Department's Census Bureau. These data are collected under different regulations, utilizing disparate definitions under programs that have varying missions. The state databases have issues of incompleteness and inconsistency primarily due to jurisdictional reporting variances among the states as well as diversity in data processing capability. A review of the various pertinent databases initially assembled for this project follows.

2.1.1 Federal Databases

Hazardous Materials Information System (HMIS). The HMIS is a system of databases maintained and managed by the Office of Hazardous Materials Safety (OHMS) within the RSPA. The major database in the HMIS and the most pertinent for the FMCSA risk assessment study is the incident/accident database. This database dates back to 1971, contains more than 300,000 records, and currently adds approximately 14,000 reports annually. Although the HMIS is a multi-modal database, about 85 percent of the records are in the highway mode. The HMIS consists of incidents where an unintentional release of a hazardous material in commerce occurs during the course of transportation or is possibly imminent and results in the closure of a major artery or an evacuation of the general public. Although the HMIS annually adds more than 10,000 truck transport-related reports, an average of 250 reports represent highway accidents with the great majority (approximately 200) involving cargo tanks.

Until recently, the intrastate carriers, those operating in only one state, were not required to file HM incident reports. Thus, for most of the recording period, the HMIS reports encompassed motor carriers that operate interstate and those that transport certain highly hazardous materials interstate. This reporting requirement was extended to intrastate motor carriers on October 1, 1998. In 49CFR, Parts 171.15 and 171.16 provide the specific reporting requirements. As a result of the distribution practices of some hazardous materials, such as gasoline, fuel oil, propane, and fertilizers that are transported in large volumes by intrastate motor carriers, a substantial increase in HMIS reports was predicted but has not been immediately realized. The HMIS is specifically designed to capture information concerning the unintentional release of a hazardous material. Although an accident checkbox is available on the HMIS report form, the only detailed information involving the causation of an accident is found in the narrative section or in attachments.

For the purposes of FMCSA's risk assessment study, the HMIS represents the only national database of hazardous materials highway transportation accidents and incidents with details of the material, packaging, and consequences involved. This database is mature, well maintained, and has been extensively examined; as a result, its limitations can be identified. The consequences associated with an incident are not comprehensive and in some instances the report form may not even be complete. This deficiency, together with the lack of accident information, intrastate carrier incidents and non-spill incidents, requires input from additional databases whose strengths will complement the HMIS for conducting the risk assessment. Of all the databases, this database is one of the more thoroughly checked and most inconsistencies have been eliminated. While it is clear that some accidents must be reported, two carriers might experience essentially the same minor incident and one will report it and the other will not. The minor incidents that are reported dominate the truck transport records contained in the HMIS database.

Registration Database. The registration database for carriers, shippers, and offerors of certain types or quantities of hazardous materials is contained within RSPA's HMIS. An annual registration form must be completed and submitted to RSPA that indicates the company's primary activity and the states in which the company operates. The registration database collects approximately 26,500 records annually and may be sorted by primary activity, whether the registrant is a carrier, offeror or both and whether the registrant operates inter- or intrastate. Recent annual tabulations show that of the 26,500 registrations received by RSPA, 2,820 are intrastate carriers and 731 indicate that they are both carriers and offerors on an intrastate basis. This database may prove useful in estimating the lack of intrastate incidents not recorded in 1999.

News Clippings Database. The RSPA contracts with a private clipping service to provide nationwide coverage of newspaper reports of hazardous material incidents. Copies of these incidents are forwarded to RSPA for entry into an electronic database. This database supplements HMIS data by compiling hazardous materials incidents not reported to RSPA. Paper copies of this database were obtained from RSPA, and after review, data elements were entered into a separate database for comparison with the HMIS database.

Safetynet MCMIS Database. The Motor Carrier Management Information System (MCMIS) is a system of databases - not unlike RSPA's HMIS - managed by the FMCSA. The Safetynet database, also known as the accident file, is comprised of police accident reports (PAR) assembled by the states and forwarded to the FMCSA. Each state has adopted the National Governors Association's (NGA) twenty-two uniform truck accident data elements on their PAR. This database was designed to provide a census of truck accidents nationwide. Among the states, there is a wide variance among the local jurisdictions that provide PARs for a state's submittal into Safetynet. Because of this wide diversity of reporting jurisdictions within the states, some states have a more comprehensive data set in Safetynet than others. This database captures the general details of a crash, as well as information on the vehicle and hazardous material cargo involved.

For the purposes of the FMCSA risk assessment study, Safetynet data files were requested for eight selected states (PA, IN, IA, MN, CO, OR, OH, and CA). Six of these states belong to the Performance and Registration Information Systems Management (PRISM) program that links U.S. DOT's information system to the states' systems. The PRISM program began as a mandate from Congress in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 to explore the potential of linking the commercial vehicle registration process to motor vehicle safety. The PRISM program includes two major processes: the Commercial Vehicle Registration Process and the Motor Carrier Safety Improvement Process (MCSIP). These two processes work in parallel to identify motor carriers and to hold them responsible for the safety of their operations. The six states participating in the PRISM program are also part of an effort to improve the accuracy and timeliness of data reported to the federal government. The two non-PRISM states selected, OH and CA, were chosen because they produce additional state databases that were expected to be useful for the purposes of the FMCSA risk assessment study. The Safetynet database proved very useful in adjusting the HMIS database by adding intrastate carrier accidents and non-spill accidents.

Trucks in Fatal Accidents. The Trucks in Fatal Accidents (TIFA) is a database developed by the University of Michigan Truck Research Institute (UMTRI) from the Fatal Accident Reporting System (FARS) compiled by the U.S. DOT. Under contract to the U.S. DOT, UMTRI identifies truck accidents in FARS and does extensive follow up on details of the fatal truck accident, including the presence of hazardous materials as cargo. TIFA does not however contain any details on the consequences resulting from a hazardous materials spill. This makes it difficult to compare TIFA with other databases containing HM data.

Commodity Flow Survey (CFS). The processing of the 1997 CFS hazardous materials report was completed in the spring of 2000. Much needed data regarding the flow of hazardous materials for risk assessment studies is now available from the 1997 CFS. The largest contribution to hazardous materials data comes from the highway data produced from the 1997 CFS. In sharp contrast to a single HM table produced from the 1993 CFS, a total of 26 HM tables were produced from the 1997 CFS. All but four of the 1997 CFS HM tables had some application to hazardous material transportation in the highway mode.

The 1997 CFS hazardous materials tables included fourteen tables concerned with HM class or division, six mode specific tables, three state/geographic tables, and three tables on selected materials. The tabulations of the 1997 CFS hazardous materials data was compiled using the standard CFS breakout of tons, ton miles, average shipment distance and weight. These data were tabulated utilizing the data set assembled in the 1997 CFS from responses containing a UN/NA entry. Presentations of the 1997 CFS hazardous materials data were constructed from the UN/NA data set.

In addition to the 1997 CFS hazardous materials tables, estimates were derived and employed in this risk assessment study to establish the approximate number of miles hazardous materials were transported by truck to help in the identification of the exposure level of hazardous materials on our nations' highways. The hazardous material tables from the 1997 CFS can be found in the document 1997 Commodity Flow Survey issued April 2000, EC97TCF-US (HM) RV. Included in this report are twenty-six tables, an overview of the 1997 CFS, a review of the sample design, data collection, and an estimation methodology and sample report forms and instructions.

Vehicle Inventory and Use Survey (VIUS). The Vehicle Inventory and Use Survey (VIUS), known as the Truck Inventory Use Survey (TIUS) until 1992, is a component of the quinquennial Census of Transportation and complements the CFS. The name change occurred because other vehicles such as buses and recreational vehicles were intended to be added to the sample frame in 1997. However vehicles other than trucks were not included in the sample so VIUS remains solely a truck survey.

The 1997 VIUS was released in early 2000 and is now available for review and analysis. A hard copy report has been published and the micro data is available on a CD ROM. The VIUS provides figures for the number and type of trucks in operation, together with the physical and operating characteristics of the country's truck population. The format for hazardous materials data collection in the VIUS involves an indication of whether the truck was used to transport placarded hazardous materials, with a hazard class breakout. A broad breakout of the national percentage of trucks that have carried hazardous materials by hazard class and equipment type is available. Limitations associated with this database include definitional issues (e.g., a truck may also include a pickup, and a placard must have been used) and little trailer information, as well as a limited sample of about 131,000 registered private and commercial trucks to draw on.

2.1.2 State Databases

State reports and databases were utilized for Ohio, California, and Colorado. They included reports from the Public Utility Commission of Ohio and databases from the California Highway Patrol and Colorado State Patrol. These databases focus on hazardous material incidents and provide an independent source of data.

California Highway Patrol (CHP). The CHP maintains a database of all reported hazardous material incidents. A subset of the CHP database was obtained from the CHP for analysis in FMCSA's risk assessment study. This database includes information on the actual incident, hazardous material, and casualties but lacked carrier information and whether the incident was actually an incident or accident. However, the database was able to provide enough information on 1996 Class 3 accidents to supplement the HMIS database.

Colorado State Patrol. The Colorado State Patrol also maintains a database of all reported hazardous material incidents. The 1996 hazardous material incidents database was obtained for analysis for Phase I of FMCSA's risk assessment study. The database contains information concerning the actual incident, along with detailed information on the hazardous material and carrier information. Thus, the database was able to provide enough information to supplement HMIS.

The Public Utilities Commission of Ohio (PUCO) Incident Reports. The PUCO provided copies of HM incident reports from January 1, 1996 to mid 1998. These reports contained information on the incident and carrier along with evacuation and road closure details. The reports were also very valuable in that they typically contained a detailed description of the incident, an item missing in most of the other databases. The PUCO reports were reviewed and data was extracted and entered into a database for comparison to HMIS.

2.1.3 Other Databases

Dialogue (Newspaper Clippings). A search of newspaper clippings from the eight states was completed to identify Classes 3, 2.1, and 8 accidents/incidents for the annual portrait. Those that were identified were included in the adjustment of the HMIS database. Most of the articles also provided additional detailed information about the accident/incident.

2.2 Methodology for Estimating Accidents/Incidents

The following sections describe the methodology used in the effort to estimate accidents/incidents for the one-year period.

2.2.1 Selection of Reference Database

The first step was to select a reference database. For the purposes of OMC's risk assessment study, the HMIS represents the only national database of hazardous materials highway transportation incidents with details of the material, packaging, and consequences involved, although these consequences may not be comprehensive. The database is well maintained and carrier participation is required. Deficiencies include a lack of accidents or incidents involving intrastate carriers (although this deficiency is being corrected for FY 1999) and lack of coverage for no-spill HM accidents. No-spill HM accidents should be included in an analysis because law enforcement and fire protection officials often treat any HM accident as a potential spill even if no release of material is apparent. Any accident involving a truck transporting HM should receive serious scrutiny from officials and the DOT.

DOT has done an excellent job maintaining the integrity of the database as various changes have been made in the definition of the classes/divisions of Hazardous Materials and as additional fields have been added. For example, when the explosive categories were changed from A, B, and C to numerical categories, the 1982 through 1990 records were modified to show the A through C class accidents as 1.7 through 1.9. This enables a database search to go back as far as 1982 and get meaningful accident data on the classes of HM.

When the project was started, 1996 was chosen as the base year for the analysis. At that time it happened to be the last year for which complete data were available from all data sources. The first analysis was for Class 3, flammable and combustible liquid transport. Because this single class represents more than 50 percent of all HM truck transport, good statistics could be obtained by looking at just one year. The first study during the second part of Phase I added two additional classes/divisions of HM to the analysis, Division 2.1 (flammable gases) and Class 8 (corrosives). Because these materials are involved in fewer accidents, the analysis base was expanded to 3 years of records, 1995 - 1997. During Phase II, this analysis was subsequently extended to all classes/ divisions of HM truck transport. In the expanded categories of HM, some categories have few incidents occurring in a given year. Thus, for the final analysis, data from 1990 through March 1999 were used to create an annual portrait of HM impacts. This provided the greatest quantity of HM incident data from which consequence and likelihood values could be obtained.

While data from 1982 on could have been used, prior to 1990, only total impact costs were provided. Since breaking the total cost out into multiple cost categories is crucial for the risk assessment, and pre-1990 data did not have this information, it was not used. While more than nine years of data were used to evaluate consequences and likelihoods, the risk portrait continued to describe one year. Whenever the approach is to collect data that covers several years in order to consider the results to be representative of a year portrait, there is always a concern about trends. Accident rate changes and cost escalation trends might be expected to be major concerns. However, the data for the period 1982 to 1998 shows that the average total cost of an accident remained constant. Furthermore, the total number of accidents reported each year did not seem to change significantly over the 17-year period. While this result was somewhat surprising given the significant cost increases in parameters such as the vehicle cost, the HMIS data provided no basis for the selection of an escalation factor, so none was used. Although the costs were checked with other sources to determine reasonableness, subsequent research and analyses should be conducted to confirm whether increased accident costs occurred during these years.

2.2.2 Selection of Additional Databases

Additional databases with strengths complementing the HMIS for conducting the risk assessment were consulted to supplement HMIS data with data on other spill accidents (especially intrastate accidents) and non-spill accidents. In all cases, the additional databases covered fewer years. However, because it was always possible to reduce the statistics to cover a single year, this limitation was not significant. The greatest limitation was in the time period covered by the databases. Where the databases covered the same time period, it was feasible to look at data from a single year in a wide variety of databases and, in so doing, evaluate the underreporting that was present in the databases. However, it was not feasible to continue to compare databases over many years of data and for all HM classes. First of all, most databases, particularly the state databases, are generated for a specific purpose and the information may only have been collected for a year or two. Secondly, if accidents are very infrequent, which is the case for some of the classes/divisions of HM, when one database misses one accident, the correction factor for underreporting of that class/division of HM would be large and making such corrections would not be an accurate representation of reality. Thus in the second part of Phase I, two additional classes/divisions — Division 2.1, flammable gases and Class 8, corrosives — were used to compare multiple databases for estimating the number of accidents/incidents occurring in a year. When added to the data from Class 3, the comparison represents more than 75 percent of all the HM shipped by truck in a given year. Given the large fraction of HM shipments represented by these categories of HM, it was felt to be appropriate to apply the underreporting factors developed for these three HM categories to all the remaining HM categories.

The search criteria used to identify the 1996 Class 3 and 8 and Division 2.1 truck shipments for each database is located in Appendix B. Because each database has its own field characteristic, individual queries were generated to identify the truck shipments. Criteria used across each database included the following:

- Year
- Accident (vs. Incident)
- Class
- Placarded vehicle
- Enroute (traveling from origin to destination).

2.2.3 Approach for Estimating Accidents

As stated in the previous section, two distinct approaches were used to estimate the frequency of accidents for a given hazard class. Using the data for Classes 3 and 8 and Division 2.1 in each database, underreporting factors were developed for accidents and incidents in HMIS and non-spill accidents in MCMIS. These underreporting factors were developed by using the HMIS database and comparing additional spill accidents that were present in the other databases. Accidents that appeared in the other databases but not in HMIS were assumed to represent underreporting. These underreporting factors were then applied to the other classes/division of HM. The following paragraphs describe this process in more detail.

The specific approach to supplementing the HMIS data involved focusing on the eight-state sample and more intensively on California, Colorado, and Ohio because of additional state database availability. The HMIS data for the eight states were systematically compared with respect to specific accidents, which were found in one or more of the additional databases. By identifying accidents, which appeared in other databases and probably should have also appeared in the HMIS, a portion of those underreported accidents were identified. The Safetynet data proved to be the most useful of the other databases because it included both intrastate and no-spill accidents involving HM. After analyzing the data in the various databases described above, the accident count for the eight states was used as a measure to calculate the number of accidents for the nation. This process required four steps:

1. The number of accidents for the eight states was estimated by supplementing the HMIS data with data from the other databases.

   Tables C-1 through C-24 provide the tables for each of the eight states which summarize the accident information used to estimate the number of accidents for the annual portrait. (Note that for the analysis, the three states where state databases and dialogue information was used were weighted more heavily.)

2. A proportion of the national accidents represented by the eight states was calculated. Commodity flow and truck registration data for the eight states were both used to estimate the portion of the total HM traffic represented by the eight states. The 1993 Commodity Flow Study tabulation of ton-miles provides an estimation of the total commodity ton-miles allocated to HM for each of the eight case-study states. The total ton-miles within the eight states represent about 30 percent of the total ton-miles for the United States. California, Ohio and Pennsylvania alone represent about 19 percent of the total US ton-mileage.

3. The accident estimates for each of the eight states were totaled.

4. The total estimated national accident number was calculated by assuming the additional 70 percent of the national accidents occurred at the same rates and types and then by adding the estimate for the remaining 42 states to the eight-state estimate.

Tables 1, 2, and 3 show the estimated unique accidents for 1996 for both release (spill) and non-release (no-spill) accidents for Classes 3, 2.1, and 8. The tables also show how these numbers were converted into national numbers.

2.2.4 Approach for Estimating Incidents

Incidents were estimated in a more direct manner. Because the HMIS is the best source for enroute and loading/unloading incidents, these numbers were used for the fifty states. They were augmented by the percentage represented by the number of intrastate incidents that were not covered in the HMIS for the 1996 data. Utilizing the Safetynet data for the eight states, the percentage of accidents represented by intrastate carriers was about 22 percent. Thus the incidents for the fifty states were supplemented by 22 percent.

Table 1. Class 3 Truck Shipments — Estimated Unique Accidents for 1996 (HMIS used as a base)

State	Data Source and Accident Numbers							Summary Accident Numbers					
	HMIS and TIFA	SAFETYNET		State		News Clippings		Spills			No Spills		
		Spill	No	Spill	No	Spill	No	#	I	F	#	I	F
Colorado	9	4	21	4	1	0	1	17	10	0	23	21	0
Ohio	10	3	3	2	1	2	2	17	6	0	6	5	1
California TIFA	7 3	8	46	1	1	2	3	21	4	4	50	31	1
Indiana*	6	6	20	3	2	2	1	17	11	1	23	21	0
Oregon*	4	7	19	1	1	1	1	13	11	0	21	13	2
Iowa*	5	0	5	1	1	1	1	7	3	0	7	5	1
Minnesota*	10	1	1	3	1	1	1	15	5	1	3	1	0
Pennsylvania	11	25	151	3	1	1	1	40	35	3	153	104	6
							Totals	**147**	**85**	**9**	**286**	**201**	**11**

I = injuries; F= fatalities

* HMIS spill accidents increased by 26 percent to compensate for no state database. No-spills increased 12 percent. News clippings number increased by 10 percent to compensate for Dialogue.

8 states represent 30 percent of the total U.S. accidents.

147 ÷ 0.30 = 490 spills   spill injuries = 283   fatalities = 30

286 ÷ 0.30 = 953 no spills   no spill injuries = 670   fatalities = 37

Using this method, the number of Class 3 accidents with spills for 1996 was estimated at 490 and the number of no spill accidents at 953.

Table 2. Class 2.1 Truck Shipments — Estimated Unique Accidents for 1995–1997 (HMIS used as a base)

State	HMIS Spill	Data Source and Accident Numbers								Summary Accident Numbers					
		TIFA		SAFETYNET		State		News Clippings		Spills			No Spills		
		Spill	No	Spill	No	Spill	No	Spill	No	#	I	F	#	I	F
Colorado	0	0	0	4	19	0	0	0	0	4	2	0	19	12	7
Ohio	2	0	2	2	7	1	2	1	1	6	4	1	12	7	2
California	4	0	2	2	15	1	0	1	0	8	6	1	17	14	3
Indiana*	1	0	1	1	18	0	0	1	0	3	0	0	19	13	1
Oregon*	2	0	0	0	8	0	0	0	0	2	0	0	8	5	1
Iowa*	2	0	0	1	6	0	0	0	0	3	0	0	6	5	1
Minnesota*	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Pennsylvania	3	0	1	7	47	0	0	0	0	10	7	0	48	33	2
									Total	37	19	2	129	89	16

I = injuries; F = fatalities

* HMIS spill accidents increased by 26 percent to compensate for no state database. No-spills increased 12 percent.

3 years of data averaged to represent 1996

42 ÷ 3 = 14

139 ÷ 3 = 46

8 states represent 30 percent of the total U.S. accidents.

14 ÷ 0.30 = 47 spills   spill injuries = 23   fatalities = 2

46 ÷ 0.30 = 154 no spills   no spill injuries = 106   fatalities = 18

Using this method, the number of Class 2.1 accidents with spills for 1996 was estimated at 47 and the number of no spill accidents 154.

Table 3. Class 8 Truck Shipments — Estimated Unique Accidents for 1995–1997 (HMIS used as a base)

State	HMIS Spill	Data Source and Accident Numbers								Summary Accident Numbers					
		TIFA		SAFETYNET		State		News Clippings		Spills			No Spills		
		Spill	o	Spill	No	Spill	No	Spill	No	#	I	F	#	I	F
Colorado	3	0	0	1	6	0	0	1	0	5	2	1	6	2	1
Ohio	8	0	0	0	8	3	5	5	0	16	1	1	13	18	6
California	3	0	0	3	11	8	0	3	1	17	3	0	12	5	1
Indiana*	3	0	0	5	16	0	0	1	1	9	3	1	17	17	0
Oregon*	0	0	0	2	8	0	0	0	0	2	1	0	8	4	0
Iowa*	1	0	0	0	7	0	0	0	0	1	0	0	7	4	0
Minnesota*	2	0	0	1	0	0	0	0	0	3	0	0	0	0	0
Pennsylvania	4	0	0	2	51	0	0	1	0	7	4	1	51	50	2
									Total	50	14	4	114	100	10

I = injuries; F = fatalities

- HMIS spill accidents increased by 26 percent to compensate for no state database. No-spills increased 12 percent.

3 years of data averaged to represent 1996

66 ÷ 3 = 22

124 ÷ 3 = 41

8 states represent 30 percent of the total U.S. accidents.

22 ÷ 0.30 = 73 spills	spill injuries = 18	fatalities = 5
41 ÷ 0.30 = 138 no spills	no spill injuries = 121	fatalities = 11

Using this method, the number of Class 8 accidents with spills for 1996 was estimated at 73 and the number of no spill accidents at 138.

2.3 Impact Methodology

To derive an estimate of the annual economic impact of incidents/accidents involving truck shipments of hazardous materials, a number of incident/accident consequences must be taken into consideration.

To develop the impacts of accidents and incidents, a six-step process was followed. The study

1. Selected impact categories that could be compared among the incidents/accidents. The impacts categories selected were:

    - Injuries and Deaths
    - Cleanup Costs
    - Property Damage
    - Evacuation
    - Product Loss
    - Traffic Incident Delay
    - Environmental Damage.

2. Reviewed several sources of information to establish reasonable estimates of the economic impacts of each consequence. It also conducted a comprehensive literature review to identify unit costs that have been used in prior economic evaluation studies related to transportation, environmental health, and safety. In addition, the study analyzed the HMIS and several state databases to the extent that economic consequences were been reported.

3. Tallied impacts reported in federal and state databases.

4. Supplemented impacts found in the databases with impacts derived from literature sources and interviews with knowledgeable sources.

5. Modeled impacts not readily available from the above sources to develop impact estimates. For example, incident delay was modeled because HMIS and the other databases do not report this parameter.

6. Converted all impacts into dollar values to enable comparison among the impacts and the preparation of a total impact figure for the annual portrait year.

Where feasible, an attempt was made to compensate for accidents whose impacts are unlikely to be representative when a single year's data is used. For example, several years of HMIS data were used to estimate average property loss costs.

The following sections present the parameters and background used to calculate impacts for the annual portrait year. Based on this review and analysis, "ball park" unit costs of hazardous materials transportation events can be established.

2.3.1 Injuries and Deaths

Injuries and fatalities associated with HM shipments can be attributed to the effects of the hazardous cargo or to other non-hazardous material related causes. This differentiation is sometimes clear-cut. For example, in 1978 in Spain as a result of a traffic accident, a LPG tank rocketed into a trailer park and exploded. The ensuing fire injured and killed more than two hundred people. They would not have been injured or killed if the material involved in the accident were not hazardous.

Differentiation becomes especially difficult when the traffic accident involves flammable material. For example, if a truck carrying Class 3 material collides with a car, trapping a person, and a fire ensues and burns and kills that individual, can we attribute this death directly to the hazardous cargo? Because gasoline is associated with the car, the individual might have died in a non-HM accident as well. Or perhaps it was the leaking cargo from the truck that caused the car fuel to burn. Although the HMIS tabulates only those fatalities attributable to HM, other databases such as MCMIS include fatalities regardless of the direct cause. For the purpose of this evaluation, injuries and fatalities associated with all accidents were tabulated whether or not they were known to have been caused by HM.

Injuries and deaths were tabulated from the major federal and state databases and estimated through analysis of the data for the eight states. To accomplish this, the HMIS data for the eight selected states were used as the reference case and data from the other databases were used to estimate the total fatalities and injuries for those states. As was the case for the accident numbers, the numbers of fatalities and injuries were extrapolated for the entire country. Injuries and deaths were estimated in detail for Classes 3, 2.1, and 8.

Preparation of impact estimates for all 12 groups of HM classes/divisions employed a two-tiered approach. This approach involved tabulating injuries and fatalities for accidents in HMIS, developing a rate per accident and using these as representative of injuries and fatalities caused by HM. For these, accidents, an injury and fatality rate per accident was calculated from MCMIS for non-HM and used to represent all injuries and fatalities that could be expected to develop as a result of the truck crash itself. Both rates were added to give the total injury and fatality rate for HM shipments.

The value placed on an injury or fatality suffered in an accident varies considerably. Part of this discrepancy can be attributable to different approaches to calculating the value. One approach is to see an injury or fatality in terms of lost income and economic productivity to society. Another more comprehensive approach collects data not only on lost productivity, but also quality of life. This estimate might more closely approximate compensation awarded by the courts for fatalities and injuries in accidents. Finally, a third approach considers the cost of a fatality or injury as the amount of money required to prevent it from happening.

The National Highway Transportation Safety Administration (NHTSA) estimated the cost of fatalities and injuries in 1994 and presented these estimates in terms of lost productivity. In 1996 dollars, a fatality would be worth about $913,000 and a critical injury about $780,000 (NHTSA, 1996). An earlier report, the Cost of Highway Crashes, (FHWA, 1991), utilizes a comprehensive approach. In 1996 dollars, this report estimates that a fatality would be worth about $3,170,000 and an incapacitating injury about $225,000.

The National Safety Council is considered another primary source for obtaining estimates of the impacts of deaths and injuries in economic terms (National Safety Council, 1996). One approach presented is based on comprehensive costs, which indicate what people are actually willing to pay to reduce their safety and health risks. The cost estimates include wage and productivity losses (i.e., wages and fringe benefits, replacement cost and travel delays caused by the accident), medical expenses (i.e., doctor fees, hospital charges, cost of medicines, future medical costs and other emergency medical services), administrative expenses (i.e., insurance premiums and paid claims, police and legal costs), motor vehicle damage (i.e., property damage to vehicles), and employer costs (i.e., time lost by uninjured workers, investigation and reporting time, production slowdowns, training of replacement workers and extra costs of overtime for uninsured workers). Comprehensive costs tend to be three to four times higher than historical costs for each human health consequence category because of a societal desire to avoid these consequences in the future. The 1996 estimates of comprehensive costs are:

- $2,790,000 per death
- $138,000 per incapacitating injury
- $35,700 per non-incapacitating injury

- $17,000 per possible injury
- $1,700 per non-injury.

It is important to recognize that these estimates are based on motor-vehicle accidents as a whole. The impact of a truck accident is likely to be more severe across several of the components that comprise these unit costs. Moreover, a truck accident involving the transport of hazardous materials would add to the economic considerations because of the inherent danger of a cargo spill. Therefore, for this portrait, these numbers should be considered low-end estimates of the economic consequences.

Finally, a third approach, developed by NHTSA, that estimates the cost of avoiding the fatality or injury, resulted in an estimate of $2,800,000 for a fatality and $400,000 for an injury requiring hospitalization. This estimate is used by some portions of the USDOT to estimate the cost of avoiding a fatality or serious injury (NHTSA, 1996).

For the purposes to this report, the latter estimate of the cost for avoiding the fatality or serious injury is used as a means to estimate the overall cost for the accidents during the annual portrait year. For minor injuries, an estimated value of $4,000 is used. The distribution of major and minor injuries in the HMIS for 1995, 1996, and 1997 was used to determine the ratio of major to minor injuries. During those three years, the two types of injuries are evenly distributed. Thus, an estimated cost of $200,000 is used as the cost of avoiding an accident/incident injury.

2.3.2 Cleanup Costs

Cleanup costs are assumed to encompass the costs of both stopping the spread of a spill and removing spilled materials. Cleanup costs vary widely depending on the size, type of materials, and location of the spill.

Different approaches exist to placing financial value on these considerations. Clean-up can include initial response costs, soil and groundwater remediation, incineration, and restoration. Our literature review identified the following relevant statistics:

- A New York State Department of Environmental Conservation Study placed clean-up costs for small trucks at $6,717 per vehicle and large trucks at $13,437 per vehicle (U.S. EPA, 1996). These costs were reported in 1987 dollars and converted to 1996 dollars for this report. They apply only to the removal of the vehicle from the scene.

- The same study reports clean-up costs as $40.38, $57.26, and $78.40 per square meter of impact area if the incident/accident occurs in an urban, suburban or farmland setting, respectively. Furthermore, clean-up costs associated with environmental impairment are estimated to be $131.01, $61.83, and $429.47 per square meter of affected woodland, park, or river/lake respectively. These figures were also reported in 1987 dollars and converted to 1996 dollars.

Private environmental contractors provide yet another source for cleanup estimates. For example, PRO TERRA, a Columbus based environmental contracting company, estimates the average cost of a cleanup at about $14,000. However, their record cost was $102,000 to clean up a jet fuel spill at the Rickenbacker AFB that required 10 men at the site (Hogue, J., 1998). The average HM cleanup costs about $1,000 per hour.

The HMIS database includes a field for cleanup costs. This data is submitted by the carrier and it should be accurate since the carrier is responsible for paying the cleanup costs. For 1990 to1999, cleanup costs averaged about $24,000 per enroute accident cleanup, $1,300 per cleanup for an enroute incident spill, and $260 for an unloading/loading accident and incident spill cleanup. To create a conservative estimate, these figures were applied as the average cleanup cost for all spills.

2.3.3 Evacuation

A small percentage of HM accidents causes the evacuation of people and business operations. This is one important impact of HM transportation. The HMIS database and the Ohio PUCO are among the few databases which provide evacuation data. Of the two, the HMIS provides a comprehensive picture. For example, three years of HMIS data (1995, 1996, 1997), 498 records of Class 3 shipment accidents showed that about eight percent resulted in an evacuation. These evacuations involved 1,974 people, an average of 51 per evacuation.

For the 1320 incidents recorded, about one percent resulted in evacuations. Thus, a total of 431 people were evacuated with an average of 25 people per evacuation.

The cost of evacuations is very difficult to estimate since there are numerous variables. These costs include the expense for temporary lodging and food, losses due to lost wages and business disruptions, inconvenience to the public and the cost of agencies assisting with the operation. The U.S. Nuclear Regulatory Commission, for example, uses a range of $600 to $1,800 per person evacuated. A reasonable estimate would be $1,000 per person evacuated (Transportation Research Board, 1993). This $1,000 estimate is also used by the Federal Railroad Administration (FRA) to estimate impacts from railroad evacuations. For this report, evacuations were also assumed to be possible for all HM classes whether or not a release occurred. Evacuations for non-release accidents were assumed to occur at the same rate as evacuations for release accidents.

2.3.4 Product Loss

Product loss refers to the quantity and value of the HM material lost during a spill. The HMIS provides estimates for product loss in its cost estimates. For example, for Class 3 enroute accident related spills, the average cost of product lost per spill 1990 to 1999 was $3,208. For enroute incident spills, the average cost of product lost during the same three-year period was $117. Incidents and accidents during loading and unloading accounted for average product loss of about $61 over the more than nine years. Similarly, for Class 2.1 accidents, the average cost of product lost per enroute accident related to a spill accident during the same period was $1,140. For enroute Class 2.1, incident spills, the average cost of product lost during the same three-year period was $1,656; for incidents and accidents during loading and unloading, it was $171. During the same period, Class 8 spill accidents averaged $4,910 in product loss while product lost during enroute incidents averaged $124; for loading and unloading incidents, it averaged $62.

2.3.5 Public Property Damage

Property damage encompasses damage to other vehicles, which may have been involved in the accident, and damage to both public and private property in addition to the vehicles involved in the accident. For example, this could include damage to a private building, public utilities, or a public roadway and related structures. Environmental damage to property that results in economic losses is another category of damage that will be addressed in Section 2.3.9.

The HMIS provides estimates of property damage in one of its fields. This estimate appears to be reliable for damage to vehicles involved in the accident but perhaps less reliable when estimating public property damage. However, these estimates have been used as the basis for calculating the impacts to property and the amount of damage. For the over nine-year period for which the HMIS was analyzed, the average property damage for Class 3 enroute accidents was $16,041, while the average property damage for enroute incident spills was $274. Property damage for leaks occurring during loading and unloading incidents and accidents was $68. Average property damage for Class 2.1 enroute accidents, enroute spills, and loading and unloading incidents were $3,147, $173, and $2,315, respectively. For Class 8, the average values for enroute accidents, enroute spill incidents, and loading and unloading incidents were $3,104, $67, and $17, respectively.

2.3.6 Carrier Damage

Carrier damage includes damage to the truck and associated equipment transporting the Class 3, Class 2.1, and Class 8 materials.

A New York State Department of Environmental Conservation study reported the economic loss from damaged vehicle downtime as $7,887 per large truck, expressed in 1996-dollar terms, converted for this report from the original 1987 dollars of the study (U.S. EPA, 1996).

The estimate provided by the HMIS database is probably a more reliable estimate. For the 1990 to 1999, the more than 9-year period for which the HMIS was analyzed, the average carrier damage for Class 3 enroute accidents was $33,013; the average carrier damage for enroute incident spills was $174; and the damages for spills associated with unloading and loading accidents/incidents was $37. Class 2.1 carrier damage for enroute accidents, enroute spills, and for loading and unloading incidents averaged $25,582, $1,407, and $815 respectively. Class 8 carrier damage averaged $25,541 for enroute accidents. Class 8 carrier damage for enroute spills and for loading and unloading incidents averaged $165 and $17.

2.3.7 Traffic Incident Delay

Although an aspect of these costs is embedded in the National Safety Council estimates, it is important to isolate this effect because HM spills (or suspected spills) typically require a different type of emergency response that tends to lengthen traffic delays considerably. To aid in this effort, HM incident delay was extracted from data collected by the states of California and Ohio. This was supplemented by several studies reported in the literature (Agent, K.R, 1995; Grenzeback, L.R., 1990).

Traffic incident delay had no relatively simple method of estimating the costs of incident delay induced by an accident. Consequently, a model was adapted to be able to estimate the number of hours and the cost of incident delay. For Section 2.3.7, all accidents and incidents are referred to as incidents.

Delay Estimation. There are two groups of approaches to estimating incident delays, namely deterministic and stochastic. The former approach is simpler and easier to apply and is intended for after incident evaluation where information of traffic flow is assumed known. Incident delay is affected by a number of factors, including incident duration, road capacity, arrival pattern, traffic volume, functional class of the road, and the time of day. A deterministic approach developed by Morales (1977) is used in this study because of its simplicity relative to other methods e.g., Fu et al. (1997). Moreover, the data requirements for the deterministic approach can be more easily obtained or derived.

In this study, incident delay is estimated, assuming the condition of simple lane closure. This assumption is practical given that HM incidents involve trucks and invariably result in lane or road closures. For this condition, estimates for three types of traffic flow are required:

1. Demand traffic flow that would have gone through a point if the incident had not occurred, S_2
2. Reduced traffic flow resulting from the incident, S_3
3. The gateway flow after the incident has been cleared, S_1.

This flow is assumed to be equal to the capacity of the roadway. The demand and bottleneck flows are assumed steady state flows for the particular time of day. These are illustrated in Figure 1.
In addition to the flows, the duration of the incident,
T, is required to estimate the delay.

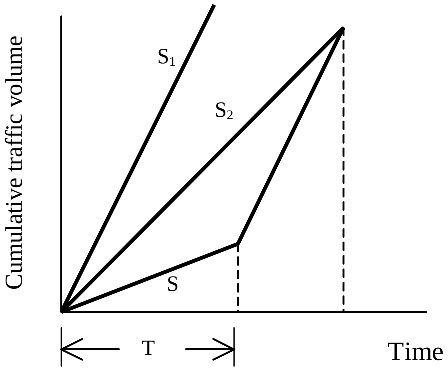

Figure 1. Demand and Bottleneck Traffic Flows

Information on practical capacity was obtained from the Highway Capacity Manual (1994) and actual traffic flow data from 1996 Highway Statistics (U.S. DOT, 1997b). First, the capacity of each functional class was used to estimate the average demand traffic flow for levels of service expressed as traffic volume (v) to service flow (sf) v/sf ratios between 0.5 and 0.9. The demand traffic values are then compared with ADT data in Highway Statistics to establish reasonableness.

The v/sf ratio range is chosen to include the threshold value above which congestion occurs i.e., v/sf = 0.80 and free-flow conditions reflecting non-peak flows which occur at v/sf less than 0.80. Bottleneck traffic flow is assumed to be about 60 percent of the actual (demand) flow. This assumption is consistent with earlier observations (Jacobson, 1992) that about 80 percent of incidents reduce capacity by at least one-third, regardless of whether a lane was blocked. Incident delay is estimated as a function of the level of service offered for four functional highway classes: (1) urban interstate, freeways and expressways; (2) other urban roads; (3) rural interstate; and (4) other rural roads. It is important that incident delay be considered within the context of highway functional class because of differences in the level of service, the volume of traffic, and the average annual vehicle miles traveled (VMT). VMT is a utilization measure of the highway facility, therefore an indication of the level of exposure or the risk of being involved in an incident.

Incident delay can be estimated from the following equations for simple lane closure condition (Morales, 1977).

$$D = T.\kappa$$

$$\kappa = \frac{(S_1 - S_3)(S_2 - S_3)}{2(S_1 - S_2)}$$

Figure 2 shows the variation of κ with v/sf ratio for the four functional highway classes. For a given demand traffic flow, the v/sf ratio on a particular highway class and the κ can be determined from the graphs in Figure 2. This value can be multiplied by the incident duration, T, to obtain an estimate of the incident delay in veh-hr on the particular highway class. Figure 3 shows the variation of incident delay in vehicle-hours with incident duration for the congestion threshold v/sf value of 0.80. This v/sf ratio represents a typical operating condition on the interstate system. Data from the 1966 Highway Statistics indicate that 95 percent of the rural interstate, 66 percent of the urban interstate and 75 percent of other freeways and expressways operate at v/sf ratios less than 0.80. As noted in the equation and depicted in the figure, incident delay is a linear function of the duration of the incident. Figures 2 and 3 are developed based on service flows (or capacity) that are considered typical minimum values for each functional highway class as derived from the Highway Capacity Manual (1994). The curves may be considered conservative given the differences in traffic flows, HM types, and type of incident and incident response management.

To obtain the user costs resulting from incident delays, information on the occurrence or probability of an occurrence of an incident or the split between trucks and other vehicles on the various highway systems may be required. Data on VMT for trucks and other vehicles for the various functional highway classes may be used to obtain the distribution of incident delay costs between trucks and other vehicles. Table 4 summarizes the percent of VMT by trucks and other vehicles on the four groups of functional highway classes and the distribution of VMT among on the functional classes, using both truck VMT data only and total VMT.

Table 4. Distribution of VMT by Functional Class and Vehicle Type

Functional Highway class	Percent of VMT by vehicle type (%)	
	Trucks	Other vehicles
Rural Interstate	18.22	81.78
Other Rural highways	7.97	92.03
Urban Interstate	8.33	91.67
Other Urban highways	4.63	95.37
Functional Highway class	**Percent of VMT by highway class (%)**	
	Truck VMT	**Total VMT**
Rural Interstate	22.6	9.2
Other Rural highways	31.8	29.4
Urban Interstate	15.8	14.0
Other Urban highways	29.8	47.4

Source: 1997 HCAS Base Case VMT data (U.S. DOT, 1997c)

Incident Delay Cost. The cost associated with incident delay can be estimated by applying the unit cost of delay by the values obtained from the graphs in Figures 2 or 3. These delay costs due to traffic are based on value of time and do not include the clean up costs of the incident. Earlier studies (Grenzeback, L.R. et al., 1990) assumed the cost of incident delay to be about $20 for trucks and $10 for other vehicles. A study of the congestion costs estimated average unit cost to be $14.43 per vehicle-hour of delay. This is calculated from a unit cost per vehicle hour of $10.92 (1990 dollars) from the Highway Economic Requirements System (HERS) multiplied by a CPI of 1.25 to adjust the figure to 1998 dollars. To account for the increase fuel consumption due to congestion, add [(0.7 gal/hour) * $1.11 per gallon (1998 dollars)]. The unit delay cost includes value of time and fuel costs.

Available Incident Data. Data on HM incidents in the California Highway Patrol database, the Ohio PUCO Incident Reports, and literature indicate the following:

- California data (1994 to 1998)
  - Average duration of HM incidents, specifically DOT Hazard Class 3 (flammable and combustible liquids), is 4.8 hours with a standard deviation of 2.1 hours.
  - Only 4 percent of HM incidents have duration less than 1 hour and about 6 percent have duration greater than 12 hours.
  - 75 percent of HM incidents resulted in partial or full road closures.

- Ohio data (1995-1998)
  - Duration of incidents on rural interstates is 2 to 18 hours with 70 percent lane or road closures
  - Duration of incidents on other rural roads is 3 to 22 hours with 60 percent lane or road closures
  - Duration of incidents on urban interstates is up to 4 hours with 100 percent lane or road closures
  - Duration of incidents on other urban roads is 2 to 20 hours with 75 percent lane or road closures.

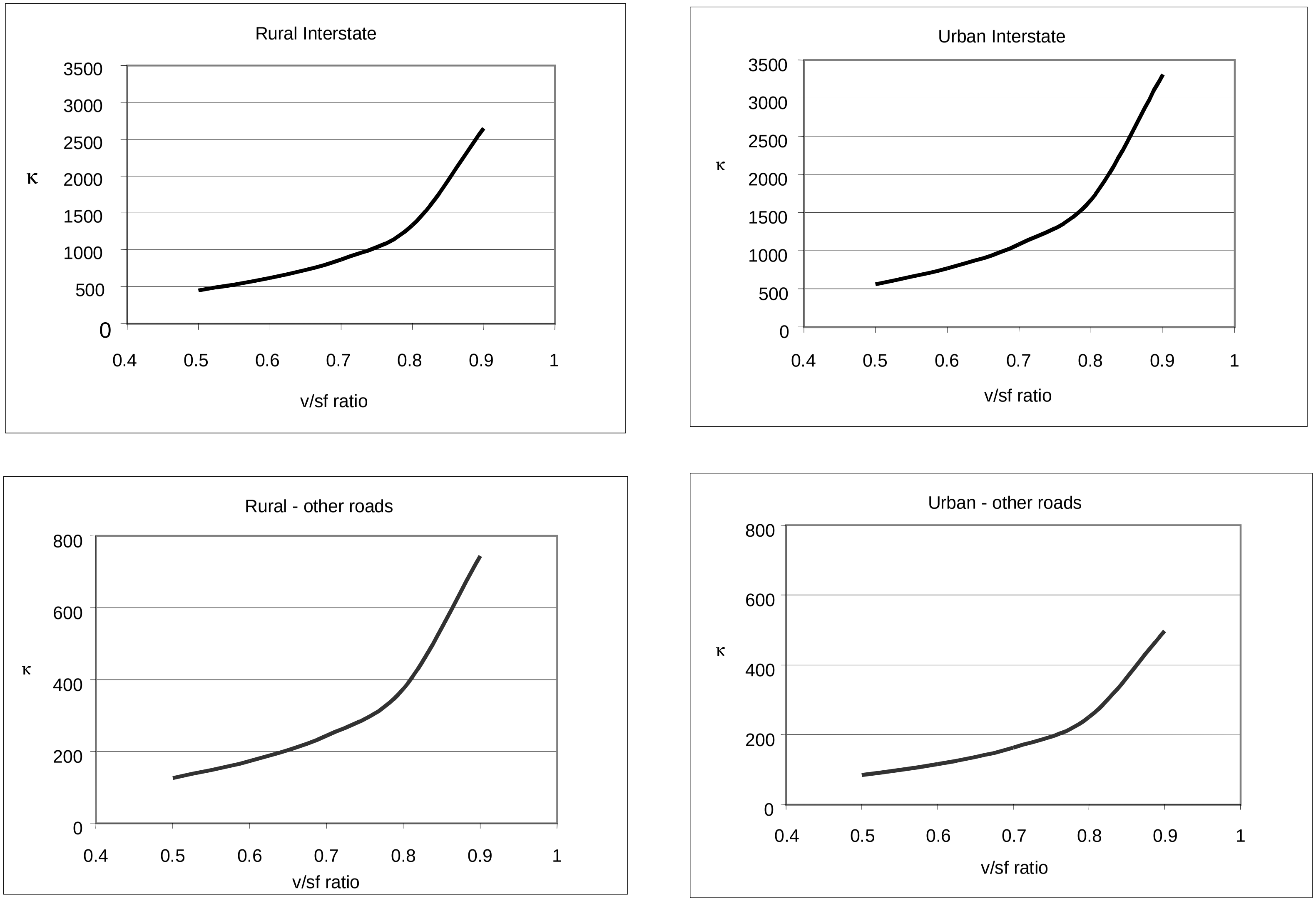

Figure 2.   Level of Service Versus Delay Traffic Volume

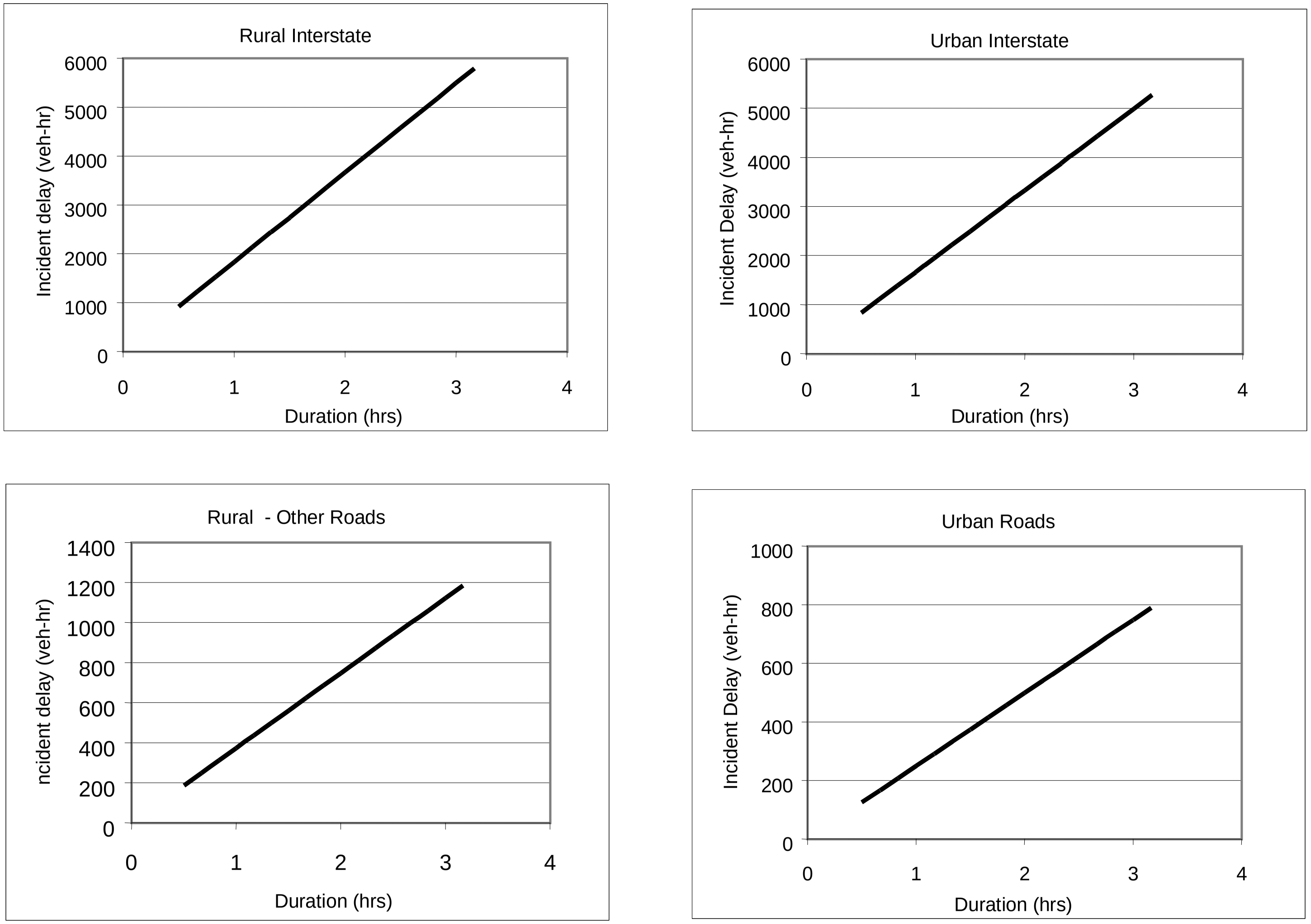

Figure 3.   Level of Service Versus Delay Traffic Volume

Note: These graphs are developed for v/sf = 0.80. Similar graphs can be generated for other v/sf ratio value

- Literature
  - — Major incidents constitute 5 to 10 percent of all truck incidents (Grenzeback, L.R. et al., 1990). A major incident is one that blocks two or more lanes of the freeway for 2 hours or longer.
  - — Average duration of major incidents is 3 hours 39 minutes, and it triggers an average of 2,800 veh-hr of delay on freeways around it. Major incidents lasting 10 to 12 hours triggered 30,000 to 40,000 veh-hr delay (Recker et al., 1988).
  - — Average duration of a common incident is 1 hour with an average 1,200 veh-hr delay (Recker et al., 1988).
  - — About two thirds of major incidents are the result of overturns, spills, or shifted loads.

Input Data Summary. The following is a summary of inputs for estimating incident delays based on the limited data discussed above. These are for the purposes of obtaining rough estimates of incident delays and associated costs, using the process described in *Delay Estimation*.

- Average duration of all incidents – 5 hours.
- Average duration of major incidents (those requiring closure of all lanes) – 12 hours.
- Average duration of common incidents - 2 hours.
- About 5 percent of all incidents can be classified as major incidents.
- Average unit cost of delay is $15 per vehicle-hour.
- Minimum service flows (or capacities) expressed in vehicles per hour (vph) per direction used in developing the curves are:
  - — Rural interstate – 3,200 vph
  - — Rural other highways – 900 vph
  - — Urban interstate – 4,000 vph
  - — Urban other highways – 600 vph

  These values are used to calculate the v/sf ratio and determine κ from Figure 2.

Illustration. The following illustration describes the sequential steps followed to calculate incident delay. Assume that average traffic volumes shown above are representative of the respective groups of functional highway classes. Assume average duration of 5 hours per incident regardless of the functional class of highway. The steps in estimating the incident delays are summarized in Table 5 and described below.

Step 1 — Determine the design service flow (vph in each direction of travel) for the functional highway class in question.
Step 2 — Determine the average actual traffic flow (vph) per direction for that highway.

Step 3 — Calculate the v/sf ratio by dividing the value of Step 2 by that of Step 1.

Step 4 — With the v/sf ratio read off the corresponding κ-value from Figure 2.

Step 5 — Obtain the average duration of incidents for the type of incident and/or highway from historical data.

Step 6 — Multiply the κ-value from step 4 by the duration in step 5. The product is delay in veh-hr per incident on that highway class.

Step 7 — Multiply delay by unit cost of $15 to obtain cost per incident on each highway.

Step 8 — Determine the number of incidents on each highway class for the time period under consideration.

Step 9 — Multiply cost of incident by the number of incidents to obtain the total cost of incidents on the highway class for the given time period.

Step 10 — Sum total cost to obtain the grand total for all highway classes.

Table 5. Summary of Steps

Highway class	sf (vph) (1)	v (vph) (2)	v/sf (3)	κ (4)	T (hr) (5)	D (veh-hr) (6)	Cost @ $15 (7)	# of incidents (8)	Total cost $ (9)
Rural Interstate	3200	1900	0.6	615	5	3075	$46,125	408	18,819,000
Rural Other	900	450	0.5	125	5	625	$9,375	574	5,381,250
Urban Interstate	4000	3200	0.8	1660	5	8300	$124,500	285	35,482,500
Urban Other	600	400	0.7	160	5	800	$12,000	538	6,456,000
							(10)	Grand Total	66,138,750

For calculating incident delay in this report, the following incident delay durations were used:

• HM release accident, explosion	12 hours
• HM release accident fire only	8 hours
• HM release only accident	5 hours
• HM non-release accident	5 hours
• HM leak enroute incident	5 hours
• Non-HM accidents	2 hours

2.3.8 Environmental Damage

Environmental damage is considered to be damage to the environment that remains after cleanup has been completed. This damage can be calculated in terms of loss of economic productivity as in agricultural production lost and/or in loss of habitat or ecosystem deterioration. Most estimates of environmental damage have been conducted for major ecological disasters, such as major oil spills in oceans or large lakes. Some estimates of environmental damage have been assembled for such contaminated sites as superfund and CERCLA sites where penalties have been levied.

Three estimates of environmental damage costs are presented for this section. The loss of agricultural productivity can be estimated as the crops that could not be grown during a 20-year period due to contamination. If wheat were used as an example, a field could produce 35 bushels per acre with a value of $5 per bushel. This wheat crop for an acre would amount to a gross income of $3,500 over a 20-year period. For corn, a field could produce 128 bushels per acre with a value of $2.50 per bushel that would be worth $320 for one year and $6,400 of gross income for a twenty-year period. Of course, the net income would be considerably less.

A New York State Department of Environmental Conservation study reported property damage to the incident/accident site as subsequent economic loss of 8.3 percent of the annual net revenue generated per square meter of property impacted, with a corresponding property devaluation of 5 percent of the resale value of property per square meter (EPA, 1996). The same study reported that economic loss due to environmental impairment was estimated as $7.37 per square meter of impacted area in woodland, park and river/lake settings. This would mean an additional loss of approximately $469 per acre. These figures were reported in 1987 dollars and converted to 1996 dollars for this report.

Natural resource damage settlements were selected as presenting a more conservative estimate of environmental damage. Damages were collected for 18 cases where environmental damage settlements were completed (Battelle Compilation of Environmental Settlements, 1998). These settlements were primarily against companies that had damaged the environment and were now paying a fine. The average per acre settlement price was $3,792. This average per acre settlement price could be for more serious pollution cases than that represented by a spill of Class 3, Class 2.1, or Class 8 materials. However, the average figure represents one conservative estimate of environmental damage. This figure was selected as a simple estimate of environmental damage that could be used as a representative number. A table listing all of the settlements is shown in Appendix D.

To calculate the natural resource environmental damage from a truck release of Class 3, Class 2.1, or Class 8 materials, its necessary to know how much material was spilled, where the spill occurred, and what sort of surface it covered. An assumption was made that all of the spills would occur on land and on a dirt surface. In reality, a certain proportion of the spills would occur in water or a paved surface. Furthermore, at least one barrel, or 55 gallons, had to escape in order for the spill to be considered. Below this threshold no damage was considered to occur.

HMIS data was consulted to determine spill size and distribution. For 1996 and for Class 3 enroute accidents resulting in a spill, the average spill greater than 55 gallons was 3,031 gallons, although the largest spill was 9,200 gallons. The data shows that 170 spills took place during an enroute accident and that 69 percent of the spills are represented by the 3,031 figure. For the material covered and the spill size, a formula was used which assumed that the surface would be dirt and that the spill would spread to about one centimeter in thickness. The area covered by the average spill size of 3,031 gallons would be about .21 acres. To be conservative, this estimated area of coverage was increased to .7 acres. Thus, for an average spill exceeding 55 gallons, $2,654 dollars of environmental damage would occur, calculating this spill as a percentage of the $3,792 figure cited earlier. However, since this estimate was applied to only 69 percent of the enroute spills, all spills over 55 gallons would average about $1,800 of environmental damage where only a release occurred.

For the typical full tanker spill of 8,000 gallons, an estimated $7,000 of environmental damage would be incurred.

The area suffering environmental damage from Class 2.1 materials would be expected to be smaller than for Class 3 materials. Appendix E provides a discussion of the likely behavior of Class 2.1

materials in an accident. Class 2.1 represents liquefied petroleum gases. The most common materials are Liquefied Petroleum Gas (LPG) and Liquefied Natural Gas (LNG). LPG is predominately propane and LNG is predominately methane. For this report, we assume the spill area is 60 percent of the area we used for Class 3 flammable liquids, such as gasoline. The LNG calculation indicates that 70 percent is a reasonable estimate but when the LNG is released from the tank, there will be some mixing with air that decreases the spill percentage. This will result in additional vaporization for the colder LNG and will bring the two estimates closer together.

Class 2.1 accidents enroute spills averaged about 2144 gallons per spill. The 2144 gallon spill would cover about 0.09 acres (assuming 60 percent coverage of a Class 3 spill). The 0.09 acres are increased to 0.30 acres to be conservative. This represents a cost of about $1,138 per spill. However, only about 35 percent of the spills exceeded 55 gallons and the average spill size distributed among all of the accidents was estimated to be 750 gallons per spill. Consequently, the average cost of environmental damage per spill for an enroute Class 2.1 accident spill is $398.

Unlike Class 2.1 spills, Class 8 (corrosives) spills are assumed to cover about the same area as Class 3 spills. For Class 8 incidents enroute, an average spill totaled about 496 gallons. Thus, each spill would affect about 0.12 acres. This area was increased to 0.4 acres to ensure a conservative estimate. This amounts to about $1,517 of environmental damage per spill. In 1996, only 66 accidents had spills greater than 55 gallons (about 13 percent). Thus, the average environmental damage for each of the 522 enroute incident spills would be $191.

Class 8 accidents enroute registered 60 spills over the 1995 to 1997 period. These spills averaged 911 gallons. Sixty-seven percent of all spill accidents had spills greater than 55 gallons. Each 911-gallon spill would cover about 0.06 acres, which was then increased by 3.33 times to 0.21 acres to be conservative. This amounts to $796 per average spill. However, since only 67 percent of all spill accidents would have an average spill greater than 55 gallons, the value of environmental damage for an average spill accident for 1996 would be $533.

The analysis of environmental damage assumed that release-only accidents (no fire or explosion) for the other nine HM classes/divisions would be similar to either Class 3, Class 2.1, or Class 8 in environmental damage. For Class 7 radioactive materials, environmental damages are estimated to be about the same as for a spill-only accident for Class 3.0, while damages for a Class 2.2 spill-only accident averages about the same as Class 2.1, $398 in environmental damage. All of the other HM groups except for Class 2.3 have an average environmental damage for a spill-only accident of about $533, the same as for Class 8.

HM release accidents with a fire and those with an explosion, result in greater environmental damage, due to thermal damage from fire and blast damage from explosions. Accidents with a fire result in an average environmental damage of about $7,584, while damages from explosions average an estimated $30,336.

Class 2.3 (poison gas) releases constitute the greatest environmental damage. Dispersion models for chlorine gas indicates that an average of $53,336 of environmental damage will result.

2.4 Impact Summary Discussion

The primary objective of this effort is to estimate the annual economic impact of transportation safety involving truck transport of Class 3, Class 2.1, and Class 8 hazardous materials. While the goal is to establish a high degree of confidence in these estimates, the reality is that the quality of available data limits the ability to do so. Among the reasons for this are:

- Concerns about the non-reporting of incidents/accidents to HMIS, as well as the accuracy of the reports that have been filed.
- The impacts of catastrophic events on these estimates; the absence or existence of a single catastrophic event can significantly alter the reported estimates.
- The vintage of the literature being used and its implications in terms of safety investments which may have been made since then, as well as the net present economic value of the reported costs.
- The study sample and its relevance to truck transport of Class 3, Class 2.1, and Class 8 hazardous materials on a national level.

Taking these observations into consideration, one should view the results in the context of establishing a general estimate or bound on the financial impact of this problem rather than a precise valuation. As such, it represents a valid attempt to benchmark the financial implications of the problem based on best available data.

3.0 High Consequence Low Probability Accidents

3.1 Introduction

The consideration of high consequence/low probability accidents is essential for completing a comprehensive risk assessment. To determine the likelihoods and sequencing of these accidents, the first step was to develop event trees for each of the HM class/division groups used for this analysis. Next, a historical record of severe accidents was compiled. These severe events are logical appendages to the event trees. Then the likelihood of severe accidents occurring was calculated by looking at the record of severe accidents and the likelihood of an accident sequence. Then the study staff estimated the fraction of the accidents represented by accident sequences of the severity documented by the historical record. For many of the classes/divisions of hazardous materials, the historical record identified no severe accidents. In these cases, no appending was performed. The special analysis section describes the approach that was used in the few cases where the above process failed to produce the needed results.

The appending of the severe accidents to the event trees is considered to be an important step in the risk assessment since these severe accidents get extensive media coverage. As a result, the public is more aware of these accidents than the less severe accidents that occur much more frequently. As will be shown, these tragic and sensational events are not the events that control the risk level. However, the general public would consider any assessment that did not explicitly include severe accidents to be incomplete.

Most of the probabilities shown on the event trees were obtained from the databases maintained by the Department of Transportation. The primary source of information on non-release accidents was the MCMIS Accident File. The primary source of information on release accidents was the HMIS database. Both databases were corrected for underreporting, using additional secondary sources that also should have captured the same accidents recorded by DOT. Numerous queries were run to identify any relationships that might enable the model to better represent the accident risk. Evaluations of accident likelihood as a function of time identified no significant trends. Similar evaluations of accident cost over time also showed no significant trend. While this was somewhat surprising given the known increases in the costs of vehicles, property, and materials, no trend was observed. So no corrections were made. In actuality, the absence of time-related trends simplified the analysis because no time weighting was needed. This enabled the queries to use an extended time period without correction.

3.2 Event Tree Application

Although there seemed to be no overall cost or accident frequency trends, queries showed that the severity of an accident was a function of whether or not a fire or explosion occurred as part of the accident sequence. Thus, where the data supported breaking out explosions and fire as separate accident sequences, the breakout was made. One way to show accident sequences is by event trees. An analysis of the data for all the classes/divisions of HM material being shipped, revealed that all the classes/divisions could be presented using four event trees. These event trees are shown in Figures 4 though 8. All begin with “accident occurs.” Figure 4 is representative of the event tree structure for five of the 12 HM categories being considered in this analysis. These classes or divisions represented by the Figure 4 event tree structure are 1.1, 1.4, 2.1, 3, and 9. For each of these HM categories, the second branch is “release occurs,” the next set of branches are “fire occurs” and the third set of branches are “explosion occurs.”

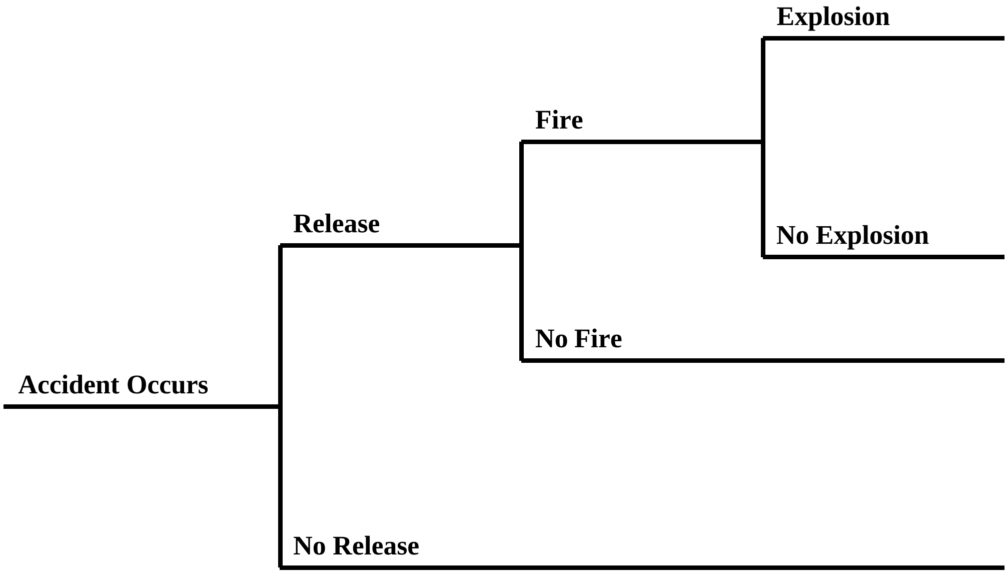

Figure 4. Event Tree Used to Model Division 1.1, 1.4, 2.1, Class 3 and Class 9 Accidents

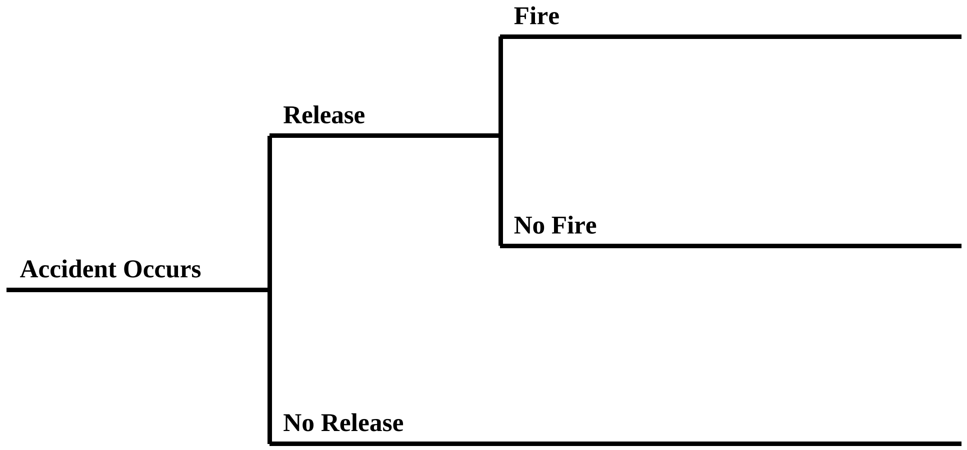

Figure 5. Event Tree Used to Model Division 2.2, Classes 5, 6, and 8 Accidents

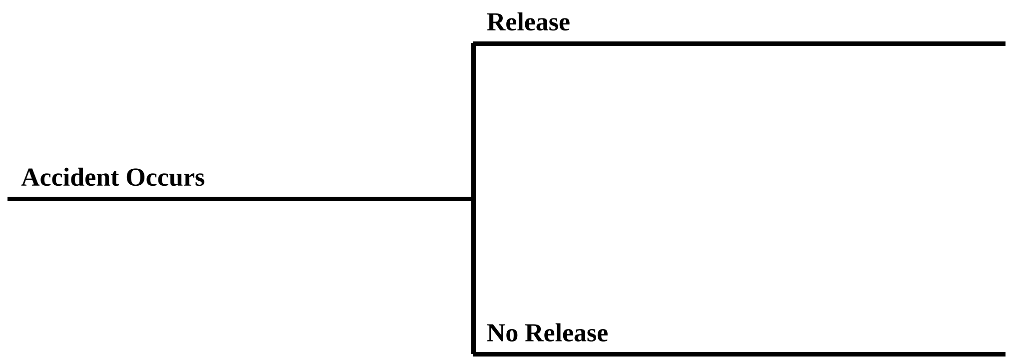

Figure 6. Event Tree Used to Model Class 4 Accidents

Although the structure is the same, the branch probabilities are different for each HM category. The branch probabilities are presented in Table 6. The second event tree structure is very similar to the first except that there is not enough information to develop the “explosion occurs” branches. This smaller event tree is presented as Figure 5. It is representative of the structure used for five additional HM categories, specifically 2.2, 5, 6, 8, and 4. The event tree probabilities for these HM categories are presented at the bottom of Table 6.

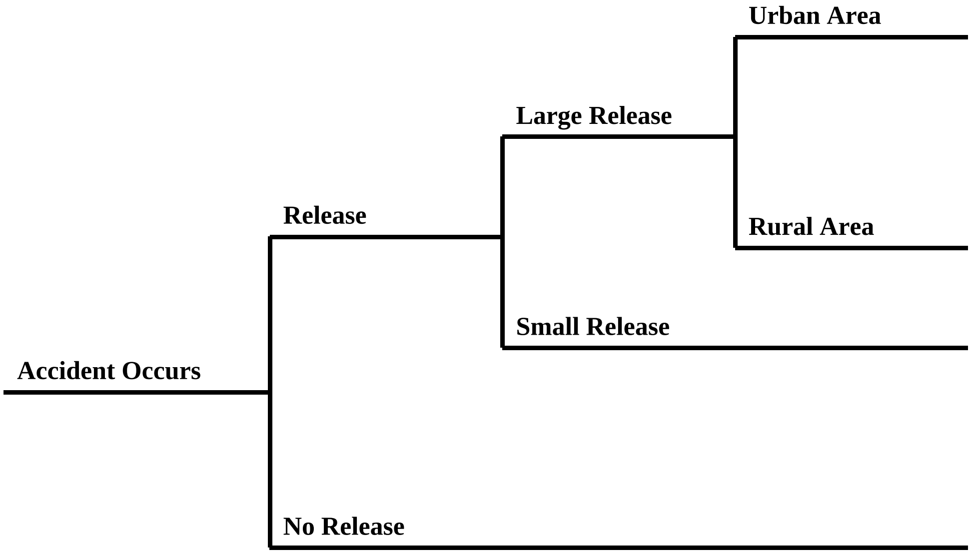

Figure 7. Event Tree Used to Model Division 2.3 Accidents

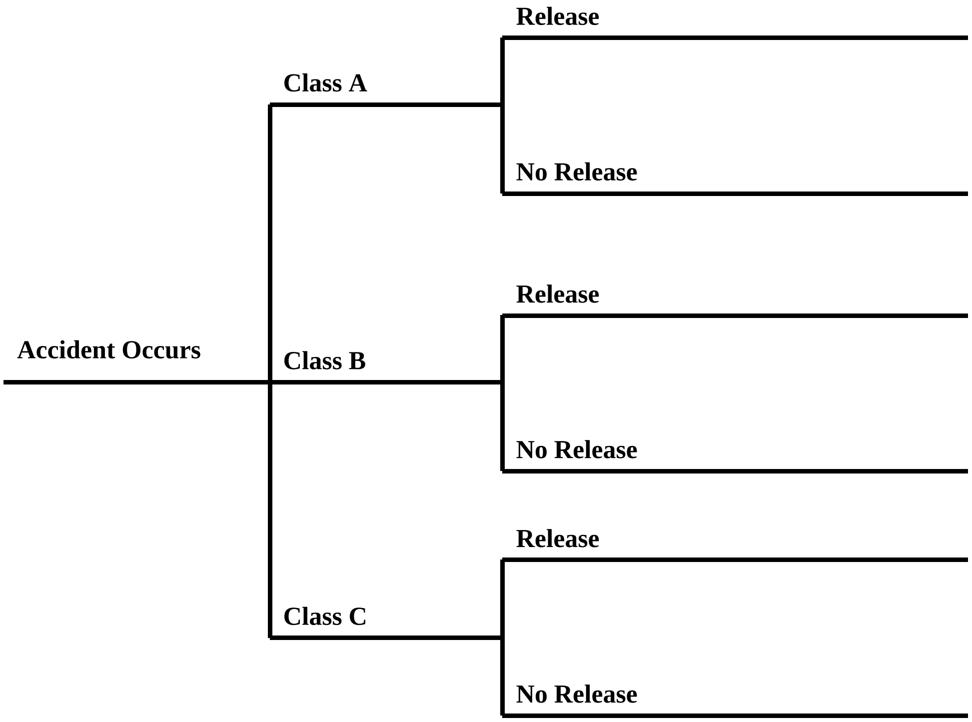

Figure 8. Event Tree Used to Model Class 7 Accidents

Distinct event trees are presented for the two remaining HM categories, Division 2.3 – "Poison Gases," and Class 7 – "Radioactive." As shown in Figure 6, the event tree branches for "Poison Gases" considers "Release," "Large Release" and "Urban Release" as subsequent branches on the event tree. Table 7 presents the probabilities for the HM Division 2.3 event tree branches.

Table 8 presents the event tree branch probabilities for Class 7 shipments. For Class 7 shipments, the initial set of branches consider three types of radioactive material "A," "B" or "C;" the subsequent branches consider "release occurs." The event tree probabilities presented in Tables 6 through 8 form the basis for the risk analysis that is developed in subsequent chapters of this report.

3.2.1 Explosions

When the event trees for the various categories of hazardous material were compared, sufficient accident data were available to divide the fire category into an additional branch "explosion occurs" for Class 1, Division 2.1, Class 3, and Class 9. In the case of Class 1 materials, no explosions occurred during the study period of 1990 to1999. However, there were several National Transportation Safety Board reports on truck explosions that occurred during the past 50 years. Based on the historical record, there will be one explosion of Division 1.1, 1.2, or 1.3 explosives every 10 years. The impacts reported for the explosion scenario were obtained by averaging the impacts associated with the explosions that have occurred over the last 50 years.

3.2.2 Fire and Explosion Relationships

Comparisons of the impacts from different classes/divisions of material were made by analyzing fire without explosion scenarios and explosion scenarios. If the comparisons showed trends that did not seem to be representative of the accident environment, the results were handled in one of two ways. In some cases, where there were only one or two accidents in a ten-year period, the decision was made to not break out the fire and explosion accidents as a separate accident category with independent impact costs. In other cases, there were quite a few accidents but some of the impact categories had smaller impacts than the non-fire scenario. When this occurred, an average impact ratio from a class with more data, i.e., Class 3 was used to adjust the data for that cost category. One such category was personal property damage. The amount of damage is dependent on where the accident occurs. For example, a fire involving a truck and several other vehicles in an urban setting could result in considerably higher costs than one involving fewer vehicles that occurred in a rural setting. When there are not many records for a category, often these records are from accidents that occurred in rural areas with low population density and dispersed built-up areas and, therefore, show low impacts. However, in the case of Class 3, there are enough data for the historical record to capture some accidents in areas where the population density, and therefore the personal property damage, is likely to be high.

3.2.3 Special Analyses

There are a couple of categories where special analyses were performed to develop the event trees. Over the last 50 years, there have been a few releases following truck accidents involving Division 2.3 material—poisonous gases. However, none of these releases have been large, and none have occurred in populated areas. If such a release occurred in a populated area, fatalities could be expected. Given the limited quantity of division 2.3 hazardous material being shipped by truck, the absence of a large release with subsequent fatalities is consistent with the historical record. Thus, the procedure used for other divisions/classes of hazardous material does not yield the desired result for division 2.3 shipments. The containers for shipping poisonous gases of division 2.3 are quite similar to the containers used to ship large quantities of flammable gases, of division 2.1 Therefore, probabilities that could not be filled in on the division 2.3 event tree could be taken from the 2.1 event tree. The probability that one of the accidents in division 2.1 would be severe was then estimated using the constructed 2.3 event tree as the starting point. Once the probability of a large release was obtained, the study transformed the accident location into a highly populated area by assuming that nine percent of the transport would be in such an area. This figure corresponds to percentages used in routing models such as HIGHWAY. The number of fatalities was then estimated assuming the material released was chlorine.

The final category for which there was no release data was Class 7, radioactive materials. The vast majority of radioactive material shipments are small packages, many of which are transported by package delivery services. If the material being shipped is a liquid, there must be sufficient absorbent material in the packaging to prevent the material from being released as a free liquid. Thus, the impacts are very small. There are very infrequent accidents that have larger impacts. What was done was to model one of each, neither of which, it turns out, adds significantly to the overall risk of shipping hazardous materials.

3.2.4 Incorporation of High Consequence Accidents

While the event trees enable the modeling of accidents with varying severity within the same hazard class or division, the approach is to use average impact numbers and not extremes. Furthermore, because it was recognized that some very severe accidents might not be present in the database records, an effort was made to look at accidents around the world that have been recorded during the last 50 years to see if any significant accidents have been missed. As a result, several severe, less frequent events were added. As each was added, a check was made to see if the addition presented a type of significant accident that had not been previously considered. As more and more accidents were added, fewer accidents could be considered distinct. Therefore, additional scenarios contributed less to the overall risk of transporting hazardous material. For example, a bus-gasoline truck accident in which many of the bus passengers were trapped in the ensuing fire was added because a similar accident killed more than 50 people in Brazil in 1998. Once that accident scenario was added, a similar accident scenario could be added to consider the situation where the truck was carrying other types of flammable material, for example, flammable gas, division 2.1. That scenario presented a risk similar to that of the bus--flammable gasoline truck fire scenario Therefore, that accident scenario was not added. Once professional judgement indicated that all of the various types of accident scenarios had been evaluated, the process of identifying additional accidents for inclusion ended, based on the assumption that no significant risks (ones that would significantly increase the overall risk) of shipping hazardous materials had been neglected.

Table 6. Initiating Event Frequency and Event Tree Branch Probabilities for Various Classes/Divisions of HM Being Transported by Truck

Class or Division	Accident Frequency	Release (Y/N)	Branch Probability (Release Y/N)	Fire (Y/N)	Branch Probability (Fire Y/N)	Explosion (Y/N)	Branch Probability (Explosion Y/N)	Branch Frequencies
1.1	142	Y	1.55E-01	Y	9.10E-02	Y	5.00E-01	1.00E+00
		Y	1.55E-01	Y	9.10E-02	N	5.00E-01	1.00E+00
		Y	1.55E-01	N	9.09E-01			2.00E+01
		N	8.45E-01					1.20E+02
1.4	321	Y	2.84E-01	Y	1.10E-02	Y	1.00E-02	1.00E-02
		Y	2.84E-01	Y	1.10E-02	N	9.90E-01	9.93E-01
		Y	2.84E-01	N	9.89E-01			9.02E+01
		N	7.16E-01					2.30E+02
2.1	276	Y	1.70E-01	Y	1.92E-01	Y	2.20E-01	1.98E+00
		Y	1.70E-01	Y	1.92E-01	N	7.80E-01	7.03E+00
		Y	1.70E-01	N	8.08E-01			3.79E+01
		N	8.30E-01					2.29E+02
3	1380	Y	3.55E-01	Y	1.47E-01	Y	3.06E-01	2.20E+01
		Y	3.55E-01	Y	1.47E-01	N	6.94E-01	5.00E+01
		Y	3.55E-01	N	8.53E-01			4.18E+02
		N	6.45E-01					8.90E+02
9	179	Y	3.36E-01	Y	2.20E-02	Y	2.30E-01	3.04E-01
		Y	3.36E-01	Y	2.20E-02	N	7.70E-01	1.02E+00
		Y	3.36E-01	N	9.78E-01			5.88E+01
		N	6.64E-01					1.19E+02
2.2	178	Y	1.46E-01	Y	7.70E-02			2.00E+00
		Y	1.46E-01	N	9.23E-01			2.40E+01
		N	8.54E-01					1.52E+02
5	61	Y	4.75E-01	Y	6.90E-02			2.00E+00
		Y	4.75E-01	N	9.31E-01			2.70E+01
		N	5.25E-01					3.20E+01
6	50	Y	3.00E-01	Y	6.70E-02			1.01E+00
		Y	3.00E-01	N	9.33E-01			1.40E+01
		N	7.00E-01					3.50E+01
8	257	Y	2.84E-01	Y	2.70E-02			1.97E+00
		Y	2.84E-01	N	9.73E-01			7.10E+01
		N	7.16E-01					1.84E+02
4	33	Y	2.42E-01					7.99E+00
		N	7.58E-01					2.50E+01

Table 7. Initiating Event Frequency and Event Tree Branch Probabilities for Division 2.3 (Poison Gases) by Truck

Class or Division	Accident Frequency	Release (Y/N)	Branch Probability Release Y/N	Large Release (Y/N)	Branch Probability Large Release - Y/N	Urban Release (Y/N)	Branch Probability Urban Release Y/N	Branch Frequencies
2.3	1.20E-01	Y	1.68E-01	Y	2.20E-01	Y	9.10E-02	4.04E-04
		Y	1.68E-01	Y	2.20E-01	N	9.09E-01	4.03E-03
		Y	1.68E-01	N	7.80E-01			1.57E-02
		N	8.32E-01					9.98E-02

Table 8. Initiating Event Frequency and Event Tree Branch Probabilities for Class 7 (Radioactive) by Truck

Class or Division	Accident Frequency	Type	Branch Probability Release Y/N	Release (Y/N)	Branch Probability Release Y/N	Branch Frequencies
7	1.20E-01	A	9.00E-01	Y	2.20E-01	2.38E-02
		A	9.00E-01	N	7.80E-01	8.42E-02
		B	9.00E-02	Y	1.00E-01	1.08E-03
		B	9.00E-02	N	9.00E-01	9.72E-03
		C	1.00E-02	Y	6.00E-05	7.20E-08
		C	1.00E-02	N	1.00E+00	1.20E-03

4.0 Accident and Incident Numbers and Impacts

This chapter summarizes the analysis of the annual impacts of accidents and incidents for the 12 categories of HM classes and divisions selected for analysis.

4.1 Accident and Incident Likelihood

This section presents an overview of the estimated annual number of HM accident and incidents.

Table 9 shows the breakdown by the 12 categories of accidents and incidents. It includes enroute release accidents broken into release (spill), non-release (no spill) accidents, leaks enroute, and loading and unloading incidents. Totals are presented for each HM category and accident/incident type.

Table 9. HM Accident and Incident Likelihood

HM Category	Enroute Accident			Leak Enroute	Loading/ Unloading	Total For All Hazmat Incidents	% of Total (by Categories)
	Release	No Release	Release/Non Release				
1.1, 1.2, 1.3	2.200	12.000	14.200	1.00	1	**16.200**	0.11%
1.4, 1.5, 1.6	9.101	23.000	32.101	3.00	3	**38.101**	0.26%
2.1	47.000	229.000	276.000	15.00	67	**358.000**	2.44%
2.2	26.000	152.000	178.000	19.00	126	**323.000**	2.20%
2.3	2.020	10.000	12.020	5.00	20	**37.020**	0.25%
3	490.021	889.000	1,379.021	587.00	4855	**6,821.021**	46.45%
4.1, 4.2, 4.3	8.000	25.000	33.000	13.00	92	**138.000**	0.94%
5.1, 5.2	29.000	32.000	61.000	50.00	372	**483.000**	3.29%
6.1, 6.2	15.000	35.000	50.000	125.00	760	**935.000**	6.37%
7	6.001	6.000	12.001	4.00	4	**20.001**	0.14%
8	73.000	184.000	257.000	539.00	4130	**4,926.000**	33.55%
9	60.300	119.000	179.300	94.00	316	**589.300**	4.01%
All Categories	**767.642**	**1,716.000**	**2,483.642**	**1455.00**	**10746**	**14,684.642**	100.00%
% of Total Incidents	**5.23%**	**11.69%**	**16.91%**	**9.91%**	**73.18%**	**100.00%**	
% of Total Enroute Accidents	**30.91%**	**69.09%**	**100.00%**				

Likelihood is the number of accidents that occur in one year. Enroute accident likelihood accounts for 2,483.6 accidents. The 0.6 accident represents accidents that are not expected to occur each year. The release accidents are estimated at 767.6 and non-release at 1,716. Enroute leak incidents totaled 1,455 and loading/unloading incidents 10,746.

Class 3 accounts for about 64 percent of the enroute accidents with releases and about 52 percent of the non-release accidents. Class 3 along with categories: 2.1, 2.2, 5.1, 5.2, 8, and 9 represent about 94 percent of all enroute accidents with releases and about 93 percent of all enroute non release accidents.

Classes 3 and 8 alone are involved in about 77 percent of all of the enroute leaks in the year. For loading and unloading incidents, these two classes were involved in about 84 percent of all incidents.

Table 10 shows the breakdown of enroute release accident types. The table breaks release accidents into three types: release only, fire but no explosion, and explosion. Approximately eight percent of all release accidents result in a fire. About three percent result in an explosion. Thus, about 12 percent of all release accidents result in either a fire or explosion. However, for categories 2.1 and 3, the percentages are 19 percent and 15 percent respectively. The number of accidents with fire or explosion is especially important because of their association with larger impacts. These impacts are discussed in following sections of the report.

Table 10. Enroute Release Accident Types

HM Category	Fire	Explosion	Release-Only	Total
1.1, 1.2, 1.3	0.1	0.1	2	2.20
1.4, 1.5, 1.6	0.1	0.001	9	9.10
2.1	7	2	38	47.00
2.2	2	0	24	26.00
2.3	0	0	2.02	2.02
3	50	22.0205	418	490.02
4.1, 4.2, 4.3	0	0	8	8.00
5.1, 5.2	2	0	27	29.00
6.1, 6.2	1	0	14	15.00
7	0	0.0005	6	6.00
8	2	0	71	73.00
9	1	0.3	59	60.30
All Categories	**65.2**	**24.422**	**678.02**	**767.64**
% of Total Enroute Release Accidents	**8.49%**	**3.18%**	**88.33%**	**100.00%**
% of Total Hazmat Accidents	**2.63%**	**0.98%**	**27.30%**	**30.91%**

4.2 Shipment Impact Summary

This section summarizes the annual shipment impacts for each of the HM categories.

4.2.1 Total Impact Costs

Tables 11 and 12 provide a summary of the total annual estimated impacts for HM shipments. Table 11 shows dollar values for the following categories: enroute release accidents, non-release accidents, leak enroute, loading/unloading. In Table 12, enroute release accidents are broken into release-only, fire, and explosion. The costs are totaled for each category and for each type of accident.

In addition, the percentage that each category contributes to the total HM accident picture is displayed. Total HM annual impacts are estimated at about $1.2 billion. Enroute accidents with impacts of about $1 billion account for about 89 percent of the total impacts. Release accidents with impacts of approximately $416 million account for a total of about 40 percent of the enroute accident impact. Within the release accident category, accidents with a fire and accidents with an explosion have total impacts of nearly $140 million, about 34 percent of the total cost of enroute release accidents. However, individually these accidents are important because their impact is greater. The total number of these accidents represents only 12 percent of the total number of enroute release accidents but 34 percent of cost. Non release accidents make up about 60 percent of the total enroute accident impacts for the annual portrait.

Table 11. Estimated Annual Accident and Incident Impacts (Costs)

HM Category	Enroute Accident			Leak Enroute	Loading/ Unloading	Total For All Hazmat Accidents	% of Total (by Category)
	Release	No Release	Release/ NonRelease				
1.1, 1.2, 1.3	$3,700,000	$6,000,000	$9,700,000	$100,000	$0	$9,800,000	0.84%
1.4, 1.5, 1.6	$4,100,000	$7,900,000	$12,000,000	$100,000	$100,000	$12,200,000	1.05%
2.1	$25,500,000	$81,100,000	$110,000,000	$800,000	$1,000,000	$110,000,000	9.31%
2.2	$9,600,000	$55,000,000	$64,600,000	$1,500,000	$2,100,000	$68,200,000	5.85%
2.3	$3,100,000	$3,400,000	$6,500,000	$2,000,000	$2,300,000	$10,800,000	0.93%
3	$290,300,000	$320,000,000	$610,000,000	$26,100,000	$12,600,000	$650,000,000	55.78%
4.1, 4.2, 4.3	$3,000,000	$10,000,000	$13,000,000	$700,000	$700,000	$14,500,000	1.24%
5.1, 5.2	$10,600,000	$7,700,000	$18,300,000	$2,500,000	$2,000,000	$22,800,000	1.96%
6.1, 6.2	$8,800,000	$9,800,000	$18,600,000	$5,700,000	$6,400,000	$30,700,000	2.63%
7	$2,100,000	$2,400,000	$4,500,000	$200,000	$0	$4,700,000	0.40%
8	$31,200,000	$66,700,000	$97,900,000	$27,900,000	$24,200,000	$150,000,000	12.88%
9	$23,700,000	$45,300,000	$68,900,000	$4,500,000	$2,100,000	$75,500,000	7.13%
All Categories	$415,800,000	$616,000,000	$1,031,800,000	$72,100,000	$53,500,000	$1,157,300,000	**100.00%**
% of Total Costs	**35.93%**	**53.23%**	**89.15%**	**6.23%**	**4.62%**	**100.00%**	
% of Total Enroute Accidents	**40.30%**	**59.70%**	**100.00%**				

Table 12. Estimated Annual Release Accident Impact Costs

HM Category	Enroute Release Accidents			Total
	Fire Costs	Explosion	Release-Only	
1.1, 1.2, 1.3	$710,000	$1,820,000	$1,190,000	$3,720,000
1.4, 1.5, 1.6	$710,000	$18,000	$3,360,000	$4,090,000
2.1	$4,500,000	$7,720,000	$13,360,000	$25,540,000
2.2	$810,000	$0	$8,820,000	$9,630,000
2.3	$0	$0	$3,050,000	$3,050,000
3	$63,600,000	$52,500,000	$174,200,000	$290,300,000
4.1, 4.2, 4.3	$0	$0	$3,000,000	$3,000,000
5.1, 5.2	$780,000	$0	$9,840,000	$10,610,000
6.1, 6.2	$2,830,000	$0	$5,970,000	$8,800,000
7	$0	$10,000	$2,090,000	$2,100,000
8	$2,900,000	$0	$28,400,000	$31,230,000
9	$380,000	$130,000	$23,200,000	$23,690,000
All HM Categories	$77,200,000	$62,200,000	$276,400,000	$415,800,000
%of Total Enroute Release Accident Costs	**18.56%**	**14.96%**	**66.48%**	**100.00%**
% Total Enroute Accident Costs	**7.42%**	**5.99%**	**26.59%**	**40.00%**

Leaks enroute account for about $72 million, an additional 6 percent; loading/unloading incidents cost $53.5 million or about 4.6 percent of the impacts.

Class 3 represents 56 percent of all of the impacts, while categories 8, 2.1, 2.2, and 9 represent about13 percent, 9 percent, 6 percent and 7 percent respectively. These five categories alone account for approximately 91 percent of the estimated annual impacts for HM shipments. No other category accounts for more than three percent of the total impacts.

For Class 3 enroute release accidents, the importance of impacts from fires and explosions is dramatic. Of the $290 million impact value (about 70 percent of the impacts from enroute release accidents), fire and explosion accidents account for an estimated $114.5 million or about 40 percent of the value. Fire and explosion accidents constitute about 15 percent of the 490 Class 3 release accidents in a year. Similarly, for Division 2.1, fire and explosion impacts represent about 48 percent of the $25.5 million release accidents impact value, although it only represents about 19 percent of the accidents.

4.2.2 Average Impact Costs

This subsection describes the average costs of HM accidents for the portrait year. The total impact was divided by the accident likelihood to calculate the average cost. Each high consequence/low frequency accident represents one accident even though only a fraction (based on its likelihood of occurring in one year) of the full accident cost has been allocated to impacts for the portrait year. Table 13 shows the average costs by HM category for annual accidents and incidents; Table 14 shows average costs for the different types of release accidents.

The tables demonstrate that for the two types of materials that could result in catastrophic impacts in an accident, average impacts are high. These include Categories 1.1, 1,2 and 1.3 (explosives) and Division 2.3 (poison gas). Table 14 shows that for Category 1.1, 1.2, 1.3, the average cost of a release accident is about $930,000 and for Division 2.3, the average cost of a release accident is about $1,020,000. However, Table 14 shows Class 3 with far greater total impacts and with many more accidents. The average cost per release accident for Class 3 is about $590,000.

The tables also demonstrate that the average cost is considerably higher for an enroute accident with an explosion than for an accident with only a fire. The tables also show that an accident with only a release has considerably lower average cost per accident than one with a fire. As Table 14 shows, accidents with explosions have the highest average cost per accidents. Table 14 shows that accidents with explosions average $2,070,000; those with fires, $1,150,000; and those with a release only, $410,000 per accident. All release accidents together averaged $540,000 in annual impacts. Enroute accidents without a release averaged about $359,000 per accident in the portrait year. Appendix F provides case study descriptions of selected Class 3, Division 2.1, and Class 8 accidents. Incidents have the lowest average cost. Leak enroute average about $50,000 per incident, while loading/unloading incidents average only about $5,000 per incident.

Table 13. Average Accident/Incident Costs for the Portrait Year

HM Category	Enroute Accident			(y) Leak Enroute	(z) Loading/ Unloading	Sum: (x,y,z) (incidents being constant)	% Difference from Mean
	Release	No Release	(x) Release/ Non Release				
1.1, 1.2, 1.3	$930,000	$501,000	$608,000	$80,000	$0	$688,000	46.8%
1.4, 1.5, 1.6	$372,000	$343,000	$352,000	$48,000	$24,000	$424,000	-9.6%
2.1	$543,000	$354,000	$386,000	$52,000	$15,000	$453,000	-3.3%
2.2	$370,000	$362,000	$363,000	$77,000	$17,000	$457,000	-2.5%
2.3	$1,017,000	$341,000	$497,000	$409,000	$115,000	$1,021,000	118.0%
3	$590,000	$361,000	$443,000	$44,000	$3,000	$490,000	4.5%
4.1, 4.2, 4.3	$375,000	$402,000	$395,000	$57,000	$7,000	$460,000	-1.8%
5.1, 5.2	$366,000	$240,000	$300,000	$50,000	$6,000	$355,000	-24.1%
6.1, 6.2	$587,000	$279,000	$371,000	$45,000	$8,000	$425,000	-9.3%
7	$300,000	$400,000	$346,000	$39,000	$1,000	$386,000	-17.6%
8	$428,000	$362,000	$381,000	$52,000	$6,000	$439,000	-6.4%
9	$388,000	$380,000	$383,000	$47,000	$7,000	$437,000	-6.7%
All Categories	$536,000	$359,000	$414,000	$50,000	$5,000	$469,000	**0.0%**

Table 14. Average Accident Costs for the Portrait Year

HM Category	Enroute Release Accidents			Total Releases
	Fire Costs	Explosion	Release-Only	
1.1, 1.2, 1.3	$710,000	$1,820,000	$590,000	$930,000
1.4, 1.5, 1.6	$710,000	$18,200	$370,000	$370,000
2.1	$640,000	$3,860,000	$350,000	$540,000
2.2	$400,000	N/A	$370,000	$370,000
2.3	N/A	N/A	$1,020,000	$1,020,000
3	$1,270,000	$2,190,000	$420,000	$590,000
4.1, 4.2, 4.3	N/A	N/A	$380,000	$380,000
5.1, 5.2	$390,000	N/A	$360,000	$370,000
6.1, 6.2	$2,830,000	N/A	$430,000	$590,000
7	N/A	$7,200	$350,000	$300,000
8	$1,430,000	N/A	$400,000	$430,000
9	$380,000	$130,000	$390,000	$390,000
All Categories	$1,150,000	$2,070,000	$410,000	$540,000
% inc./dec. relative to Average Release-Only Accident Cost	**183%**	**409%**	**0.00%**	**32%**
% inc./dec. relative to Average HM Enroute Accident Cost	**176%**	**397%**	**-2.4%**	**28%**

As stated above, the full cost of high consequence/infrequent accidents were not included in Tables 13 and 14. Table 15 shows average impacts per release accident as if the infrequent accident had occurred in the portrait year and all of its value was assigned to that year. The table presents a comparison between what average impacts could have been if these high consequence accidents had happened in the portrait year and the average values based on the fraction of the total accident impacts allocated to that year. The comparisons are greatest for those HM materials that can result in catastrophic impacts in an accident but have a low likelihood, such as Division 2.3 and category 1.1, 1.2, 1.3. Although there are very high consequence/low frequency accidents associated with Class 3, the average cost per accident doesn't increase as much when the full cost of a high consequence accident is added to the total because of the high likelihood. For example, as Table 15 shows, for category 1.1, 1.2, 1.3 the average cost of a release accident for the portrait year would have been $6.6 million and for Division 2.3, $26.9 million if the full impacts of the high consequence accidents were included in the calculation of the average impacts. These average accident impacts compare to $930,000 for Category 1.1, 1.2, 1.3 (14 percent of the cost) and $1,020,000 for Division 2.3 (about 4 percent of the cost). The averages were calculated after the cost of the high consequence/infrequent accident was distributed according to the likelihood of occurrence. For Class 3, the two figures are closer. There are an estimated $1,030,000 in average impacts per accident when the full value of high consequence accident impacts are included in the average and $590,000 of impacts (about 57 percent of the cost) when only the fraction of the high consequence accident is included.

Table 15. Average Impacts per Accident as if the High Consequence/Infrequent Accident had Occurred in the Portrait Year Compared to Average Costs for that Year

HM Category	Number of High Consequence Accidents	Average Release Cost with High Consequence Accidents In 1 year	Portrait Year Average Release Cost with Percentage of High Consequence Accidents Relative to its Likelihood	High Consequence Accident Likelihood (number per year)
1.1, 1.2, 1.3	2	$6,600,000	$930,000	.1 / .1
1.4, 1.5, 1.6	2	$2,600,000	$370,000	.1 / 0.001
2.3	1	$26,900,000	$1,020,000	0.02
3	2	$1,030,000	$590,000	.02 / .005
7	1	$2,400,000	$300,000	0.0005
9	1	$390,000	$390,000	0.3

4.2.3 Accident and Incident Major Impact Components

This subsection discusses the major components of the impacts for both accidents and incidents. Tables 16 through 23 present the major impact components for total enroute release and non-release accidents, total enroute release accidents, enroute release accidents without fire or explosion, enroute release accidents with a fire, enroute release accidents with an explosion, non-release accidents, leak enroute incidents, and loading/unloading incidents. Table 16 provides an overview of the major impact components for all HM accidents, including release and non-release accidents. The tables include the following impact categories: cleanup, product loss, carrier damage, property damage, environmental damage, injuries, fatalities, evacuations, and incident delay. Analyzing impacts by major components confirms that injuries and fatalities account for the major part of the impacts. For both release and non-release accidents combined, injuries represents about 40 percent of the impact costs. Fatalities represent about 40 percent of all impact costs for enroute accidents. Thus, injuries and fatalities together account for about 80 percent of the impact cost. Incident delay for both release and non-release enroute accidents add up to about nine percent of the total cost. Carrier, property damage, and product loss together represent about eight percent of the total; clean up, environmental damage, and evacuations account for the remaining approximately three percent of impacts.

Table 16. Enroute Accidents: Total HM (Release/Non-Release) Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	14.2	$29,000	$4,000	$240,000	$700,000	$4,900	$2,200,000	$3,100,000	$2,962,500	$530,000	**$9,700,000**	**0.94%**
1.4, 1.5, 1.6	32.101	$22,000	$13,000	$640,000	$260,000	$5,600	$5,000,000	$4,600,000	$210,000	$1,180,000	**$12,000,000**	**1.16%**
2.1	276	$68,000	$54,000	$5,200,000	$640,000	$130,000	$45,400,000	$44,000,000	$690,000	$10,380,000	**$107,000,000**	**10.33%**
2.2	178	$24,000	$62,000	$4,900,000	$70,000	$25,000	$27,600,000	$25,000,000	$230,000	$6,570,000	**$64,600,000**	**6.26%**
2.3	12.02	$610	$2,500	$98,000	$200,000	$110,000	$2,700,000	$2,800,000	$176,000	$440,000	**$6,500,000**	**0.63%**
3	1379.021	$15,600,000	$1,600,000	$36,100,000	$17,600,000	$1,800,000	$232,000,000	$254,000,000	$90,000	$52,800,000	**$611,000,000**	**59.23%**
4.1, 4.2, 4.3	33	$130,000	$25,000	$300,000	$110,000	$4,300	$4,900,000	$6,200,000	$150,000	$1,210,000	**$13,000,000**	**1.26%**
5.1, 5.2	61	$150,000	$52,000	$950,000	$50,000	$30,000	$9,400,000	$5,300,000	$52,000	$2,280,000	**$18,300,000**	**1.77%**
6.1, 6.2	50	$530,000	$120,000	$610,000	$96,000	$15,000	$8,800,000	$4,300,000	$2,180,000	$1,860,000	**$18,600,000**	**1.80%**
7	12.0005	$5,500	$3,600	$68,000	$5,900	$11,000	$2,600,000	$1,400,000	$500	$440,000	**$4,500,000**	**0.44%**
8	257	$1,140,000	$358,421	$5,100,000	$620,000	$53,000	$44,900,000	$35,000,000	$1,230,000	$9,470,000	**$97,900,000**	**9.49%**
9	179.3	$810,000	$110,000	$3,900,000	$630,000	$48,000	$31,500,000	$25,000,000	$10,000	$6,610,000	**$68,900,000**	**6.68%**
All Categories	**2483.642**	**$18,500,000**	**$2,400,000**	**$58,100,000**	**$20,900,000**	**$2,200,000**	**$417,000,000**	**$411,000,000**	**$7,990,000**	**$93,800,000**	**$1,032,000,000**	**100.00%**
% of Total Costs		**1.80%**	**0.23%**	**5.63%**	**2.03%**	**0.22%**	**40.40%**	**39.84%**	**0.77%**	**9.09%**	**100.00%**	

Examining release accidents by themselves reveals differences with all HM enroute accidents. Table 17 shows that clean-up costs alone account for about 4.5 percent of the impacts. Although environmental damage only accounts for about 0.5 percent of all impacts, it is more then twice the relative importance compared with environmental damage for all HM accidents. Table 18 shows that the distribution of impacts for enroute accidents, release-only, is similar to that shown for total releases except that the percentage of impacts related to fatalities and injuries differ. Injury impacts for enroute accident release-only account for more that 46 percent and fatality account for about 30 percent of the impacts, compared to about 37 percent for injuries and 41 percent of the fatalities for total release-only.

Enroute release accident with a fire and no explosion indicates the relative importance of fatalities in this accident type. Table 19 shows that fatalities account for more than 61 percent of impacts and injuries only about 19 percent. Incident delay accounts for only about five percent of the impacts for this category. Enroute release accidents with explosions are characterized by a similar impact relationship between fatalities and injuries, as occurs with fire only accidents. Table 20 shows that fatalities in explosion accidents account for more than 67 percent while injuries only about 16.5 percent. As might be expected, carrier and property damage and product loss are higher and accounts for about 10.5 percent compared to about eight percent for release accidents with fire-only. Incident delay represents less that four percent of the impact total for explosions compared to about five percent of the total for accidents with fires.

Table 21shows the impacts for enroute accidents without a release. For these accidents, fatalities and injuries still account for most of the impacts and together total about 82 percent of the impacts. Incident delay represents about 10 percent of the total. Unlike the release accidents, there are no impacts attributed to clean-up costs, product loss, and environmental damage.

The distribution of the costs differs for leak enroute incidents when compared to enroute accidents. Table 22 shows that about 74 percent of the cost for leak incidents enroute is composed of incident delay cost. About 22 percent of the cost relates to injuries, 2.6 percent to cleanup costs, and about 1.25 to the cost of product loss, carrier damage, and property damage combined.

Table 23 shows that for loading and unloading incidents, there are no incident delay costs but the cost to avoid injuries accounts for about 91 percent of the costs. Cleanup accounts for about five percent of the impact costs and product loss; carrier and property damage add up to about three percent of the total.

Table 17. Enroute Accident: Total Releases, Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	2.2	$29,000	$4,000	$64,000	$690,000	$4,900	$382,000	$1,800,000	$710,000	$88,000	**$3,700,000**	**0.89%**
1.4, 1.5, 1.6	9.101	$22,000	$13,000	$240,000	$230,000	$5,600	$1,700,000	$1,400,000	$181,000	$336,000	**$4,100,000**	**0.98%**
2.1	47	$68,000	$54,000	$1,202,000	$150,000	$130,000	$10,600,000	$11,100,000	$200,000	$2,000,000	**$25,500,000**	**6.14%**
2.2	26	$24,000	$62,000	$980,000	$14,000	$25,000	$4,500,000	$3,000,000	$32,000	$997,000	**$9,600,000**	**2.32%**
2.3	2.02	$610	$2,500	$24,000	$200,000	$107,000	$1,100,000	$1,400,000	$46,000	$75,000	**$3,100,000**	**0.73%**
3	490.0205	$15,600,000	$1,600,000	$16,200,000	$7,900,000	$1,800,000	$95,600,000	$131,500,000	$66,000	$20,200,000	**$290,300,000**	**69.82%**
4.1, 4.2, 4.3	8	$130,000	$25,000	$96,000	$36,000	$4,300	$1,400,000	$990,000	$36,000	$293,000	**$3,000,000**	**0.72%**
5.1, 5.2	29	$150,000	$52,000	$540,000	$29,000	$30,000	$5,400,000	$3,300,000	$24,000	$1,100,000	**$10,600,000**	**2.55%**
6.1, 6.2	15	$530,000	$120,000	$234,000	$37,000	$15,000	$3,400,000	$1,766,000	$2,100,000	$572,000	**$8,800,000**	**2.12%**
7	6.0005	$5,500	$3,600	$40,000	$5,600	$11,000	$1,000,000	$770,000	$500	$220,000	**$2,100,000**	**0.50%**
8	73	$1,138,000	$360,000	$1,900,000	$230,000	$53,000	$15,800,000	$8,200,000	$883,000	$2,700,000	**$3,100,000**	**7.51%**
9	60.3	$810,000	$110,000	$1,700,000	$270,000	$48,000	$11,700,000	$6,800,000	$3,500	$2,200,000	**$23,700,000**	**5.70%**
All Categories	**767.642**	$18,500,000	$2,400,000	$23,100,000	$9,700,000	$2,200,000	$152,600,000	$172,000,000	$4,300,000	$30,800,000	**$415,800,000**	**100.00%**
% of Total Costs		**4.46%**	**0.57%**	**5.56%**	**2.34%**	**0.54%**	**36.71%**	**41.37%**	**1.03%**	**7.42%**	**100.00%**	

Table 18. Enroute Accident: Release Only, Impacts Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	2	$28,600	$4,000	$63,600	$690,000	$4,900	$382,000	$1,800,000	$710,000	$88,000	**$3,700,000**	**0.43%**
1.4, 1.5, 1.6	9	$21,600	$13,500	$241,000	$233,000	$5,600	$1,700,000	$1,400,000	$181,000	$336,000	**$4,100,000**	**1.21%**
2.1	38	$67,800	$53,600	$1,200,000	$148,000	$129,000	$10,600,000	$11,100,000	$200,000	$1,980,000	**$25,500,000**	**4.83%**
2.2	24	$24,100	$62,200	$980,000	$14,100	$24,700	$4,500,000	$3,000,000	$31,800	$997,000	**$9,600,000**	**3.19%**
2.3	2.02	$610	$2,500	$23,900	$200,400	$106,700	$1,100,000	$1,400,000	$46,000	$75,100	**$3,100,000**	**1.10%**
3	418	$15,600,000	$1,600,000	$16,200,000	$7,900,000	$1,800,000	$95,600,000	$131,500,000	$66,100	$20,200,000	**$290,300,000**	**63.01%**
4.1, 4.2, 4.3	8	$132,000	$24,600	$95,500	$36,000	$4,300	$1,400,000	$1,000,000	$35,900	$293,000	**$3,000,000**	**1.09%**
5.1, 5.2	27	$151,000	$52,200	$543,000	$28,500	$29,600	$5,400,000	$3,300,000	$23,600	$1,110,000	**$10,600,000**	**3.56%**
6.1, 6.2	14	$534,000	$124,400	$234,000	$36,900	$15,000	$3,400,000	$1,800,000	$2,088,200	$572,000	**$8,800,000**	**2.16%**
7	6	$5,500	$3,600	$40,400	$5,600	$10,800	$1,000,000	$800,000	$500	$220,000	**$2,100,000**	**0.76%**
8	71	$1,100,000	$358,000	$1,900,000	$227,000	$53,000	$15,800,000	$8,200,000	$883,000	$2,720,000	**$3,100,000**	**10.27%**
9	59	$814,000	$112,000	$1,700,000	$267,000	$48,100	$11,700,000	$6,800,000	$3,500	$2,250,000	**$23,700,000**	**8.38%**
All Categories	**678.02**	$18,500,000	$2,400,000	$23,100,000	$9,700,000	$2,230,700	$152,600,000	$172,000,000	$4,270,000	$30,800,000	**$415,800,000**	**100.00%**
% of Total Costs		**5.89%**	**0.60%**	**6.61%**	**0.88%**	**0.36%**	**46.29%**	**30.09%**	**0.29%**	**8.99%**	**100.00%**	

Table 19. Enroute Accident: Fire, Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	0.1	$5,000	$2,000	$10,000	$213,000	$1,000	$17,000	$291,000	$167,000	$6,000	**$712,000**	**0.92%**
1.4, 1.5, 1.6	0.1	$5,000	$2,000	$10,000	$213,000	$1,000	$17,000	$291,000	$167,000	$6,000	**$71,000**	**0.92%**
2.1	7	$19,000	$12,000	$324,000	$60,000	$53,000	$1,540,000	$1,930,000	$111,000	$411,000	**$4,460,000**	**5.78%**
2.2	2	$16,000	$1,000	$90,000	$0	$15,000	$347,000	$221,000	$0	$117,000	**$808,000**	**1.05%**
2.3	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
3	50	$1,280,000	$436,000	$2,760,000	$1,900,000	$379,000	$10,200,000	$43,700,000	$17,000	$2,930,000	**$63,600,000**	**82.46%**
4.1, 4.2, 4.3	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
5.1, 5.2	2	$24,000	$5,000	$42,000	$6,000	$15,000	$347,000	$221,000	$0	$117,000	**$778,000**	**1.01%**
6.1, 6.2	1	$277,000	$91,000	$35,000	$25,000	$8,000	$174,000	$111,000	$2,100,000	$59,000	**$2,800,000**	**3.67%**
7	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
8	2	$22,000	$27,000	$91,000	$5,000	$15,000	$1,600,000	$221,000	$750,000	$117,000	**$2,850,000**	**3.70%**
9	1	$3,000	$2,000	$25,000	$1,000	$8,000	$174,000	$111,000	$0	$59,000	**$381,000**	**0.49%**
All Categories	**65.2**	$1,700,000	$577,000	$3,390,000	$2,420,000	$494,000	$14,400,000	$47,100,000	$3,260,000	$3,830,000	**$77,200,000**	**100.00%**
% of Total Costs		**2.15%**	**0.75%**	**4.39%**	**3.13%**	**0.64%**	**18.71%**	**61.04%**	**4.23%**	**4.96%**	**100.00%**	

Table 20. Enroute Accident: Explosion Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	0.1	$10,000	$2,000	$10,000	$473,000	$3,000	$17,400	$1,130,000	$167,000	$8,800	**$1,820,000**	**2.93%**
1.4, 1.5, 1.6	0.001	$100	$20	$100	$4,700	$30	$170	$11,300	$1,670	$88	**$18,200**	**0.03%**
2.1	2	$1,500	$12,700	$64,000	$33,600	$60,700	$2,480,000	$4,890,000	$7,500	$176,000	**$7,720,000**	**12.42%**
2.2	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
2.3	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
3	22.0205	$575,000	$132,000	$1,400,000	$4,390,000	$667,547	$7,700,000	$35,664,360	$37,200	$1,937,159	**$52,500,000**	**84.40%**
4.1, 4.2, 4.3	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
5.1, 5.2	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
6.1, 6.2	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
7	0.0005	$1,000	$30	$500	$5,000	$15	$0	$0	$500	$170	**$7,200**	**0.01%**
8	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**0.00%**
9	0.3	$930	$500	$10,900	$436	$9,100	$52,100	$33,200	$0	$26,400	**$134,000**	**0.21%**
All Categories	**24.422**	**$588,000**	**$147,000**	**$1,480,000**	**$4,910,000**	**$740,000**	**$10,300,000**	**$41,700,000**	**$214,000**	**$2,150,000**	**$62,200,000**	**100.00%**
% of Total Costs		**0.95%**	**0.24%**	**2.39%**	**7.89%**	**1.19%**	**16.48%**	**67.08%**	**0.34%**	**3.45%**	**100.00%**	

Table 21. Enroute Accidents Non-Release Accidents Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	12	$0	$0	$178,000	$15,200	$0	$1,780,000	$1,340,000	$2,250,000	$440,000	**$6,010,000**	**0.98%**
1.4, 1.5, 1.6	23	$0	$0	$401,000	$26,500	$0	$3,360,000	$3,220,000	$31,000	$843,000	**$7,880,000**	**1.28%**
2.1	229	$0	$0	$3,980,000	$490,000	$0	$34,700,000	$33,000,000	$489,000	$8,400,000	**$81,100,000**	**13.16%**
2.2	152	$0	$0	$3,890,000	$56,000	$0	$23,100,000	$22,200,000	$202,000	$5,570,000	**$55,000,000**	**8.93%**
2.3	10	$0	$0	$74,400	$1,000	$0	$1,530,000	$1,300,000	$130,000	$367,000	**$3,410,000**	**0.55%**
3	889	$0	$0	$20,000,000	$9,690,000	$0	$136,000,000	$122,000,000	$25,000	$32,600,000	**$321,000,000**	**52.08%**
4.1, 4.2, 4.3	25	$0	$0	$203,000	$76,500	$0	$3,500,000	$5,230,000	$112,000	$917,000	**$10,047,000**	**1.63%**
5.1, 5.2	32	$0	$0	$408,000	$21,400	$0	$4,040,000	$2,020,000	$28,000	$1,170,000	**$7,690,000**	**1.25%**
6.1, 6.2	35	$0	$0	$371,000	$58,600	$0	$5,410,000	$2,550,000	$96,000	$1,280,000	**$9,760,000**	**1.58%**
7	6	$0	$0	$27,100	$0	$0	$1,570,000	$579,000	$0	$220,000	**$2,400,000**	**0.39%**
8	184	$0	$0	$3,200,000	$388,000	$0	$29,100,000	$26,900,000	$345,000	$6,750,000	**$66,700,000**	**10.82%**
9	119	$0	$0	$2,230,000	$360,000	$0	$19,800,000	$18,500,000	$7,000	$4,360,000	**$45,000,000**	**7.35%**
All Categories	**1716**	**$0**	**$0**	**$34,900,000**	**$11,200,000**	**$0**	**$264,000,000**	**$239,000,000**	**$3,717,000**	**$62,900,000**	**$616,000,000**	**100.00%**
% of Total Costs		**0.00%**	**0.00%**	**5.67%**	**1.82%**	**0.00%**	**42.89%**	**38.81%**	**0.60%**	**10.21%**	**100.00%**	

Table 22. Leak Enroute Impact Components

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	1	$12,900	$20,700	$1,700	$1,700	$0	$0	$0	$6,000	$36,700	**$79,700**	**0.11%**
1.4, 1.5, 1.6	3	$1,800	$2,800	$3,300	$0	$0	$26,100	$0	$0	$110,000	**$144,000**	**0.20%**
2.1	15	$14,400	$24,800	$21,100	$2,600	$0	$104,000	$0	$62,300	$550,000	**$780,000**	**1.08%**
2.2	19	$9,700	$13,500	$20,600	$30,600	$0	$668,000	$0	$24,700	$697,000	**$1,460,000**	**2.03%**
2.3	5	$8,300	$300	$600	$4,900	$0	$1,670,000	$0	$180,000	$183,000	**$2,040,000**	**2.84%**
3	587	$739,000	$68,900	$102,000	$161,000	$0	$3,490,000	$0	$4,700	$21,500,000	**$26,100,000**	**36.21%**
4.1, 4.2, 4.3	13	$41,600	$1,700	$17,700	$200	$0	$200,000	$0	$8,600	$477,000	**$746,000**	**1.04%**
5.1, 5.2	50	$49,000	$21,500	$16,900	$7,500	$0	$557,000	$0	$4,500	$1,830,000	**$2,490,000**	**3.46%**
6.1, 6.2	125	$258,000	$10,800	$14,500	$72,500	$0	$741,000	$0	$4,200	$4,580,000	**$5,680,000**	**7.89%**
7	4	$3,800	$400	$0	$0	$0	$0	$0	$4,300	$147,000	**$155,000**	**0.22%**
8	539	$604,000	$66,800	$88,800	$36,300	$0	$7,370,000	$0	$6,300	$19,800,000	**$27,900,000**	**38.76%**
9	94	$133,000	$6,400	$47,900	$6,500	$0	$811,000	$0	$1,800	$3,450,000	**$4,450,000**	**6.18%**
All Categories	**1455**	**$1,870,000**	**$239,000**	**$335,000**	**$323,000**	**$0**	**$15,600,000**	**$0**	**$307,200**	**$53,300,000**	**$72,100,000**	**100.00%**
% of Total Costs		**2.60%**	**0.33%**	**0.47%**	**0.45%**	**0.00%**	**21.69%**	**0.00%**	**0.43%**	**74.04%**	**100.00%**	

Table 23. Loading/Unloading Incidents

HM Category	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total (by Class)
1.1, 1.2, 1.3	1	$37	$17	$0	$0	$0	$0	$0	$0	$0	**$54**	**0.00%**
1.4, 1.5, 1.6	3	$3,000	$300	$4,300	$10,900	$0	$52,200	$0	$0	$0	**$70,800**	**0.13%**
2.1	67	$6,900	$11,500	$54,600	$155,000	$0	$684,000	$15,900	$52,700	$0	**$981,000**	**1.83%**
2.2	126	$17,400	$25,800	$8,600	$12,100	$0	$2,030,000	$0	$12,000	$0	**$2,110,000**	**3.94%**
2.3	20	$19,400	$1,300	$600	$100	$0	$2,230,000	$0	$60,800	$0	**$2,310,000**	**4.32%**
3	4855	$1,510,000	$298,000	$178,000	$331,700	$0	$10,200,000	$700	$1,000	$0	**$12,600,000**	**23.47%**
4.1, 4.2, 4.3	92	$27,400	$5,100	$107,000	$11,000	$0	$533,000	$0	$900	$0	**$685,000**	**1.28%**
5.1, 5.2	372	$58,200	$19,700	$2,300	$4,000	$0	$1,960,000	$0	$1,000	$0	**$2,050,000**	**3.83%**
6.1, 6.2	760	$330,000	$38,700	$26,300	$26,600	$0	$5,980,000	$0	$3,600	$0	**$6,410,000**	**11.99%**
7	4	$900	$3,200	$400	$0	$0	$0	$0	$0	$0	**$4,600**	**0.01%**
8	4130	$716,000	$257,700	$70,000	$69,600	$0	$23,000,000	$200	$2,200	$0	**$24,200,000**	**45.18%**
9	316	$96,800	$23,900	$9,600	$3,500	$0	$2,010,000	$0	$800	$0	**$2,140,000**	**4.01%**
All Categories	**10746**	**$2,780,000**	**$685,000**	**$462,000**	**$625,000**	**$0**	**$48,800,000**	**$16,800**	**$134,900**	**$0**	**$53,500,000**	**100.00%**
% of Total Costs		**5.20%**	**1.28%**	**0.86%**	**1.17%**	**0.00%**	**91.20%**	**0.03%**	**0.25%**	**0.00%**	**100.00%**	

4.2.4 Accident Risk and Cost Per Mile

This subsection discusses accident risk and cost per mile for each of the HM categories. Table 24 shows the mileage traveled for 1996, the likelihood for an HM enroute accident (both release and non-release), and the risk per mile for each of the 12 HM categories. Risk of an accident per mile ranges from 1.3E-07 for Division 2.2 to 7.2E-07 for Class 9. The average accident rate for HM is 3.2E-07. If enroute incidents are included, as shown in Table 25, the risk increases to an average risk of 5.0E-07. Thus, without including enroute incidents, the accident/incident rate for accidents on the road declines by about 37 percent.

Table 24. HM Accident Rate Per Mile

HM Category	Hazmat Miles	Total Hazmat Accidents	Hazmat Accident Rate Accident./Mile
1.1, 1.2, 1.3	23,000,000	14.200	6.15453E-07
1.4, 1.5, 1.6	46,000,000	32.101	7.00887E-07
2.1	805,000,000	276.000	3.42784E-07
2.2	1,400,000,000	178.000	1.30091E-07
2.3	50,000,000	12.020	2.38753E-07
3	2,800,000,000	1,379.021	4.96414E-07
4.1, 4.2, 4.3	48,000,000	33.000	6.85756E-07
5.1, 5.2	201,000,000	61.000	3.03833E-07
6.1, 6.2	218,000,000	50.000	2.29576E-07
7	30,000,000	12.001	3.94605E-07
8	1,900,000,000	257.000	1.32109E-07
9	250,000,000	179.300	7.16646E-07
All Categories	**7,800,000,000**	**2,483.642**	**3.19922E-07**

Table 25. HM Accident/Incident Risk Per Mile
(Includes Leak Enroute Incidents)

HM Categories	Hazmat Miles	Total Hazmat Accidents	Hazmat Accident Rate Accident/Mile
1.1, 1.2, 1.3	23,000,000	15.200	6.58794E-07
1.4, 1.5, 1.6	46,000,000	35.101	7.66388E-07
2.1	805,000,000	291.000	3.61413E-07
2.2	1,400,000,000	197.000	1.43977E-07
2.3	50,000,000	17.020	3.38068E-07
3	2,800,000,000	1,966.021	7.0772E-07
4.1, 4.2, 4.3	48,000,000	46.000	9.55902E-07
5.1, 5.2	201,000,000	111.000	5.52876E-07
6.1, 6.2	218,000,000	175.000	8.03516E-07
7	30,000,000	16.001	5.26134E-07
8	1,900,000,000	796.000	4.09178E-07
9	250,000,000	273.300	1.09236E-06
All Categories	**7,800,000,000**	**3,938.642**	**5.07342E-07**

Table 26 shows the average cost per mile of HM accidents. Costs range from a high of 43 cents per mile for category 1.1, 1.2, and 1.3 to a low of 5 cents per mile for categories 5.1, 5.2, 6.1, and 6.2. The estimated average accident cost per mile for HM is 13 cents per mile traveled. As shown in Table 27, if enroute leak enroute incidents are added to enroute, additional costs per mile are relatively small due to the average low cost per enroute incident.

Table 26. HM Accident Cost Per Mile

HM Category	Hazmat Miles	Total Hazmat Accidents	Hazmat Accident Rate Accident/Mile
1.1, 1.2, 1.3	23,000,000	$9,700,000	$0.42
1.4, 1.5, 1.6	46,000,000	$12,000,000	$0.26
2.1	805,000,000	$106,600,000	$0.13
2.2	1,400,000,000	$64,600,000	$0.05
2.3	50,000,000	$6,500,000	$0.13
3	2,800,000,000	$611,000,000	$0.22
4.1, 4.2, 4.3	48,000,000	$13,000,000	$0.27
5.1, 5.2	201,000,000	$18,300,000	$0.09
6.1, 6.2	218,000,000	$18,600,000	$0.09
7	30,000,000	$4,500,000	$0.15
8	1,900,000,000	$97,900,000	$0.05
9	250,000,000	$68,900,000	$0.28
All Categories	7,800,000,000	$1,032,000,000	$0.13

Table 27. HM Accident/Incident Cost Per Mile (Includes Leak Enroute)

HM Category	Hazmat Miles	Total Hazmat Accidents	Hazmat Accident Rate Accident./Mile
1.1, 1.2, 1.3	23,000,000	$9,800,000	$0.43
1.4, 1.5, 1.6	46,000,000	$12,100,000	$0.26
2.1	805,000,000	$107,400,000	$0.13
2.2	1,400,000,000	$66,100,000	$0.05
2.3	50,000,000	$8,500,000	$0.17
3	2,800,000,000	$637,200,000	$0.23
4.1, 4.2, 4.3	48,000,000	$13,800,000	$0.29
5.1, 5.2	201,000,000	$20,800,000	$0.10
6.1, 6.2	218,000,000	$24,200,000	$0.11
7	30,000,000	$4,700,000	$0.15
8	1,900,000,000	$125,800,000	$0.06
9	250,000,000	$73,400,000	$0.29
All Categories	7,800,000,000	$1,111,400,000	$0.14

Chapter 5.0 Impact Summary by HM Category

5.1 Introduction

This chapter describes and summarizes the impacts for each of the 12 HM categories analyzed for this report. Differences in HM impacts within the HM categories are analyzed and explained where feasible. For each HM category, a table compares the accident/incident likelihood and impacts for release accidents, non-release accidents, leaks enroute, and loading/unloading incidents. Release accidents are subdivided into accidents characterized by a release-only, a fire, or an explosion. Total impacts for all release accidents in that group are also provided. The data included in Tables 28 through 39 present the impacts for one of the 12 HM categories. Table 40 provides a summary for all HM categories.

5.2 HM Category 1.1, 1.2, 1.3

Divisions 1.1, 1.2, 1.3, explosives, are characterized by relatively few accidents and incidents in the portrait year but with relatively great importance placed on the impact of explosions. Table 28 shows the distribution of impacts for Divisions 1.1, 1.2, 1.3. As is the case for all of the categories, injuries and fatalities account for most of the impacts, about 54 percent for Divisions 1.1, 1.2, 1.3. As Table 28 shows, enroute explosion accidents account for about 49 percent of the impacts of all enroute release accidents and about 19 percent of all impacts and incidents for the category. This compares to about 15 percent of the impacts represented by accidents with explosions for all enroute release accidents in all HM categories and about five percent of all impacts for accidents and incidents in all HM categories.

Evacuation costs are an important component of the impact costs for Divisions 1.1, 1.2, 1.3. Evacuation costs represent more than 30 percent of the total impacts for this category. This compares to less than one percent of the impacts for all HM impacts. Category 1.1, 1.2, 1.3 account for less than one percent of the total accident/incident impacts for all HM categories.

5.3 HM Category 1.4, 1.5, 1.6

Divisions 1.4, 1.5, 1.6, explosives and blasting agents, are also characterized by relatively few accidents and incidents in the portrait year. Table 29 provides a summary of accident/incident impacts for explosions. Explosions in this category account for less than one half percent of the impacts for enroute release accidents. Accidents with fire represent more than 17 percent of this value. Impacts from Divisions 1.4, 1.5, 1.6 account for a little more than one percent of the impacts from all HM categories.

5.4 HM Category 2.1

Division 2.1, flammable gas, was involved in an estimated 47 enroute accidents resulting in releases and 229 non release accidents for the portrait year. Division 2.1 is mainly transported in bulk carriers and approximately 64 percent of all listed accidents involved cargo tanks. Table 30 summarizes the impacts in terms of dollars for the estimated Division 2.1 accidents and incidents

Table 28. Category 1.1, 1.2, 1.3

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Total Inc./Acc.
Enroute Accident Release-Only	2	$13,571	$00	$43,629	$3,714	$1,066	$347,071	$328,598	$375,500	$73,332	**$1,186,482**	31.89%	12.10%
Enroute Accident Fire	0.1	$5,000	$2,000	$10,000	$213,000	$758	$17,354	$291,054	$167,000	$5,867	**$712,032**	19.14%	7.26%
Enroute Accident Explosion	0.1	$10,000	$2,000	$10,000	$473,000	$3,034	$17,354	$1,131,054	$167,000	$8,800	**$1,822,241**	48.98%	18.58%
Enroute Accident Total Releases	**2.2**	**$28,571**	**$4,000**	**$63,629**	**$689,714**	**$4,858**	**$381,778**	**$1,750,706**	**$709,500**	**$87,998**	**$3,720,755**	**100.00%**	**37.94%**
Enroute Accident Non-Release	12	$0	$0	$178,005	$15,154	$0	$1,776,000	$1,344,000	$2,253,000	$439,992	**$6,006,151**		61.25%
Leak Enroute	1	$12,875	$20,673	$1,733	$1,747	$0	$0	$0	$6,000	$36,666	**$79,694**		0.81%
Loading Unloading	1	$37	$17	$0	$0	$0	$0	$0	$0	$0	**$54**		0.00%
Total Accidents/Incidents	**16.2**	**$41,483**	**$24,689**	**$243,366**	**$706,616**	**$4,858**	**$2,157,778**	**$3,094,706**	**$2,968,500**	**$564,656**	**$9,806,653**		**100.00%**

Table 29. Category 1.4, 1.5, 1.6

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Total Inc./Acc.
Enroute Accident Release-Only	9	$16,482	$11,441	$230,916	$15,248	$4,797	$1,633,821	$1,102,372	$12,111	$329,994	**$3,357,181**	82.13%	27.56%
Enroute Accident Fire	0.1	$5,000	$2,000	$10,000	$213,000	$758	$17,354	$291,054	$167,000	$5,867	**$712,032**	17.42%	5.84%
Enroute Accident Explosion	0.001	$100	$20	$100	$4,730	$30	$174	$11,311	$1,670	$88	**$18,222**	0.45%	0.15%
Enroute Accident Total Releases	**9.101**	**$21,582**	**$13,461**	**$241,016**	**$232,978**	**$5,586**	**$1,651,348**	**$1,404,736**	**$180,781**	**$335,949**	**$4,087,436**	**100.00%**	**33.55%**
Enroute Accident Non-Release	23	$0	$0	$401,281	$26,498	$0	$3,358,000	$3,220,000	$30,951	$843,318	**$7,880,048**		64.68%
Leak Enroute	3	$1,798	$2,817	$3,300	$0	$0	$26,087	$0	$0	$109,998	**$143,999**		1.18%
Loading/Unloading	3	$3,045	$346	$4,348	$10,870	$0	$52,174	$0	$0	$0	**$70,782**		0.58%
Total Accidents/Incidents	**38.101**	**$26,425**	**$16,623**	**$649,945**	**$270,345**	**$5,586**	**$5,087,609**	**$4,624,736**	**$211,732**	**$1,289,265**	**$12,182,265**		**100.00%**

Table 30. Category 2.1

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Total Inc./Acc.
Enroute Accident Release-Only	38	$47,783	$28,959	$814,734	$54,748	$15,124	$6,594,354	$4,329,471	$81,132	$1,393,308	**$13,359,613**	52.30%	12.33%
Enroute Accident Fire	7	$18,561	$11,963	$323,621	$59,586	$53,088	$1,544,161	$1,926,715	$111,143	$410,662	**$4,459,500**	17.46%	4.11%
Enroute Accident Explosion	2	$1,467	$12,667	$64,000	$33,594	$60,672	$2,480,405	$4,887,745	$7,500	$175,996	**$7,724,045**	30.24%	7.13%
Enroute Accident Total Releases	**47**	**$67,811**	**$53,590**	**$1,202,356**	**$147,928**	**$128,884**	**$10,618,920**	**$11,143,931**	**$199,774**	**$1,979,966**	**$25,543,158**	**100.00%**	**23.57%**
Enroute Accident Non-Release	229	$0	$0	$3,983,634	$490,112	$0	$34,746,390	$32,979,624	$488,924	$8,396,514	**$81,085,200**		74.81%
Leak Enroute	15	$14,398	$24,833	$21,103	$2,588	$0	$104,348	$0	$62,333	$549,990	**$779,593**		0.72%
Loading/Unloading	67	$6,856	$11,506	$54,622	$155,073	$0	$683,932	$15,879	$52,746	$0	**$980,614**		0.90%
Total Accidents/Incidents	**358**	**$89,065**	**$89,929**	**$5,261,715**	**$795,701**	**$128,884**	**$46,153,589**	**$44,139,434**	**$803,779**	**$10,926,470**	**$108,388,564**		**100.00%**

Table 31. Category 2.2

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	24	$8,087	$61,261	$889,271	$14,090	$9,552	$4,164,855	$2,760,458	$31,833	$879,984	**$8,819,391**	91.61%	12.94%
Enroute Accident Fire	2	$16,000	$952	$90,280	$0	$15,168	$347,071	$221,078	$0	$117,332	**$807,880**	8.39%	1.18%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**26**	**$24,087**	**$62,212**	**$979,551**	**$14,090**	**$24,720**	**$4,511,926**	**$2,981,536**	**$31,833**	**$997,316**	**$9,627,272**	**100.00%**	**14.12%**
Enroute Accident Non-Release	152	$0	$0	$3,894,092	$56,013	$0	$23,060,507	$22,199,702	$201,611	$5,573,232	**$54,985,157**		80.64%
Leak Enroute	19	$9,682	$13,548	$20,636	$30,587	$0	$667,568	$0	$24,684	$696,654	**$1,463,358**		2.15%
Loading/Unloading	126	$17,413	$25,792	$8,631	$12,073	$0	$2,030,211	$0	$12,048	$0	**$2,106,168**		3.09%
Total Accidents/Incidents	**323**	**$51,182**	**$101,553**	**$4,902,909**	**$112,762**	**$24,720**	**$30,270,212**	**$25,181,238**	**$270,176**	**$7,267,202**	**$68,181,954**		**100.00%**

Table 32. Category 2.3

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	2.02	$606	$2,456	$23,880	$200,400	$106,708	$1,147,071	$1,448,598	$46,000	$75,092	**$3,050,811**	100.00%	28.21%
Enroute Accident Fire	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**2.02**	**$606**	**$2,456**	**$23,880**	**$200,400**	**$106,708**	**$1,147,071**	**$1,448,598**	**$46,000**	**$75,092**	**$3,050,811**	**100.00%**	**28.21%**
Enroute Accident Non-Release	10	$0	$0	$74,392	$1,360	$0	$1,534,884	$1,302,326	$130,000	$366,660	**$3,409,621**		31.53%
Leak Enroute	5	$8,252	$267	$594	$4,872	$0	$1,666,667	$0	$179,800	$183,330	**$2,043,782**		18.90%
Loading/Unloading	20	$19,409	$1,287	$589	$95	$0	$2,227,848	$0	$60,750	$0	**$2,309,977**		21.36%
Total Accidents/Incidents	**37.02**	**$28,267**	**$4,009**	**$99,455**	**$206,727**	**$106,708**	**$6,576,470**	**$2,750,924**	**$416,550**	**$625,082**	**$10,814,192**		**100.00%**

Table 33. Category 3.0

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	418	$13,760,506	$1,003,878	$12,020,077	$1,573,326	$752,400	$77,640,566	$52,076,913	$11,720	$15,326,388	**$174,165,774**	60.00%	26.81%
Enroute Accident Fire	50	$1,284,483	$435,772	$2,758,513	$1,895,624	$379,200	$10,215,243	$43,708,773	$17,200	$2,933,300	**$63,628,107**	21.92%	9.79%
Enroute Accident Explosion	22.0205	$574,646	$132,238	$1,398,578	$4,391,629	$667,547	$7,700,034	$35,664,360	$37,188	$1,937,159	**$52,503,380**	18.09%	8.08%
Enroute Accident Total Releases	**490.0205**	**$15,619,635**	**$1,571,888**	**$16,177,168**	**$7,860,579**	**$1,799,147**	**$95,555,843**	**$131,450,046**	**$66,108**	**$20,196,847**	**$290,297,261**	**100.00%**	**44.68%**
Enroute Accident Non-Release	889	$0	$0	$19,956,608	$9,692,676	$0	$136,359,577	$122,173,169	$24,926	$32,596,074	**$320,803,031**		49.37%
Leak Enroute	587	$738,946	$68,901	$102,193	$160,600	$0	$3,491,166	$0	$4,733	$21,522,942	**$26,089,480**		4.02%
Loading/Unloading	4855	$1,505,954	$297,586	$177,541	$331,687	$0	$10,236,600	$734	$958	$0	**$12,551,058**		1.93%
Total Accidents/Incidents	**6821.021**	**$17,864,534**	**$1,938,375**	**$36,413,509**	**$18,045,542**	**$1,799,147**	**$245,643,185**	**$253,623,949**	**$96,725**	**$74,315,863**	**$649,740,830**		**100.00%**

Table 34. Category 4.1, 4.2, 4.3

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	8	$131,557	$24,647	$95,512	$36,020	$4,264	$1,388,285	$991,833	$35,875	$293,328	**$3,001,321**	100.00%	20.73%
Enroute Accident Fire	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**8**	**$131,557**	**$24,647**	**$95,512**	**$36,020**	**$4,264**	**$1,388,285**	**$991,833**	**$35,875**	**$293,328**	**$3,001,321**	**100.00%**	**20.73%**
Enroute Accident Non-Release	25	$0	$0	$202,962	$76,543	$0	$3,504,673	$5,233,645	$112,110	$916,650	**$10,046,582**		69.39%
Leak Enroute	13	$41,587	$1,727	$17,675	$203	$0	$200,000	$0	$8,615	$476,658	**$746,465**		5.16%
Loading/Unloading	92	$27,380	$5,120	$107,315	$11,017	$0	$532,966	$0	$913	$0	**$684,711**		4.73%
Total Accidents/Incidents	**138**	**$200,524**	**$31,494**	**$423,464**	**$123,783**	**$4,264**	**$5,625,923**	**$6,225,478**	**$157,513**	**$1,686,636**	**$14,479,078**		**100.00%**

Table 35. Category 5.1, 5.2

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	27	$126,253	$47,311	$501,078	$22,572	$14,391	$5,018,795	$3,092,075	$23,630	$989,982	**$9,836,088**	92.67%	43.05%
Enroute Accident Fire	2	$24,498	$4,919	$42,336	$5,950	$15,168	$347,071	$221,078	$0	$117,332	**$778,351**	7.33%	3.41%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**29**	**$150,750**	**$52,230**	**$543,414**	**$28,522**	**$29,559**	**$5,365,866**	**$3,313,154**	**$23,630**	**$1,107,314**	**$10,614,439**	**100.00%**	**46.46%**
Enroute Accident Non-Release	32	$0	$0	$407,748	$21,401	$0	$4,042,105	$2,021,052	$28,005	$1,173,312	**$7,693,624**		33.68%
Leak Enroute	50	$48,988	$21,462	$16,895	$7,508	$0	$556,962	$0	$4,480	$1,833,300	**$2,489,595**		10.90%
Loading/Unloading	372	$58,207	$19,662	$2,345	$4,046	$0	$1,962,590	$0	$987	$0	**$2,047,836**		8.96%
Total Accidents/Incidents	**483**	**$257,945**	**$93,355**	**$970,402**	**$61,476**	**$29,559**	**$11,927,524**	**$5,334,206**	**$57,102**	**$4,113,926**	**$22,845,494**		**100.00%**

Table 36. Category 6.1, 6.2

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	14	$256,584	$33,401	$198,963	$11,935	$7,462	$3,256,771	$1,655,067	$38,214	$513,324	**$5,971,722**	67.86%	19.48%
Enroute Accident Fire	1	$277,000	$91,000	$35,000	$25,000	$7,584	$173,536	$110,539	$2,050,000	$58,666	**$2,828,325**	32.14%	9.23%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**15**	**$533,584**	**$124,401**	**$233,963**	**$36,935**	**$15,046**	**$3,430,307**	**$1,765,606**	**$2,088,214**	**$571,990**	**$8,800,047**	**100.00%**	**28.71%**
Enroute Accident Non-Release	35	$0	$0	$371,221	$58,603	$0	$5,409,091	$2,545,455	$95,536	$1,283,310	**$9,763,215**		31.85%
Leak Enroute	125	$257,855	$10,836	$14,476	$72,491	$0	$740,552	$0	$4,152	$4,583,250	**$5,683,612**		18.54%
Loading/Unloading	760	$329,672	$38,749	$26,304	$26,579	$0	$5,984,252	$0	$3,591	$0	**$6,409,147**		20.91%
Total Accidents/Incidents	**935**	**$1,121,111**	**$173,987**	**$645,963**	**$194,608**	**$15,046**	**$15,564,202**	**$4,311,061**	**$2,191,493**	**$6,438,550**	**$30,656,020**		**100.00%**

Table 37. Category 7

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	6	$4,484	$3,589	$39,882	$565	$10,800	$1,041,214	$770,755	$0	$219,996	**$2,091,285**	99.66%	44.90%
Enroute Accident Fire	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Explosion	0.0005	$1,000	$30	$500	$5,000	$15	$0	$0	$500	$170	**$7,215**	0.34%	0.15%
Enroute Accident Total Releases	**6.0005**	**$5,484**	**$3,619**	**$40,382**	**$5,565**	**$10,815**	**$1,041,214**	**$770,755**	**$500**	**$220,166**	**$2,098,500**	**100.00%**	**45.06%**
Enroute Accident Non-Release	6	$0	$0	$27,120	$384	$0	$1,572,414	$579,310	$0	$219,996	**$2,399,224**		51.51%
Leak Enroute	4	$3,843	$378	$14	$0	$0	$0	$0	$4,250	$146,664	**$155,149**		3.33%
Loading/Unloading	4	$947	$3,234	$379	$0	$0	$0	$0	$0	$0	**$4,560**		0.10%
Total Accidents/Incidents	**20.0005**	**$10,274**	**$7,231**	**$67,895**	**$5,949**	**$10,815**	**$2,613,628**	**$1,350,065**	**$4,750**	**$586,826**	**$4,657,433**		**100.00%**

Table 38. Category 8

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	71	$1,115,129	$331,320	$1,773,214	$221,612	$37,843	$14,208,371	$7,955,795	$133,282	$2,603,286	**$28,379,852**	90.86%	18.92%
Enroute Accident Fire	2	$22,494	$27,101	$91,286	$5,007	$15,168	$1,604,214	$221,078	$750,000	$117,332	**$2,853,681**	9.14%	1.90%
Enroute Accident Explosion	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	0.00%	0.00%
Enroute Accident Total Releases	**73**	**$1,137,623**	**$358,421**	**$1,864,500**	**$226,619**	**$53,011**	**$15,812,585**	**$8,176,874**	**$883,282**	**$2,720,618**	**$31,233,533**	**100.00%**	**20.82%**
Enroute Accident Non-Release	184	$0	$0	$3,195,701	$388,420	$0	$29,055,044	$26,946,949	$345,406	$6,746,544	**$66,678,064**		44.45%
Leak Enroute	539	$603,744	$66,804	$88,816	$36,302	$00	$7,365,059	$0	$6,317	$19,762,974	**$27,930,017**		18.62%
Loading/Unloading	4130	$715,717	$257,700	$69,998	$69,6126	$0	$23,043,465	$173	$2,177	$0	**$24,158,842**		16.11%
Total Accidents/Incidents	**4926**	**$2,457,084**	**$682,925**	**$5,219,015**	**$720,953**	**$53,011**	**$75,276,153**	**$35,123,995**	**$1,237,183**	**$29,230,136**	**$150,000,455**		**100.00%**

Table 39. Category 9

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	59	$810,134	$109,670	$1,631,990	$265,441	$31,447	$11,512,465	$6,645,058	$3,475	$2,163,294	**$23,172,974**	97.83%	30.68%
Enroute Accident Fire	1	$3,087	$1,669	$24,651	$1,118	$7,584	$173,536	$110,539	$0	$58,666	**$380,849**	1.61%	0.50%
Enroute Accident Explosion	0.3	$926	$501	$10,918	$436	$9,101	$52,061	$33,162	$0	$26,399	**$133,503**	0.56%	0.18%
Enroute Accident Total Releases	**60.3**	**$814,146**	**$111,839**	**$1,667,560**	**$266,995**	**$48,132**	**$11,738,062**	**$6,788,759**	**$3,475**	**$2,248,359**	**$23,687,327**	**100.00%**	**31.36%**
Enroute Accident Non-Release	119	$0	$0	$2,234,257	$359,500	$0	$19,784,362	$18,511,111	$7,008	$4,363,254	**$45,259,492**		59.91%
Leak Enroute	94	$133,022	$6,415	$47,879	$6,489	$0	$810,782	$0	$1,798	$3,446,604	**$4,452,988**		5.89%
Loading/Unloading	316	$96,814	$23,886	$9,608	$3,483	$0	$2,008,367	$0	$766	$0	**$2,142,924**		2.84%
Total Accidents/Incidents	**589.3**	**$1,043,983**	**$142,140**	**$3,959,303**	**$636,467**	**$48,132**	**$34,341,572**	**$25,299,870**	**$13,046**	**$10,058,217**	**$75,542,731**		**100.00%**

Table 40. All HM Categories

HM Accident/ Incident Type	Likelihood	Cleanup Costs	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury Costs	Fatality Costs	Evacuation Costs	Incident Delay Costs	Total Costs	% of Total Enroute Acc.	% of Tota Inc./Acc.
Enroute Accident Release-Only	678.02	$16,291,175	$1,657,935	$18,263,146	$2,419,671	$995,854	$127,953,640	$83,156,994	$792,771	$24,861,308	$276,392,494	66.48%	23.88%
Enroute Accident Fire	65.2	$1,656,122	$577,375	$3,385,687	$2,418,285	$494,477	$14,439,539	$47,101,908	$3,262,343	$3,825,023	$77,160,758	18.56%	6.67%
Enroute Accident Explosion	24.422	$588,139	$147,456	$1,484,097	$4,908,389	$740,399	$10,250,026	$41,727,631	$213,858	$2,148,612	$62,208,606	14.96%	5.38%
Enroute Accident Total Releases	**767.642**	**$18,535,436**	**$2,382,765**	**$23,132,929**	**$9,746,345**	**$2,230,730**	**$152,643,205**	**$171,986,533**	**$4,268,973**	**$30,834,943**	**$415,761,858**	**100.00%**	**35.93%**
Enroute Accident Non-Release	1716	$0	$0	$34,927,020	$11,186,664	$0	$264,203,046	$239,056,344	$3,717,477	$62,918,856	$616,009,408		53.23%
Leak Enroute	1455	$1,874,988	$238,661	$335,314	$323,387	$0	$15,629,189	$0	$307,163	$53,349,030	$72,057,731		6.23%
Loading/Unloading	10746	$2,781,452	$684,884	$461,679	$624,533	$0	$48,762,404	$16,786	$134,935	$0	$53,466,672		4.62%
Total Accidents/Incidents	**14684.642**	**$23,191,876**	**$3,306,310**	**$58,856,942**	**$21,880,928**	**$2,230,730**	**$481,237,844**	**$411,059,663**	**$8,428,547**	**$147,102,829**	**$1,157,295,670**		**100.00%**

for the portrait year. As shown in the table, the cost for the year was $108,388,564. Injuries and fatalities accounted for approximately 83 percent of the total cost. Carrier damage and incident delay costs together accounted for about 15 percent of the total estimated cost for the year. The cost related to accidents is considerably higher than that for incidents. Both release and non release accidents account for about 98 percent of the estimated costs for the portrait year. Release accidents with explosions or fires total only seven and two respectively but represent about 48 percent of the impacts for all enroute release accidents and about 11 percent of the annual impacts for all Division 2.1 incidents and accidents.

Non release accidents alone account for about 75 percent of the costs. This is primarily because the number of non release accidents is more than three times the number of spill accidents and results in more injuries and fatalities. Although there are no cleanup costs for the product or environmental damage costs, the costs are still considerably more than for the spill accidents.

Impacts from Division 2.1 represent about nine percent of the impacts from all HM incidents and accident impacts in the portrait year.

5.5 HM Category 2.2

Division 2.2, non-flammable gas, was involved in an estimated 24 enroute release accidents and 152 non-release accidents in the portrait year. As Table 31 shows, none of the release accidents resulted in an explosion and only two in fires. Release accidents represent about 14 percent of the impacts; non-release accidents represent more than 80 percent of the total impacts for the portrait year.

5.6 HM Category 2.3

Trucks shipping Division 2.3, poison gas, experienced an estimated two enroute accidents and 10 non-release accidents in the portrait year. Because of the nature of the hazard, catastrophic impacts are possible. One high consequence accident with an estimated probability of once every 50 years was added to the release accidents. The total enroute release impact for the portrait year, as shown in Table 32, is estimated at about 28 percent of the total impact cost.

5.7 HM Category 3

Class 3, flammable and combustible liquids, accident and incident impacts are the most important single category of the 12 categories examined in this report. Impacts from Class 3 accidents and incidents account for about 56 percent of all of the impacts for HM in the portrait year. Class 3 materials travel predominantly in bulk carriers. For the total number of enroute accidents estimated for the year, an estimated 88 percent of listed accidents involved cargo tanks. This does not include the approximately four percent of accidents for which this information is unavailable.

As Table 33 shows, Class 3 accidents include an estimated 490 release accidents and about 889 non-release accidents in the portrait year. Total accidents and incidents totaled more than 6,620. The cost related to accidents is considerably higher than that for incidents. Both release and non release accidents account for about 94 percent of the estimated costs for the portrait year. Enroute release accidents account for about 45 percent of all Class 3 impacts. Impacts from fires and explosions are important. Impacts from enroute release fire and explosion accidents account for an estimated 40 percent of the cost of all Class 3 release accidents, although they only represent 15 percent of these accidents. As shown in table 33, the cost for the portrait year for all Class 3 impacts was about $650 million. The costs of injuries and fatalities accounted for about 77 percent of the total.

5.8 HM Category 4.1, 4.2, 4.3

Divisions 4.1, 4.2, 4.3—flammable solids, spontaneously combustible, and dangerous when wet materials—accounted for only an estimated 33 enroute accidents in portrait year. Eight were release accidents. These eight accidents represented about 21 percent of the total impacts for the year. As Table 34 shows, there were no enroute release accidents associated with either an explosion or a fire. Non-release accidents represented about 70 percent of the impact value.

5.9 HM Category 5.1, 5.2

Divisions 5.1, 5.2, oxidizers and organic peroxides, experienced an estimated 56 accidents in the portrait year. Table 35 shows that 27 of these were release accidents. Of these 27 accidents, two resulted in fires. As shown in Table 35, release accident accounted for about 46 percent of the total impacts, compared to only about 34 percent for the non-release accidents. Total impacts for these divisions amounted to about $23 million in the portrait year

5.10 HM Category 6.1, 6.2

Divisions 6.1, 6.2, toxic materials and infectious substances, had a total of 50 accidents in the portrait year of which only 15 were release accidents. One of the release accidents resulted in a fire. In addition to the enroute accidents, there were 125 leak enroute incidents and 760 loading and unloading incidents. As Table 36 shows, although almost 61 percent of the impacts were associated with the accidents, more than 39 percent were associated with incidents. Impacts for Divisions 6.1, 6.2 in the portrait year totaled about $30,500,000.

5.11 HM Category 7

Class 7, radioactive materials, experienced only about 12 enroute accidents in the portrait year. Half of these resulted in releases. One high consequence accident was added to the release accidents. However, it was judged to occur once in a couple of thousand years. As Table 37 shows, the impact from release accidents totals about 45 percent of the total impacts. Enroute accidents represent almost 97 percent of all the impacts. Impact costs for the portrait year totaled about $4.6 million.

5.12 HM Category 8

Class 8, corrosive materials, represents the HM category with the second greatest proportion of the impacts after Class 3. As shown in Table 38, the cost of the Class 8 category for the portrait year was about $150 million. This constitutes about 13 percent of the total impact cost for all of the HM categories. There were an estimated 257 release accidents in the portrait year of which 73 were release accidents and two were associated with a fire. As Table 38 shows, enroute accidents accounted for more than 65 percent of the total impacts. Enroute leaks and loading/unloading incidents alone accounted for about 35 percent of the total impacts. Costs for avoiding injuries and fatalities accounted for approximately 74 percent of the total costs with injury costs alone representing an estimated half of all impact costs.

5.13 HM Category 9

Class 9, miscellaneous dangerous goods, represents about seven percent of the total HM impacts. For the portrait year, Table 39 shows an estimated 179 accidents of which about 60 were release accidents. One accident was associated with a fire and one explosion with a likelihood of 0.3 was estimated for the year. More than 91 percent of the impacts for the class are associated with enroute accidents. Non-release accidents represented about 60 percent of the total Class 9 impacts and release accidents about 31 percent of the total. Total Class 9 impacts for the portrait year amounted to about $76 million.

5.14 All HM Categories

Table 40 summarizes the impacts for all HM categories. The table follows the same format as Tables 28 through 39 and therefore, facilitates comparisons among the 12 categories.

The HM category summaries show clearly that more detail can be developed for some categories of HM because those classes or divisions have more accident exposure. For example, fire and explosion statistics were developed for Division 2.1, Classes 3 and 9, but it was not possible to separate out the accident statistics for many other categories. For these other categories, the impact costs for fire and explosion accidents are included in the class or division impact costs. If the likelihood of occurrence is greater than about 0.2 per year, they have been included. If all accidents were captured by the databases, this number would be about 0.1 since about 10 years of accident history were analyzed. However, because of under reporting, this number should be significantly higher. For fire and explosion to be segmented into separate categories, one should have at least five actual records of fires or explosions reported during the almost 10-year evaluation period. If there were fewer accidents, the only cases where fire and explosion were separated out was for groups of HM divisions in which the severity was sufficient to generate many detailed accident reports over the last 50 years.

The 1.1, 1.2, and 1.3 HM category fell into this category. In all other cases, the fire and explosion impacts were not broken out. Thus, when comparing the 12 categories of HM analyzed, comparisons of the average impacts among HM categories might be the only valid comparison that can be made. Where maximum impacts are presented, they are based on the historical record and are made only where data support the results. Thus, categories for which maximum impacts are not presented could have accidents that are of similar severity to those that are captured in the database. The absence of such maximum impact cases does not distract from the results, as long as the limitation that is imbedded in analyses based on historical information is recognized.

6.0 Non-Hazardous Materials Accident Totals and Impacts

6.1 Introduction

In estimating the annual non-HM truck transport risk, the study attempted to establish consistency within the HM risk assessment methodology to allow for valid comparisons. Annual non-HM accident counts were derived from the MCMIS data and subsequently modified to reflect under reporting using the same factors that were applied to HM non-release accident counts. The economic consequences of each non-HM accident were derived by using the same impact considerations as for HM. However, cleanup costs, environmental damage and evacuation costs were omitted from consideration since they occur to a much lesser degree in non-HM accidents. For the remaining financial considerations (e.g., delay costs, injuries, etc.), the study derived impact ratios of non-HM accidents to HM accidents from the results of research performed by Harwood and Russell (Harwood et al, 1989). The study then derived the overall annual non-HM risk by taking the aforementioned estimates and applying exposure measures reported in the CFS.

6.2 Accident and Incident Totals

This section summarizes an analysis of non-hazardous material truck shipment accidents for the annual portrait year and the tabulation of impacts and associated costs. To determine the impacts from non-HM accidents for the annual portrait, 1996 was used as a representative year. One year of data was judged to be sufficient due to the high frequency of non-HM accidents in one year.

Table 41 shows the estimated non-HM accidents for 1996. These numbers were derived from the MCMIS database. The number of truck accidents was increased using factors suggested in a GAO report for accidents without fatalities and those with fatalities. The 92,127 truck accidents were increased to 126,880 to compensate for estimated underreporting of 38 percent for accidents without fatalities (122,732) and 30 percent for accidents with fatalities (4,148) (GAO June 1999). Numbers of fatalities and injuries were increased using a similar approach. The 3,853 fatalities in MCMIS were increased by 30 percent to 5,009. The 79,766 injuries in MCMIS were increased to compensate for underreporting in two steps. First the 75,732 injuries not associated with a fatality were increased to 104,510 injuries, and second the 4,053 injuries associated with fatal accidents were increased to 5,269 injuries. This resulted in a total of 109,779 injuries.

Table 41. Estimated Non-HM Accidents in 1996

1996 Estimate of Non-HM Truck Accidents, Deaths, Injuries		
Accident Numbers	Deaths	Injuries
126,880	5,009	109,779

6.3 Non-HM Accident Impacts

This section provides an estimate of the impacts of non-HM truck transportation accidents. Impact estimates for non-HM accident product loss, carrier and property damage have been estimated relative to impacts for HM accidents. During late 1999 and early 2000, information needed for a more detailed analysis was requested from major trucking companies. Unfortunately, the companies were unable or unwilling to provide accident impact data.

Table 42 summarizes the impacts in terms of dollars for the estimated non-HM accidents in 1996. As shown in the table, the estimated cost for the annual portrait year was about $43 billion. The costs for avoiding injuries and fatalities accounted for approximately 83 percent of the total cost. Carrier and property damage together accounted for about nine percent of the total. Incident delay and product loss each contributed about four percent of the total for the year. Despite an average product loss that is higher for non-HM accidents, incident delay costs are considerably lower and environmental damage and decontamination costs are absent. Thus, all but $7 billion of the impact cost of about $43 billion results from injuries and fatalities.

The impact of a non-HM accident averages about $340,000 per accident.

Table 42. Estimated Annual Non-HM Accident Impacts

Annual Number	Product Loss	Carrier/Property Damage	Injury	Fatal	Incident Delay
126,880	$12,416 per[1] (estimated) $1,575,342,080	$29,125 per[2] (estimated) $3,695,434,558	$200,000 per[3] 109,779= $21,955,800,000	$2,800,000 per[4] 5,009 fatalities = $14,025,200,000	$15/per person hour[5] = 1,860,948,960
				Total	**$43,112,725,598**

1 HMIS database, four times average cost for Class 3 accident in 1990 to 1999
2 HMIS database, 68 percent of average cost per accident for 1990 to 1999 (Harwood et al, 1989)
3 Value placed on avoiding injury
4 Value placed on avoiding a fatality
5 Includes passenger vehicles and trucks

6.4 Non-HM Accident Risk and Cost per Mile

Based on the 1997 Commodity Flow Survey, non-HM materials traveled an estimated 174 billion miles in 1997. With an estimated 126,880 accidents in 1996, this results in an accident risk of 7.3E-07 per mile traveled.

Based on the total impact cost of $43 billion, the estimated average accident cost per mile for non-HM is 25 cents per mile traveled.

7.0 Comparative Impacts and Risk of HM and Non-HM Shipments

7.1 Introduction

This section examines the comparative impacts of shipping HM and non-HM cargoes on the nation's highways. Due to some inherent data uncertainties with respect to material flows, these comparisons are preliminary. Future research will be needed to present more definitive risk comparisons. Section 9.0 presents data needs and opportunities.

7.2 Comparative Costs

Although non-HM shipments have a far greater cumulative impact than HM shipments, approximately $43.1 billion as compared to $1.1 billion in the portrait year, the cost per individual accident differs considerably.

Despite an average product loss that is higher for non-HM accidents, incident delay costs for non-HM accidents are considerably lower and environmental damage and decontamination costs are usually limited. For example in the portrait year,

- all release and non-release enroute accidents for all HM categories have an average value of about $414,000 per accident;
- non-HM accidents averaged about $340,000 per accident; however
- the average per HM release accident costs about $536,000

There is a large difference when non-HM accident impacts are compared with HM release accident impacts.

An even greater contrast occurs when the average impact costs of a release accident with a fire or one with an explosion are compared to the average cost of a non-HM accident. In the portrait year, the average cost of

- an HM release accident with a fire was about $1,152,000. This average cost is almost three times as much as for the non-HM accident.
- an HM release accident with an explosion is about $2,100,000 or more than five times the average cost of a non-HM accident.

7.3 Comparative Risk and Cost per Mile

The non-HM accident rate of 0.73 per million vehicle miles is more than double the average HM accident rate of 0.32 per million vehicle miles. These accident rates are shown in Table 43. The table also compares accident rates for each of the 12 HM categories with the accident rate for non-HM. The table shows that for all HM classes, the accident rate is lower than for non-HM. However differences vary from about four percent higher for Divisions 1.4, 1.5, 1.6 to almost 80 percent higher for Class 8. Table 43 also indicates that the average accident rate is about 56 percent lower for all HM classes when compared with non-HM shipments.

Table 43. HM and Non-HM Accident Rate per Mile

HM Class/Division	Hazmat Miles	Total Hazmat Accidents	Hazmat Accident Rate Accident/Mile	% Decrease Relative to Non-Hazmat Accident Rate (7.27652E-07)
1.1, 1.2, 1.3	23,100,000.00	14.2	6.15E-07	-15.4%
1.4, 1.5, 1.6	45,800,000.00	32.101	7.01E-07	-3.7%
2.1	805,000,000.00	276	3.43E-07	-52.9%
2.2	1,368,000,000.00	178	1.30E-07	-82.1%
2.3	50,300,000.00	12.02	2.39E-07	-67.2%
3	2,778,000,000.00	1,379.02	4.96E-07	-31.8%
4.1, 4.2, 4.3	48,100,000.00	33	6.86E-07	-5.8%
5.1, 5.2	201,000,000.00	61	3.04E-07	-58.2%
6.1, 6.2	218,000,000.00	50	2.30E-07	-68.5%
7	30,400,000.00	12.001	3.95E-07	-45.8%
8	1,945,000,000.00	257	1.32E-07	-81.8%
9	250,000,000.00	179.3	7.17E-07	-1.5%
All Classes	7,763,000,000.00	2,483.64	3.20E-07	-56.0%

The biggest uncertainty associated with the comparison of accident rates is the reliability of the mileage estimate derived from the Commodity Flow Study. The Commodity Flow Survey provides ton-miles by HM class and for non-HM shipments. To convert the ton-miles to mileage, ton-miles must be divided by the average weight of cargo that trucks carry. The Census Bureau was able to supply the average shipment weight for each HM class as well as for non-HM. However, trucks often carry more than one shipment. Consequently, the average number of shipments per truck must be used to multiply the average shipment weight to obtain an average weight per truckload. This weight converted into tons was divided into the ton-miles to estimate mileage. The uncertainty of the mileage estimates applied here rests in determining an accurate average number of shipments per truckload.

The entire analysis is based on the assumption that two shipments constitute a single truckload. The selection of two as the average number of shipments associated with a truckload is based on expert knowledge and assumptions about shipping patterns of HM carriers. Varying HM shipping considerations make assumptions difficult. For example, for bulk shipments, i.e. gasoline, the cargo tank may transport the gasoline to two separate service stations and then return, still placarded, but empty. That is defined as two shipments but the return placarded empty trip would still be considered as part of HM mileage. On the other hand, a different scenario might be occurring for corrosives. The truckload leaving the shipper might be placarded as a corrosive shipment on its outgoing leg and the placards might be removed and a non-HM cargo transported to some other facility after delivering the corrosive shipment to its destination. In this case, the factor of two assumes that the load of corrosive containers would, on average, be delivered to two receivers. The factor of two could be too low. There is nothing to prevent bulk carriers from dropping gasoline off at three service stations; it is also reasonable to assume that the corrosive truckload might drop off product at many locations.

Using the factor of two causes the total HM mileage to be about five percent of the total truck mileage during a year. There are many checks on the total truck mileage. The best is the collection of diesel road taxes. It's reasonable to assume that a diesel truck gets about six miles per gallon. In addition, several past surveys have estimated that the HM shipments constitute about five percent of the total truck miles traveled. To make the accident rate the same as the non-HM accident rate, the total HM truck mileage would have to be cut in half to less than 2.5% of the total mileage. No survey has estimated the HM truck mileage to be that small a fraction of the total truck mileage. Such a reduction would also require that the assumption be made that there is only one shipment per truck. This is known to be incorrect.

Perhaps the difference in accident rate per mile results from underreporting. If twice as many HM accidents went unreported as non-HM accidents, then the accident rates would be the same. However, the underreporting would be expected to be greater for non-HM accidents. Thus, even after considering the uncertainties, the lower accident rate shown for HM shipments appears to be significant.

The differences in the accident rates among hazard classes/divisions are more uncertain. First of all, some hazard classes/divisions might have a larger number of shipments on a truck when it leaves the shipping dock. Whereas the 30 percent lower rate might be reasonable for Class 3 shipments, if there were four shipments per truck for corrosives instead of two, then the accident rate for corrosives would be 40 percent less than the non-HM accident rate. This can be compared with the 80% lower rate calculated by using the two shipment average. A similar factor might be reasonable to use for Division 2.2 truck transport. If the truck is delivering liquefied gases, there are probably many cases where the facility, i.e., a hospital receiving liquefied oxygen, would not receive the entire content of the cargo tank. The cargo might be split among several facilities. Similarly, a truck delivering standard portable industrial gas cylinders might drop one or two cylinders at each of 10 to 20 facilities. Low numbers are easier to explain away than numbers approaching the non-HM accident rate. Since it is difficult to envision a scenario where the number of shipments per truck is less than two, particularly for a specialized vehicle such as a bulk cargo tank, the high accident rate for Class 9 materials compared to other HM classes/divisions might be significant. Before such a conclusion can be made, additional data is needed.

As shown in Table 44, the non-HM accident cost per mile is about 25 cents. The average HM accident cost per mile is about 13 cents. Thus, the non-HM cost per mile is nearly twice that of the average HM accident cost per mile. The slight change in ratio by moving from accident rates to cost rates is due to the fact that HM accidents have only a slightly higher average cost associated with them. This is due to the fact that accident-induced injuries and fatalities associated with both HM and non-HM accidents drive the majority of the economic impacts.

Table 44. HM Accident and Non-HM Accident Cost per Mile

HM Class/Division	Hazmat Miles	Hazmat Road Costs	Hazmat Costs per Mile	% Difference Relative to Non-Hazmat Cost per Mile ($0.25)
1.1, 1.2, 1.3	23,100,000	$9,730,000	$0.42	70.6%
1.4, 1.5, 1.6	45,800,000	$12,000,000	$0.26	5.7%
2.1	805,000,000	$107,000,000	$0.13	-46.4%
2.2	1,368,000,000	$64,600,000	$0.05	-80.9%
2.3	50,300,000	$6,460,000	$0.13	-48.1%
3	2,778,000,000	$611,000,000	$0.22	-11.0%
4.1, 4.2, 4.3	48,100,000	$13,000,000	$0.27	9.7%
5.1, 5.2	201,000,000	$18,300,000	$0.09	-63.1%
6.1, 6.2	218,000,000	$18,600,000	$0.09	-65.5%
7	30,400,000	$4,500,000	$0.15	-40.2%
8	1,945,000,000	$97,900,000	$0.05	-79.6%
9	250,000,000	$76,500,000	$0.31	23.7%
All Classes	7,763,000,000	$1,039,000,000	$0.13	-45.8%

7.4 Discussion

Comparisons between hazardous and non-hazardous transport must be made by utilizing multiple databases prepared for different purposes by several organizations. For example, the carrier files the HMIS accident/incident report and a police agency completes an accident report that is assembled by a state and submitted to MCMIS. The Commodity Flow Survey was conducted by the Census Department whose focus is primarily economic. In the first phase of this study, an investigation was conducted to determine how many unique accidents were reported in all databases. The results were key for the comparison of HM and non-HM impacts. In most situations, the accident was reported by two sources but seldom by all. These differences make it challenging to compare non-hazardous and hazardous transport risk.

Though it is difficult to compare hazardous and non-hazardous transport risk, the differences appear to be significant enough to conclude that the shear magnitude of non-hazardous transport accidents dominates highway transport risk. Furthermore, although data uncertainties are evident, the difference in accident rates for non-hazardous and HM truck shipments appear to be meaningful. Perhaps the specific hazardous material trucking regulations and the additional care provided by carriers and shippers are effectively reducing the accident rate for hazardous material shipments. This may indicate that these improvements in safety could possibly be applied to reduce non-HM shipment accident rates.

While an effort was made to collect shipment and accident information for various categories of HM over a ten-year-period, uncertainties remain. The approach taken in this analysis was to base the results on actual data as opposed to theoretical modeling. For HM categories with only a few accidents in a 10-year period, large uncertainties develop. Furthermore, it is easier to model bulk material transport as opposed to shipments containing many packages. This can be seen in the comparison of Class 3 and Class 8. Together they make up over 75 percent of the overall HM truck shipment risk. About 90 percent of the Class 3 shipments are bulk but only 50 percent of the Class 8 shipments are bulk. When a Class 8 shipment gets involved in an accident, many of the releases are from one or two packages. Although this accident enters into the statistics of estimated accident rates, the actual cost of these accidents is relatively small. This is seen in the low cost per mile rates for Class 8 as compared to Class 3. Some of the other categories with low rates are also probably influenced by non-bulk shipment.

Most analyses show that hazardous material shipments make up between four and eight percent of all shipments. Consequently, the cost of non-HM accidents dominates that of HM accidents. As shown in other sections of the report, the average cost of an accident is higher for HM, but these higher costs are not nearly large enough to overcome the large disparity in shipment volume between HM and non-HM shipments by truck. This dominance is illustrated by an assumption embedded in the analysis. In the HMIS database, all non-HM related injuries and fatalities are excluded. Therefore, the non-HM related fatalities and injuries were added back into the analysis. This was done by calculating the injury and fatality rate per accident from MCMIS and then adding this rate to the injury and fatality rate for HM, as reported in the HMIS database. The importance of this assumption is realized only after the total cost of injuries and fatalities for non-HM accidents have been obtained. These two costs dominate the impacts. As shown in the analysis, unless the HM costs for other impact categories are much higher, these two impact costs will dominate the HM risk as well.

8.0 SafeStat Applications

The economic impact of incidents and accidents associated with the truck transport of HM in the United States is substantial. The magnitude of this impact underscores the importance of effectively managing HM transportation risk. One mechanism for improving safety performance in HM transportation is making more effective use of existing programs, such as the FMCSA's Safety Status (SafeStat) Measurement System compliance initiative.

The purpose of this chapter is to explore

- how the findings of this study correlate with assumptions about HM carriers contained in the current SafeStat algorithm; and,
- if appropriate, suggest enhancements to the SafeStat algorithm that might improve its effectiveness in identifying high risk HM carriers.

This chapter is intended to serve as a conceptual discussion rather than a prescription for change.

8.1 Introduction to SafeStat

The SafeStat Program was conceived under a research project at the U.S. Department of Transportation, Volpe National Transportation System Center to monitor motor carrier safety fitness. SafeStat is designed to incorporate current on-road safety performance, enforcement history, and on-site compliance review information in an automated, data-driven analysis system for measuring the relative safety fitness of motor carriers. The objective of this initiative is to enable the Federal Motor Carrier Safety Administration (FMCSA) to target inspection resources more effectively by improving identification of those carriers with high risk profiles.

SafeStat ranks the relative performance of motor carriers in four areas: (1) accident history, (2) driver performance, (3) vehicle safety, and (4) safety management. While SafeStat algorithms do contain entries related to hazardous material transport, the impact of the HM entries on the final rankings is unclear. This makes it difficult for regulators to determine if the SafeStat algorithm is targeting sufficient resources at HM carriers, specifically bulk carriers that have been shown in previous analyses to make up about 75 percent of the HM Risk. This study will help determine if the ratio of HM to non-HM carriers being placed in the various ranking categories is commensurate with the relative risk.

8.2 Current Role of HM in the SafeStat Algorithm

As mentioned above, SafeStat evaluates carrier performance across four Safety Evaluation Areas (SEAs): Accident, Driver, Vehicle and Safety Management. Within each SEA, the performance of an individual carrier is compared to its peers. A carrier SEA score in each category is obtained by dividing the carriers into groups with similar experiences (i.e. carriers having a similar number of accidents). Then the rating compares the performance of all carriers in the group, ranking them in ascending order and assigning each a corresponding percentile ranking from 0 to 100. For example, the carrier in the group with the worst performance would be assigned a score of 100.

Carriers with a SEA score above 75 in at least one of the four safety evaluation areas are placed in an A through G category, based on its score in each of the four areas. Not all the evaluation areas are weighted equally in calculating a carrier's score. A carrier's Accident SEA score is doubled and the carrier's Driver SEA score is multiplied by 1.5 when the total score is calculated. The other two categories have a weighting of one.

To be assigned to:

- A Category, a carrier must have a weighted score in excess of 350. (Includes all 4 SEAs or 3 SEAs that result in a weighted score > 350)
- B Category, its score must be less than 350 but greater than 225. (Includes 3 SEAs that result in a weighted score of < 350 or 2 SEAs that result in a weighted score > 225).
- C Category, its score must be less than 225 and greater than 150. (2 SEAs that result in a weighted score < 225)

The remainder of the scored carriers have a score above 75 in only one area. If its score is above 75 in the accident, driver, vehicle or safety management areas, the carrier is assigned to the D, E, F or G Category respectively.

Carriers in the A and B Category receive an on site compliance review by FMCSA inspectors. Carriers assigned to a lower category are candidates for a compliance review as resources allow. Occasionally, D Category carriers, those that have an accident and score from 75 to 100 points, are reviewed by FMCSA inspectors.

The information used in the SEA calculation is obtained from accident data, compliance reviews, enforcement actions and roadside inspections. The accident data are time weighted so that poor performance during the last six-month period is more important than poor performance earlier. For the other three safety evaluation areas, a carrier's score is not time weighted.

HM is already considered in the SEA calculations to a limited extent. In the Accident SEA, if an accident results in an HM release, then points are added to the severity index component of the scoring algorithm. Similarly, the Safety Management SEA (SMSEA) contains an HM review indicator (HMRI) that is based on the number and severity of hazardous material-related acute/critical violations cited at a carrier's most recent compliance review.

8.3 SafeStat HM Analysis

To understand these relationships and their implications, an analysis was conducted to: (1) evaluate the current SafeStat algorithm in terms of the percentage of HM carriers that have been scored, (2) examine these carriers and determine if they adequately reflect HM transportation risk as demonstrated in this comparative risk assessment study and, if appropriate, (3) assess how the algorithm could be adjusted to target high risk HM carriers more effectively.

In the discussion below, the contribution of HM accidents, HM related enforcement actions, and HM on-site compliance reviews to the scoring and ranking of HM carriers is systematically determined. Sensitivity analyses are subsequently performed on the scoring and ranking algorithms to determine how changes in the algorithms would affect the scores assigned to HM carriers and their respective category ranking.

8.3.1 The Contribution of HM to SafeStat

To determine the impact of HM within SafeStat, the contribution of HM was first removed from the algorithm. To accomplish this, new Safety Evaluation Area (SEA) values were calculated without HM. The HM contribution to SafeStat most directly affects ACSEA and SMSEA.

The HM contribution to SMSEA is the easiest to remove. Rather than calculate SMSEA based on the maximum of the Enforcement History Indicator (EHI), Hazardous Material Review Indicator (HMRI), and Safety Management Review Indicator (SMRI), the SMSEA value without HM is based on the maximum of EHI and SMRI. In the recent SafeStat run of 09/23/2000, the net effect of adding HMRI to the calculation of SMSEA resulted in 26 additional carriers requiring a compliance review because their scores fell in the A or B Category as a result of the poor HM performance. The analysis also showed that 42 carriers went from unscored to scored because of this factor. When considering that there are about 1,850 known HM carriers included in the 9/23/00 SafeStat run, the effect of HMRI is limited because it only affects the value of SMSEA when it is greater than EHI, the enforcement indicator, plus SMRI, the non-HM compliance review score. It is further limited because the SMSEA has no effect on the carrier's score if it is less than 75.

The contribution of HM to the ACSEA is similar but the logic of when to use the component with the HM factor is more involved. The time weighted number of accidents, Total Consequence/Time Weighted Accidents (TCTWA), is determined by a number of factors. The TCTWA is calculated by first determining the severity of a crash. The severity score is the sum of two different components of the accident. A score of 1 is assigned to the accident if the truck involved in the accident was towed but no injuries or fatalities occurred. A score of 2 is assigned if an injury or fatality occurred. If there was a hazardous material release, a score of 1 is then added to this severity score. The severity score is then "time weighted." The TCTWA is "increased" by multiplying the severity score by

- 3 if the release occurred in the last six months,
- 2 if the release occurred in the period of time between 7 and 18 months, and
- 1 for accidents that resulted in an HM release 19 to 30 months prior to the SafeStat run date.

Note, accidents that occurred more than 30 months before the review date are not considered.

To remove HM releases from TCTWA, the MCMIS accident file was searched to identify releases that occurred in each of the three time periods. These were weighted and then added together to produce the effect on TCTWA. It was assumed that the HM releases occurred when both the accident fields, HM Placard and HM Cargo were "Y." The next step was to subtract the HM contribution to TCTWA from every carrier that had an HM release during the 30-month period. The results were placed in the "TCTWANEW" field. This number was then divided by the number of power units operated by the carrier to obtain New Accident Involvement Measure, "AIMNEW." Since the number of accidents is not changed by the occurrence of an HM spill, the carrier's accident group is not changed. Thus, the next step is to recalculate the New Accident Involvement Indicator "AIINNEW" for each carrier based on its accident group.

ACSEA is calculated from "AIINEW" and "RAI." Although "RAI" is called the reportable accident indicator, it might more accurately be called the recent accident indicator. It contains no

HM component and is calculated based on the number of reported accidents the carrier has experienced since the last compliance review. "RAI" is the percentile ranking of "RAR," which is calculated by dividing the number of accidents since the review by the annual mileage driven by the carrier in millions. "ACSEANEW" is

- set equal to "AIINEW" if there has been no compliance review in the last 12 months or
- set to be the higher of "RAI" and "AIINEW" if a compliance review has occurred in the last 12 months, but there has been no reported accident since the last compliance review.

When this methodology was applied to the 9/23/00 SafeStat run, only 24 ACSEA scores for carriers changed and of those, only 7 required a compliance review because they fell in an A or B Category. Thus, only 7 carriers, about one percent, required a compliance review because of their poor HM performance.

When HM contributions to SafeStat were removed from both the SMSEA and ACSEA values, only 29 had their scores elevated into the A, B, C, or D scoring categories.

8.3.2 Expected Influence of HM in the SafeStat Scoring from the Comparative Risk Analysis

Previous sections of this report have compared the risk of hazardous and non-hazardous material truck shipments. The analysis results provided insights into how HM could be weighted in the SafeStat algorithm.

The estimated annual accident impact for non-HM shipments is $43.1 billion as compared to $1.1 billion for HM shipments. Thus, HM comprises approximately 2.5% of the total impacts. It logically follows that HM should represent about 2.5% of the Accident SEA in SafeStat. However, a higher inspection fraction might be justifiable. As described in Chapter 7, HM accidents individually represent greater costs than non-HM accidents. Comparing the average $536,000 cost of an HM accident (including only release accidents) with the average $400,000 cost of a non-HM accident, shows that the HM accident has an impact that averages about 34% greater than that for the non-HM accident. The high consequence HM accident poses an increased transportation risk that should also be considered. The average cost of an HM accident with an explosion is about $2.1million. This is more than five times the cost of the average non-HM accident.

8.4 Changes in SafeStat Applications

There are several approaches to making HM more representative in SafeStat. They include the following:

- Selecting appropriate methodologies for identifying HM carriers.
- Segmenting bulk and non-bulk HM carriers.
- Evaluating the performance of non-bulk carriers that move both HM and non-HM
- Deciding on the vintage of "historical" data to use in the algorithms.
- Determining inputs into SEA category scoring algorithms.
- Weighting of respective SEA category scores.
- Standardizing criteria for counting a SEA score towards the overall SafeStat score.

Each of the approaches is discussed in the following sections.

8.4.1 Selecting Appropriate Methodologies for Identifying HM Carriers

If HM carriers are to be ranked, it is important to consider how they can be identified. This might seem like a straightforward process. However, there are many possible sources and the question arises as to which one is the best source. One is the MCMIS Census file. In this file, carriers register their intent to carry various classes of HM. In SafeStat there are two fields-one called "H-B" and the other "HM Review." The first field uses a "H" to designate Interstate HM carriers, an "I" to designate Intrastate HM carriers and a "B" to identify intercity commercial bus operators. The "HM Review" field is filled out if a carrier has had a recent HM compliance review. The last source, the MCMIS accident file has several fields that could be used. Since states sometimes report the release of diesel fuel from cargo tanks as an HM release, the HM Placard field was ultimately used to identify carriers that have had HM accidents.

Of the methods for identifying HM carriers, the data in the Census file did not match well with the others and was eliminated from further consideration. The two SafeStat fields tended to identify the same carriers with some exceptions. When these records were checked against the MCMIS Accident file, more HM carriers were identified. Thus, this method was used to identify the HM carriers for this analysis.

There was one other source, the RSPA registration file. Previous attempts to match MCMIS and RSPA records were unsuccessful, resulting in many unmatched carriers. As the quality of the MCMIS data has improved significantly since this earlier attempt, the comparison might be reattempted in the future. For now, the HM carriers identified from the MCMIS Accident file have been used.

8.4.2 Segmenting Bulk and non-Bulk HM Carriers

The sources for identifying bulk and non-bulk carriers are much more limited. One source was the RSPA HMIS database. The second was the MCMIS Accident file. While a great deal of use of the RSPA database has been made in the previous chapters of this report, since the MCMIS accident file contains both spill and non-spill accidents, the MCMIS Accident file was selected as the most comprehensive source for identifying bulk and non-bulk carriers that have had accidents. In making this distinction, the study recognized that many carriers transport bulk HM, non-bulk HM and general freight (i.e. non-HM shipments). Thus, a list of bulk HM carriers could contain some of the same carriers listed on a non-HM carrier list.

8.4.3 Evaluating the HM Performance of Carriers that Move both HM and non-HM

One of the problems faced when attempting to identify whether sufficient resources are being directed at HM carriers is that a carrier's poor HM performance can be easily masked by a carrier's good performance in the non-HM area. This would be particularly true if the HM component of the carrier's business represented a very small fraction of its overall business. To determine whether or not this was the case, a query was run to determine the ratio of HM to non–HM accidents for 3,695 bulk carriers. The 3,695 carriers were identified by searching the MCMIS accident file for carriers that had bulk accidents over the last nine years. For 75 percent of the carriers, it was found that the ratio of HM accidents to total accidents was greater than 50%. This suggests that, for most carriers, if they have a poor HM accident record, it will be very difficult to hide that record based on their non-HM accident record.

8.4.4 Deciding on the Vintage of "Historical" Data to Use in the Algorithms

The current SafeStat algorithm uses time weighted data collected over the last 30 months for the accident, driver and vehicle SEA determinations. For the Safety Management SEA, the HM and SM compliance measures are based on reviews over the last 12 months. For the enforcement indicator, the third measure used to calculate the safety management score, enforcement actions that have occurred over the last six years are considered in a time weighted manner. These time periods and time weighting factors have been selected for evaluating all carriers and no evidence has been collected to justify using different time periods and time weighting factors for HM shipments.

8.4.5 Determining Inputs into the SEA Category Scoring Algorithms

Currently, the major HM inputs into the scoring are in the Accident and Safety Management SEAs. The extent to which a carrier complies with the HM regulations enters into the Safety Management SEA. The time weighted number of HM spill accidents enters into the Accident SEA. While the weighting on the HM compliance scores could be increased, there seems to be no justification for making such a change.

HM bulk carriers were selected to investigate the effect of removing HM weightings or modifying the SafeStat algorithm because bulk carriers account for about 75% of all HM risk. Currently, all carriers with A or B SafeStat rankings receive a compliance review. Table 45 shows that if there is no HM contribution to the SafeStat scoring, then eight bulk HM carriers drop from the list of carriers that receive a compliance review. The implication is that only eight of the 4,457 (432 A's + 4,025 B's) carriers that are subjected to a compliance review are being reviewed because of poor HM performance. This is less than 0.2% of the carriers. Furthermore, only 1.5% of the carriers subjected to a compliance review are bulk HM carriers. In the previous chapters, it was found that approximately 2.5 % of the accident risk, expressed in dollars, is associated with HM transport. It follows that if 4,457 carriers are being subjected to a compliance review, about 110 carriers should be HM carriers. In the current SafeStat run, only eight carriers were identified because of their HM performance. To inspect 2.5% of the carriers because of poor HM performance, it follows that the number of HM carriers being inspected should be about 4%, since several will be identified for poor performance in areas other than their HM.

One approach to increasing the number of eligible bulk HM carriers is to subject all bulk HM carriers with a D score to a compliance review automatically. SEA category D are those deficient in the accident area. Accidents have been shown to be a reliable indicator for identifying unsafe carriers. The C category carriers can not have the accident SEA as one of its two SEAs since once the 75 point minimal accident score is doubled, there are insufficient points available to include the other required SEA. However, as can be seen from Table 45, although 139 carriers would now be subjected to a compliance review, 126 of these carriers are being inspected because of poor accident rate performance in the non-HM area. This strategy does not accomplish the objective of identifying 110 more bulk HM carriers to include in the compliance reviews.

Table 45. Effect of Removing All HM Weightings from the SafeStat Scoring Algorithm

Scores in 09232000 Run		Base Case				Remove all Bulk HM from Scoring			
SEA_CAT	All Carriers	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores
A	432	3	0.69%			3	0.69%		
B	4025	70	1.74%	A-B	1.64%	62	1.54%	A-B	1.46%
C	3176	30	0.94%	A-B-C	1.35%	29	0.91%	A-B-C	1.23%
D	2371	139	5.86%	A-B-D	3.10%	126	5.31%	A-B-D	2.80%
E	10202	58	0.57%			63	0.62%		
F	17880	265	1.48%			267	1.49%		
G	1924	77	4.00%			69	3.59%		
H	113677	1939	0.51%			2711	0.69%		
	411102	749							
Sum	564789	3330	0.59%			3330	0.59%		

If the Accident SEA is the best indicator of future accidents, then it follows logically that the number of non-spill HM accidents a carrier is experiencing would be a good precursor to spill accidents. Tables 46 and 47 show the results of assigning equal weight to spill and non-spill accidents in the SafeStat Accident Category scoring algorithm.

In Table 46, by comparing the last three columns to the previous three and placing equal weight on non-spill and spill accidents, the fraction of bulk carriers that are placed in the A, B, and D categories increases from 2.4 to 3.7 %. Furthermore, 39 additional bulk HM carriers have been identified for a compliance review. The greatest portion of these carriers was previously unscored. The total of the unscored bulk HM carriers in the base case is 2688 (1939+749) and that number decreases by 28 to 2,660 as a result of this scoring change. Furthermore most go into the D category. This would be expected, since only the ACSEA score is being affected by these changes. The ability to identify unscored carriers that have had HM accidents but no releases is an important finding because future accidents may result in HM spills.

Table 46. Effect of Adding Non-Spill Accidents to the Accident SEA Algorithm

Scores in 09232000 Run		Base Case				Equal Weight to Spill and Non-Spill			
SEA_CAT	All Carriers	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores
A	432	3	0.69%			3	0.69%		
B	4025	70	1.74%	A-B	1.64%	74	1.84%	A-B	1.73%
C	3176	30	0.94%	A-C	1.35%	29	0.91%	A-B-C	1.39%
D	2371	139	5.86%	A-D	2.42%	174	7.34%	A-B-D	3.68%
E	10202	58	0.57%			60	0.59%		
F	17880	265	1.48%			262	1.47%		
G	1924	77	4.00%			68	3.53%		
H	113677	1939	0.51%			2660	0.51%		
	411102	749							
Sum	564789	3330	0.59%			3330	0.59%		

In Table 47, the HM bulk weighting in the ACSEA algorithm is doubled if a carrier has a bulk HM accident. This strategy identifies 107 new bulk HM carriers that would be subjected to a compliance review. One could accept this strategy as meeting the target of inspecting 110 additional bulk HM carriers. The basis for this conclusion is that, in the base case, the total number of bulk HM A, B, and D carriers inspected is 212. The number of A, B, and D bulk HM carriers inspected if the spill and non-spill accidents are weighted double is 319 for a difference of 107. The percentage of A, B, and D bulk HM carriers that would be inspected is 4.7% of all the A, B, and D carriers scored. As with the previous case, the number of unscored carriers that became scored increased by 85 (2,688 – 2,603). In addition, there were 10 “F” scored (Vehicle) carriers and 10 “G” scored (Safety Management) carriers that would now be subjected to a compliance review. As was the case with the previous changes to the algorithm, the only way to ensure that a significantly higher fraction of the inspected carriers are bulk HM carriers is to include “D” scored bulk HM carriers in the compliance review program.

Table 47. Effect of Doubling Weight of Spill and Non-Spill Accidents to the Accident SEA Algorithm

Scores in 09232000 Run		Base Case - Bulk HM Carriers				Double Weight to Bulk HM Spill and Non-Spill			
SEA_CAT	All Carriers	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores
A	432	3	0.69%			4	0.93%		
B	4025	70	1.74%	A-B	1.74%	84	2.09%	A-B	1.97%
C	3176	30	0.94%	A-B-C	1.39%	28	0.88%	A-B-C	1.52%
D	2371	139	5.86%	A-B-D	3.10%	231	9.74%	A-B-D	4.67%
E	10202	58	0.57%			58	0.57%		
F	17880	265	1.48%			255	1.43%		
G	1924	77	4.00%			67	3.48%		
H	113677	1939	0.51%			2603	0.69%		
	411102	749							
Sum	564789	3330	0.59%			3330	0.59%		

8.4.6 Weighting of Respective SEA Category Scores

The Volpe Transportation Systems Center, the developers of SafeStat, have performed extensive studies of accident precursors and have found that the accident and driver performance measures used in SafeStat are more important than the other two as predictors of future poor carrier performance. Accordingly, the weighting factors have been set at 2 and 1.5 for the Accident and Driver SEA respectively. Without additional study requiring the collection of a great deal more data, there is no justification for moving away from the Volpe SEA SafeStat weighting factors.

8.4.7 Standardizing Criteria for Counting a SEA Score Toward the Overall SafeStat Score

At the present time, only those carriers with a score above 75 are counted. Furthermore, some groups of carriers (e.g. those with only one accident over the past 30 month period) are assigned to accident Group 1; the highest score attainable for this group is 74. If all Accident SEA scores above 70, instead of the current 75, were used for bulk carriers, then there would be an additional 5% of the Group 1 carriers that scored between 70 and 74 as well as the carriers in the other accident groups that scored above 70 that would be counted. The effect of such a scoring algorithm is shown in Table 48 and discussed in the following paragraphs.

Table 48 shows that scoring all bulk HM Carriers with ACSEA scores above 70 creates a result similar to that observed when the bulk non-spill accidents were added. The number of bulk HM carriers that would undergo a required compliance review, A and B scored carriers, would increase from 1.6 to 1.8 percent. If the A, B, and D bulk HM carriers were subjected to a compliance review, the number of carriers reviewed would increase from 3.1 to 3.9 percent. More importantly, as a result of this change, the 2,688 bulk HM carriers unscored (H = 1,939 + 749 = 2,688) is reduced by 43. Most of the newly scored carriers are scored as a “D.” However, what is different in this case is the change in the number of A-B scored carriers. There are three more carriers that become “As,”and three more that become “Bs,” and thus are automatically subjected to a compliance review. However, as in the previous cases, the greatest change is in the number of carriers that went from “H,” unscored, to “D.” Thus as in the past cases, the only way to guarantee that a “high risk” HM bulk carrier is subjected to a compliance review is to inspect the “D” scored bulk HM carriers. In terms of the target of identifying 110 new bulk HM carriers subject to a compliance review, this algorithm identifies only 54 new carriers (268 A, B, and Ds in the augmented case minus 212 A, B, and Ds in the base case).

Table 49, shown below, combines two of the cases analyzed above. First, both bulk HM spill and non-spill accidents are included in the ACSEA score and the HM weighting for both spill and non-spill accidents is doubled. Second all ACSEA scores greater than 70 when calculating the overall SafeStat score for bulk HM carriers are added. As can be seen from the table, the number of A and B scored carriers increases from 1.6 to 2.0 percent, about the same as was observed by doubling the weighting on spill and non-spill accidents. By far the biggest change was in the totals for the A, B, and D scores for bulk HM carriers. If all bulk HM carriers with an A through D score were subjected to a compliance review, the number inspected would more than triple, increasing from 1.6 to 5.2 percent. As stated above, 1.6 percent is considered the base case because that is the number of bulk HM carriers that are being inspected using the current SafeStat algorithm.

Table 48. Effect of Scoring all Bulk HM with Accident SEA >70

Scores in 09232000 Run		Base Case - Bulk HM Carriers				Score Bulk Carriers with ACSEA>70			
SEA_CAT	All Carriers	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores
A	432	3	0.69%			6	1.39%		
B	4025	70	1.74%	A-B	1.64%	73	1.81%	A-B	1.77%
C	3176	30	0.94%	A-B-C	1.35%	29	0.91%	A-B-C	1.41%
D	2371	139	5.86%	A-B-D	3.10%	189	7.97%	A-B-D	3.93%
E	10202	58	0.57%			59	0.58%		
F	17880	265	1.48%			260	1.45%		
G	1924	77	4.00%			69	3.59%		
H	113677	1939	0.51%			2645	0.69%		
	411102	749							
Sum	564789	3330	0.59%			3330	0.59%		

Table 49. Effect of Including Bulk Carriers with ACSEA Scores >70 and Adding Non-Spill to the Spill Accidents and Doubling the Weignting

Scores in 09232000 Run		Base Case – Bulk HM Carriers				Bulk Carriers ACSEA>70 & All Accidents			
SEA_CAT	All Carriers	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores	Bulk HM Carriers Scores	Percentage	Rows in Weighted Score	Weighted Scores
A	432	3	0.69%			6	1.39%		
B	4025	70	1.74%	A-B	1.64%	85	2.11%	A-B	2.04%
C	3176	30	0.94%	A-B-C	1.35%	29	0.91%	A-B-C	1.57%
D	2371	139	5.86%	A-B-D	3.10%	265	11.18%	A-B-D	5.21%
E	10202	58	0.57%			57	0.56%		
F	17880	265	1.48%			252	1.41%		
G	1924	77	4.00%			67	3.48%		
H	113677	1939	0.51%			2569	0.69%		
	411102	749							
Sum	564789	3330	0.59%			3330	0.59%		

In addition, 191new bulk HM carriers would be subjected to a compliance review (356 A, B, and Ds minus 212 A, B, and Ds in the base case).

When comparing the base case with the case shown in Figure 49, several pieces of information are worth noting. For the base case, the number of A and B carriers requiring an inspection totaled 4,457. Of this total 73 were HM bulk carriers. With the new run, adding non-spill HM accidents, doubling the weighting for them and including ACSEA scores >70, resulted in 4,391 A and B carriers. However, when the 265 HM bulk carriers in the D category are added, there would be a total of 4,656 carriers that would now require an inspection. Because the accident threshold was changed to 70, in a few cases carriers with an accident score of 70 could now fall into the C category. This applies to two carriers in the C category. If these two C carriers are required to have a compliance review, there would be an increase of 201 carriers requiring compliance reviews.

With the new run, 358 HM bulk carriers would be inspected because they were in the A, B, C, or D categories. Of these, 138 of the carriers were previously in the D category and 127 were previously unscored and moved into the D category. As stated above, two HM bulk carriers moved into the C category with the new run. One of these went from the F category and the other the G category to the C category. Seventy-two of the HM bulk carriers from the A or B Category in the base case are combined with 19 new HM carriers that rose to A or B resulting in 91 A and B HM bulk carriers subject to a compliance review. (One carrier that was on the base case list dropped off the list). Thus, a total of 283 new bulk carriers would be subject to inspection.

8.4.8 Conclusions and Recommendations

In summary, the SafeStat Algorithm has two major HM entries: (1) compliance review indicator that is part of the Safety Management SEA and (2) a weighting applied to HM spills that have occurred over the last 30 months that is incorporated into the Accident SEA. The analysis showed that using the current SafeStat algorithm resulted in about 3.1 % of the carriers receiving an A, B, or D score being bulk HM carriers. If all these carriers were being reviewed because of their poor HM performance, then simply adding the bulk HM carriers with D scores to the compliance review program would meet the arbitrary target of having the percentage of bulk HM carriers inspected equal the percentage of the total accident cost attributable to HM carriers. However, it was shown in the analysis that most of the carriers are not being identified because of poor HM performance. The analysis also showed that if the target were to be reached, then at least 110 new bulk HM carriers would have to be added to the carriers being subjected to a compliance review. Several sensitivity analyses were performed to identify possible changes in the scoring algorithm that would enable this target to be met. The study found that by adding the non-spill accidents to the HM scoring and having all A, B, and D bulk HM carriers subjected to a compliance review, the number of bulk HM carriers falling into those categories increased to 3.7%. However, this change alone would not meet the target of identifying 110 new bulk HM carriers for a compliance review. Since most of the increase occurs because unscored bulk HM carriers are now scored in the D category due to their high HM non-spill accident rate, the change in the algorithm is clearly identifying carriers that previously went unidentified and are very likely to have an accident that results in a spill in the future. Thus, this change fits very well into SafeStat’s target of identifying those carriers to prevent future accidents, in this case future HM spill accidents. Two additional changes were evaluated that would identify 110 new bulk HM carriers. One was a doubling of the accident spill and non-spill score. The second was to decrease the threshold for bulk HM carriers in the ACSEA area to 70.

Of all the possible changes, three changes came closest to attaining the target of identifying 110 new bulk HM carriers to be subjected to a compliance review. First, including non-spill HM accidents and equating them to spill accidents. Second, doubling the weighting for both of these categories of accidents. Third, combining the spill and non-spill accident weighting and the ACSEA > 70. These changes together result in an identification of over 140 new bulk HM carriers that had not been included in the A, B, C, or D categories for the base case. Rather than just increasing the weighting, these changes provide a balanced approach.

Based on the analyses that were performed for this study, the following change to the SafeStat algorithm are recommended in order to make the number of bulk HM carriers being inspected more commensurate with the risk of accidents posed by this group of carriers.

Thus, the final recommendations are:

- Add non-spill HM accidents as well as spill HM accidents to the Accident SEA scoring algorithm and double weight all of these HM accidents;

- Include all bulk HM ACSEA scores >70; and

- Expand those carriers subjected to a compliance review to include all bulk HM carriers in the A, B and D Categories as well as those in the C Category that include an accident component.

9.0 HM Database Assessments and Recommendations

9.1 Purpose and Organization

This chapter summarizes the recommendations formulated as a result of completing this risk assessment of HM and non-HM transport by truck.

9.1.1 Background

Accurate and comprehensive data is the most essential component in the production of a risk assessment. Experiential data is necessary to document the consequences and likelihood of HM accidents. Meaningful assessments of the safety of hazardous materials transportation on the nation's highways require such data. The ability to make informed decisions and to develop effective safety policies and regulations concerning hazardous material transportation can be seriously compromised if it is not based on reliable information.

This risk assessment reviewed numerous databases, managed and maintained in multiple public agencies. These agencies collect data for varying purposes, using disparate definitions under limited jurisdictional authority. As a result, much of the data available for this risk assessment was inconsistent, fragmented, and incomplete.

Databases should standardize definitions to reduce the differences in the definition of

- what constitutes an accident,
- which accidents must be reported, and
- what information must be reported.

Until this standardization occurs, it will not be possible for DOT to realize fully the benefits of a relational database structure. If such a structure were developed, the reporting requirements would be greatly simplified, accuracy would be increased, there would be fewer databases, and the overall size of the databases would be dramatically smaller.

9.1.2 Approach

The review and comparison of the databases assembled and analyzed for this risk assessment could be used to develop a road map to better data collection in the future. The limitations of the databases assembled and reviewed provided the analysts involved in this project with an overview of potential improvements to existing databases. The limitations associated with these databases became readily apparent as they were employed in the risk assessment. Possible improvements to these existing public databases are discussed in the following section.

Extensive efforts were also made by the research team to identify and obtain data from private sector sources. Solicitations were made of companies in the trucking and insurance industries for data involving the costs associated with highway accidents of both hazardous materials and non-hazardous commodities. In all cases, despite repeated efforts, no data was obtained regarding accident costs from the private sector.

The lack of any positive response to attempts to acquire cost figures for highway accidents is in keeping with past results in this area. In the Transportation Research Board's Special Report #229 "Safety Research for a Changing Highway Environment," this was succinctly discussed with the statement that from the private sector, "Detailed information is not available...." Although the empirical cost data maintained by the private sector would be invaluable in conducting a risk assessment, concerns about confidentiality and competitiveness ensure that these data are viewed as proprietary information and not releasable. Absent a major and substantial outreach program by a government safety agency to solicit private companies to cooperate and provide data for safety research, it does not appear any useful information will be forthcoming from the private sector. Therefore, as a lesson learned from efforts made in conducting this report, researchers should focus exclusively on public databases to obtain data for future studies.

9.2 Opportunities for Database Improvement

Although public databases containing information useful for conducting risk assessments are deficient in a number of areas, they can be improved. Better coordination among the multiple agencies that collect data would allow for the correction of definitional differences and the coordination of inconsistent reporting requirements. The collection of data, whether it is by a survey or in a census database, should be done with consideration and planning for consistency and coordination with other datasets. Substantive improvements to existing data sources and the implementation of useful new data sources is most effectively derived by addressing data gaps and existing database shortcomings. Opportunities that currently exist for improved hazardous material highway data might include considering the following recommendations.

Improvements in the DOT databases should be made now, anticipating the successful completion of a number of on-going initiatives. For example, there is a requirement that all carriers reregister over the next two years. This will enable DOT to update its listing of motor carriers. In anticipation of this event, the MCMIS accident file, HMIS database, and the MCMIS registration database should be restructured so all are linked by the shippers and carriers DOT registration number

9.2.1 The Trucks in Fatal Accidents (TIFA) Database

The Trucks in Fatal Accidents (TIFA) database could modestly expand the number of questions on its questionnaire that concern hazardous materials. The TIFA database currently consists of only one additional hazardous material question, "Was there a release of the material?" This is asked after the Fatal Accident Report yes/no field of "Was hazardous material present in the cargo?" Additional questions that could be asked might include a request for the identification number of the material transported, the DOT specification of the truck or trailer, and a more detailed explanation of the consequences resulting from a spill. This would be a modest effort that could result in greater knowledge of the circumstances and consequences associated with a serious incident.

Annually, about four to five percent of the FARS truck accidents followed up on in TIFA involve trucks transporting hazardous materials and only a quarter of these or one percent of all TIFA accidents result in a release of the material. Based on approximately 5,300 TIFA records from the most recent year's data, additional queries would need to be made of approximately 250 cases.

DOT should investigate ways of coupling the TIFA, MCMIS and HMIS databases so information can be shared between the databases. One potential solution might be to request that the MCMIS accident report number filed by the local law enforcement agency be included as a record in the TIFA file. Assuming DOT has already coupled the HMIS and MCMIS accident files, adding the MCMIS accident report number to the TIFA file would effectively couple TIFA with HMIS. Through such coupling, the unique information compiled by each database could be shared without requiring significant additions to any database. This effort would compensate for HMIS not containing all the fatal HM accidents in TIFA due to HMIS's exclusion of fatalities that were not caused by the hazardous material.

9.2.2 The Vehicle Inventory and Use Survey (VIUS)

The Vehicle Inventory and Use Survey (VIUS) can also with a modest expansion in the hazardous material section contribute new and useful data. A single question is currently asked of the respondent, "...was this vehicle (or combination) used to haul hazardous materials in quantities large enough to require a hazmat placard ..." A rephrasing of the question to request the respondent to provide the percentage of the time the vehicle or combination was used to haul hazardous materials would be helpful. Additional improvements to VIUS hazardous materials data could include finding a way to control for the double counting associated with the placarding responses and to somehow obtain the DOT specification numbers on responses involving cargo tanks.

9.2.3 The Motor Carrier Management Information System (MCMIS)

Under the Motor Safety Improvement Act of 1999, the Federal Motor Carrier Safety Administration (FMCSA) is obligated to require refiling of the motor carrier identification report form MCS-150 starting December 9, 2000. The current registration file in the Motor Carrier Management Information System (MCMIS) is woefully out of date and contains many cases of inaccurate information. Once an update has been completed to the MCMIS registration file, a detailed analysis should be undertaken. This analysis should include comparisons with other existing hazardous material registration databases, such as RSPA's registration database, which has recently been substantially expanded.

The accuracy of the MCMIS database should be improved by using "pick lists" when entering the data. In addition, the record should not be accepted if certain required fields are not filled out. Use of the "pick list" would reduce errors. As the person using a "pick list" starts to type in the data, such as a company name or chemical, the selection of choices narrows until the correct name is displayed among the list of choices showing on the input screen. By using a cursor, the data entry person then selects the correct entry. At the moment that is not how the system works. If you query the current database, it is evident that every field is filled out uniquely. For example,

- If the current database is queried to look for the company name and address of a large carrier associated with a specified DOT registration number, the list of variations will fill pages. Some variations concern only the presence or absence of a period at the end of "Inc."
- If the current database is queried asking for "Like 'Carrier Name,'" several DOT registration numbers will be listed for the same carrier.

- If UN number 1005 queries the database, “ammonia” will pop up, entered at least in 25 different ways. In many cases, ammonia is misspelled. Data entry personnel should not be expected to know how to spell the names of thousands of chemicals.

The use of “pick lists” will improve the accuracy of the database and also improve the accuracy of the queries because the fields will be filled out accurately. In a case where HM is involved, there should be a requirement that certain fields, such as hazard code and chemical name, be filled out before the record can be entered. Currently, the HM field is often checked in association with blank entries in all the other HM related fields.

When the accident involves HM, one of the required fields entered in the MCMIS accident file should be the HMIS report number. If none has been assigned, then it should be possible to assign one and place the relevant accident data in the HMIS file. Later on, when the HMIS report is submitted, the first step would be to see if the HMIS number had already been assigned. Given this simple coupling, it would be possible to identify carriers that are not reporting their HMIS accidents and formally request that they do so. It should also be possible to identify law enforcement agencies that are not filing MCMIS reports for HM accidents.

9.2.4 The Hazardous Materials Information System (HMIS)

The Hazardous Materials Information System (HMIS), the primary incident database for collecting data on hazardous materials incidents nationwide, is currently undergoing a revision of its form. This revision of the F 5800.1 form will have far reaching consequences for hazardous materials incident data for a decade or more to come. Major efforts need to be exerted to assure that the revisions to the form include critical data fields that will aid in conducting future risk assessments. This is enormously important to the highway mode, since approximately 85 percent of HMIS reports now involve highway transportation.

There are a number of important fields that are being considered for inclusion on the DOT F 5800.1 form. Two additional questions that would prove very useful for future research:

1. The addition of a field to capture the police accident report (PAR) number for accidents and
2. A field to record the amount in a container at the time of the release.

DOT should make the database more relational in the future. One area in particular exemplifies the need for making this significant improvement. There are many standard DOT specification containers that are used in the shipping of HM. If a standard specification container is involved in an accident, all that should be required is to list the container number. The rest of the information should be in the database. If there is concern about possible variations among containers designed to the same specification, as a minimum, all the generic information should pop up so the person entering the data can edit those fields that are different.

9.2.5 The 1997 Commodity Flow Survey (CFS)

The 1997 Commodity Flow Survey (CFS) was recently released and utilized for the estimation of mileage traveled by both HM and non-HM shipments. Although the CFS represents a major expansion in highway denominator or flow data, the data did not provide a calculated mileage estimate for truckload shipments. The data for tons miles had to be converted into mileage by dividing tons-miles by the average truck load weight of a particular hazard class. Average shipment weight was available for shipments but information regarding the number of shipments per truck was unavailable. In the future, this additional data should be made available to facilitate the assembly of reliable denominator data for future risk investigations. A review of the highway data contained in the CFS with input from data users should help identify other improvements that might be made to future surveys in both the collection and processing of responses.

Recommendations for improvements to hazardous material highway data can also be broader than enhancements to specific databases. There is a need for much better data on the costs and consequences associated with incidents involving hazardous material highway incidents. Whether this lack of reliable data is addressed by better reporting on existing forms or achieved through other means, such as greater use of survey methodology, this is a topic that should be addressed. It should be self evident that it is in everyone's interest for a coordinated effort to be made among the responsible public agencies and the private sector to identify and obtain better data for improving the safety of hazardous materials transportation on our nation's highways.

9.3 Recommendations and Conclusions

This project demonstrated that to date, no single database is able to provide all of the data required to conduct a risk analysis. For example, to catalogue the total number of accidents, the project team selected the HMIS database as the reference database and supplemented this information with data from the MCMIS and TIFA databases, as well as selected state accident databases. This was done to obtain a more complete portrait of the HM accidents for one year. This exercise demonstrated clearly that it was necessary to use more than one database to obtain the full portrait of annual accidents. This was especially true for HMIS and MCMIS because, although both included spill accidents, only MCMIS include the no-spill accident. Therefore, in order to obtain a portrait of spill and non-spill accidents for a period of time, the researcher would have to use at a minimum the HMIS and MCMIS databases. The databases should be linked through the use of a common field, such as the MCMIS accident number, so queries can be made using unique information. To accomplish this, a small committee could be formed, consisting of FMCSA and RSPA staff, to develop recommendations for an approach to link the databases. Clearly, a key will be to ensure that common fields, such as the DOT Registration Number and a unique accident number, are used so that all records related to those numbers can easily be retrieved.

The recommendations identified for the specific databases in this chapter are summarized below.

1. Over time, definitions in accident databases such as HMIS, MCMIS and TIFA should be standardized so there is a reduction in the differences in the definition of (a) what constitutes an accident, (b) which accidents must be reported, and (c) what information must be reported.

2. Accident databases should have sufficient common fields so that information about the accident entered in one database can be shared rather than duplicated in the other databases.

3. DOT should determine a viable mechanism for using carrier records for the purpose of verifying that HMIS and MCMIS reports are complete and accurate.

4. Improvements in the DOT databases should be made now, anticipating the successful completion of a number of on-going initiatives, i.e., the reregistering of carriers and shippers that started in December 2000.

5. The accuracy of the MCMIS database should be improved by using “pick lists”or other aids to improve the accuracy of entered data.

6. Electronic filing should be available for HMIS and MCMIS reports.

7. Databases should be coupled to allow DOT enforcement staff to have instant access to complete accident information in more than one database.

10.0 Conclusion

10.1 Project Significance

This report has presented the results of a project designed to better understand HM truck safety in the context of key risk contributors within the industry. The study approach and corresponding results allow for comparisons to be made across several dimensions: (1) HM vs. non-HM, (2) by HM category, and (3) by HM incident type. These results are portrayed both as estimates of annual economic impact and on a per vehicle-mile basis.

The report also demonstrates the usefulness of a methodology for effectively estimating the number of accidents and incidents for a one-year or a longer period. This methodology focuses on the use of existing national databases and the selection of data from sample states to supplement national databases. The methodology uses the HMIS database and the MCMIS accident file supplemented by state databases and news clippings to assemble an annual number of accidents from an eight-state sample. This eight-state accident count was then assigned a likely proportion of the national accidents and extrapolated to develop a national estimate of accident and incident numbers.

The report has estimated the number and type of impacts for accidents and incidents in 12 HM categories of HM classes or divisions. HM impact estimates were made for the following:

- Injuries and deaths
- Cleanup costs
- Carrier/Property damage
- Evacuation
- Product loss
- Traffic incident delay
- Environmental damage

An impact estimate was also made for accidents involving non-HM accidents. For non-HM accidents, impacts were estimated for:

- Injuries and deaths
- Cargo loss
- Carrier/Property damage
- Traffic incident delay

Based on available data, dollar cost estimates were made for each of the impact categories and translated into a per accident or incident cost. Then, the total cost for the impact was calculated based on the number of accidents or incidents.

While this study represents a valid attempt to benchmark the financial implications of the problem based on best available data, these observations should be viewed in the context of establishing a general estimate or bound on the financial impact of this problem rather than a precise valuation. Consequently, if the results are within an order of magnitude, meaningful comparisons can be derived for evaluation purposes.

Impact measures can be refined in the future by supplementing available data with impact estimates obtained from private sector sources, such as insurance companies and trucking companies.

10.2 Project Results

The annual number of non-HM accidents is estimated to be 126,880, in contrast with the approximately 15,000 HM accidents and incidents estimated to occur each year. Of these HM incidents and accidents, about 75% are represented by loading and unloading incidents. Enroute HM accidents total about 2,500 annually with about 700 (28%) of these being spill accidents.

The estimated number of annual incidents (and accidents) can be converted into rates by using annual vehicle miles of HM operation. The 1997 Commodity Flow Survey (CFS) was used for this estimate. The mileage numbers provide a general measure of differences but more rigorous comparisons must await further refinements in the accuracy of CFS mileage numbers.

The average HM accident rate is 0.32 accidents per million vehicle-miles and the average HM incident rate is 0.51 accidents per million vehicle-miles. When comparing across HM categories, Class 9 has the highest accident and incident rates, and Class 2.2 has the lowest. However, the HM category accident and incident rates are all within the same order of magnitude.

Several findings can be reported from reviewing the analysis results, including:

- HM truck incidents cost society nearly $1.2 billion on an annual basis.

- Injuries and fatalities comprise the largest components of this cost.

- Class 3 contributes the largest economic impact associated with HM incidents.

- Bulk shipments account for about 75% of the risk for HM shipments. Class 3 and Class 8 make up over 75% of the overall HM truck shipment risk. About 90% of the Class 3 shipments and 50% of Class 8 shipments are bulk. Class 2.1 gases, representing about 9% of all HM risks, is transported in bulk shipments about 64% of the time.

- Release-causing enroute accidents have the highest average cost, followed by enroute accidents in which a release does not occur. Leaks enroute are an order of magnitude lower in average cost with the average cost of loading/unloading incidents an order of magnitude lower than that. The greatest economic impact is associated with accidents enroute where a release does not occur, due to the higher frequency of these events.

- Of those enroute accidents resulting in a release, explosions have the highest per incident cost, followed by fires and then releases where neither a fire or explosion ensue; however, the release-only incidents contribute more to the annual economic impact because of the frequency of such events. Explosions result in the greatest economic impact, with an average cost of over $2.1 million per accident. The average cost of an enroute accident resulting in a fire is nearly $1.2 million, while enroute accidents that have a release without fire or explosion have an average cost of slightly over $400,000.

The annual economic impact of non-HM truck accidents is over $43 billion, considerably higher than for HM truck incidents. The annual number of non-HM accidents is 126,880 in contrast with the approximately 15,000 HM incidents. Although due primarily to a much larger volume of transport activity, the estimated non-HM truck accident rate is more than twice the HM truck accident rate, a relationship also reflected in the impact cost per vehicle-mile.

Hazardous material shipments make up between four and eight percent of all shipments. Given this small percentage, the overall cost of non-HM accidents clearly dominates the cost of HM accidents. However, although the average cost of an accident is higher for HM, these higher costs are not nearly enough to overcome the large disparity in shipment volume between HM and non-HM shipments by truck.

10.3 Recommendations for Future Projects

This section describes five future initiatives that follow from the HM risk assessment project described in this report.

1. **Database Enhancements**

   This project effort demonstrated the need to improve the data used for HM truck safety evaluations. To promote continuous improvement in HM safety data quality, the study makes the following recommendations:

   - Incident/accident databases, such as HMIS and MCMIS, should contain standardized definitions to provide greater compatibility in

     (1) What constitutes an incident/accident,
     (2) Which incidents/accidents must be reported, and
     (3) What incident/accident attributes must be reported.

   - Different incident/accident databases should have sufficient common fields to expedite sharing of information. DOT should investigate ways to cross reference the TIFA, MCMIS, and HMIS databases.

   - DOT should develop a system to verify the accuracy and completeness of HMIS reports by comparing the data with the carrier records.

   - The quality and completeness of the MCMIS database should be improved. Quality control protocols should be developed for inclusion in MCMIS accident file to ensure that required fields are properly completed.

2. **HM Risk Management Policy Development**

   Results of the HM Risk Assessment Study provide an opportunity to establish this foundation, leading to the development of future HM risk management initiatives within FMCSA. Although the FMCSA has adopted a risk-based approach for enhancing the safety of hazardous materials truck transport, the principal objective of this approach is to assign priorities and allocate resources to policies and programs that are cost-effective in satisfying the agency’s safety mission. A key to success is a thorough understanding of the likelihood and severity of incidents involving the truck transport of HM cargo.

By systematically evaluating the focus of its current risk management activities, FMCSA will have an opportunity to validate the significance of ongoing initiatives, while taking corrective actions to improve areas of deficiency. The bottom line will be a more targeted use of resources, directed at problems that cause the greatest threat to the safety of HM truck shipments.

3. HM Risk Management Training

Federal, state and local HM program managers are being asked to implement risk management methods and practices, often with little knowledge or awareness of the concept of risk management. This restricts their ability to lead this effort, which reduces the potential effectiveness of corresponding programs. Education is needed to improve understanding of risk management concepts and methods.

This could be addressed with the development of a ½ to 1-day executive management training course covering HM risk management concepts and methods. The curriculum could include findings and implications from the HM Risk Assessment study as well as best practices in risk management being used in government and industry. As part of the course, the risk assessment model developed in the study could be made available for attendees to use in their own operations.

4. Determination of HM Accident Causation

If the FMCSA is going to reach its goal of reducing the average number of truck related fatalities by 50 percent, then it is necessary to identify and address the causal factors associated with accidents.

As part of the Phase I activities, the remarks file in HMIS was examined to identify the precursor events for serious accidents. Although the precursor cause of an accident, such as a tanker rollover, could be determined, the root cause could not. For example, if the cause of the accident was driver error or some type of equipment failure on the vehicle, we could not identify why there was driver error or equipment failure. Did the driver make a mistake because he had been driving for 10 hours? Was the cause of the equipment failure poor maintenance or just a random failure? FMCSA could use other sources of data, such as police accident reports and personal interviews with drivers involved in selected accidents, to compile root causes for major HM accidents.

5. Augmentation of "HM Model"

A product of this study has been the development of the essential elements of a Hazardous Material Truck Transportation Risk Model. In any model, some elements of the model are more important than others. The most cost-effective way to improve a model is to develop better algorithms in the areas that are most important to consider. In this way, the model becomes a better risk management tool for FMCSA.

The proposed project would begin by performing sensitivity studies on the parameters incorporated in the current risk model. For example, currently mean values are being used for all the parameters. However, some parameters can take on a broad range of values, i.e., the delay cost from an HM accident. In some cases, it is just a few hours delay, but there are frequently times when the traffic flow patterns can be disrupted for weeks or longer when a critical structure, damaged by the accident, is replaced.

The development of such distributed models must be balanced by the proportion of the overall risk represented by traffic delay. If the dominant risk component is injuries, which is indicated by the current model, then collecting better data on injuries might be the most cost effective way to improved the accuracy of the model. Such an analysis would look at the extent to which the number of injuries is underreported.

The anticipated benefit of the project is the development of a more accurate risk model for hazardous material transport by truck that could be used by FMCSA to more precisely develop programs designed to reduce transportation risk and improve truck safety.

Appendix A

State Hazardous Material Flows

Appendix A
State Hazardous Material Flows

Truck Transportation of Hazardous Materials: Traffic and Commodity Flow

This appendix summarizes the results of the regional HM flow studies that have been conducted in recent years and some of the data from the national databases.

Summary of State and Local Flow Studies

Colorado

Mesa County Local Emergency Planning Committee. *Hazardous Materials in Mesa County.* August 1997

A survey was conducted on two major roadways through Mesa County, which is located in western Colorado. Two inspection stations were set up on I-70 and Highway 6 & 50 for two days (12 hours/day) in August, where each truck was classified by hazard class.

For both survey locations, HM vehicles comprised 7 percent of observed vehicles. Commodities in Hazard Class 2 (Gases) and Class 3 (Flammable Liquids) accounted for 43 percent and 36 percent of HM vehicles.

Delaware

State Emergency Response Commission. *Delaware Hazardous Material Transportation Flow Study*. June 1994

The Delaware Hazardous Material Transportation Flow Study consisted of statewide survey of HM trucks on highways in March of 1994. Trucks were classified by placard/hazard class and counted during a 4-day (8 hours/day) survey at eighteen intersections on Interstate or Principal Arterials.

For all sites, the results of the highway truck survey showed that HM vehicles accounted for 6 percent of the total truck traffic. Petroleum products, specifically gasoline, fuel oil and propane, consisted of more than 55 percent of all HM vehicles observed. Furthermore, 59 percent of all HM vehicles were carrying flammable liquids.

Kentucky

Kentucky Emergency Response Commission. *Corridor Commodity Flow Analysis Final Reports.*
I-24, January 1998
I-71, December 1997
I-75, November 1995
I-65, September 1995
I-64, June 1995

Each corridor study consisted of 600 hours of observations at weigh stations along the interstate highway. Each survey recorded placard information for HM vehicles.

For all five corridors, HM vehicles consisted of 3.4 percent of total truck traffic. Most frequently observed placards were for gasoline and motor fuel and for flammable materials consisting of approximately 17 and 12 percent of HM trucks respectively. Trucks carrying flammable liquids consisted of 57 percent of all HM vehicles.

Ohio

"Growth Fuels Talk or Route Review." Columbus Dispatch. July 21, 1996

Observations at I-70 and I-71 interchanges with I-270 through Columbus showed that 47 percent of placarded trucks were carrying flammable liquids. No information regarding date, time and duration of the observation period was specified.

Oregon

Public Utility Commission of Oregon and the Oregon Department of Transportation. *Hazardous Material Movements on Oregon Highways.* 1987

A statewide survey was conducted at 11 truck weigh scale locations for three days in both March and August. The survey recorded the hazard class, the specific material's shipping name and identification number of each HM truck.

For all sites combined, hazardous materials were being carried by six percent of the trucks observed. Fifty-four percent of placarded trucks carried goods in the flammable or combustible hazard class. Gasoline and fuel oil, followed by paint and hazardous wastes, were the most common materials being transported.

Summary of State and Local Flow Studies

Table A-1. Traffic Statistics

	Hazardous Materials Percentage of total truck traffic	**Flammable Liquids** Percent of HM vehicles
Colorado	7.1	43.0
Delaware	6.0	59.4
Kentucky	3.4	56.6
Columbus, Ohio	-	47.5
Oregon	4.9	52.9
National Fleet Safety Survey	7.2	—

Summary of National Commodity Flow Sources

National Fleet Safety Survey
Office of Motor Carriers
Federal Highway Administration, March 1997.

This survey randomly sampled over 10,000 trucks in 11 states to assess the level of compliance with Federal Motor Carrier Safety Regulations and with Hazardous Materials Regulations. The survey found 5.6 percent of all sampled trucks to be carrying hazardous materials.

The national weighted estimate of the percentage of operating trucks carrying HM was determined to be 7.2 percent. The weighting procedure considered the location of the inspections along with VMT by state and by highway functional class.

1993 Commodity Flow Survey (CFS)
Census of Transportation, Communications and Utilities
U.S. Department of Commerce, Bureau of the Census.

The CFS provides data on the movement of goods by mode of transportation. Information regarding volumes and ton-miles of hazardous commodities transported by truck was taken from Table 6 (Shipment Characteristics by Commodity and Mode of Transportation) compiled for the United States. The HM volumes and ton-miles were underestimated because data for crude petroleum and natural gas shipment was lacking. As well, the major commodity groupings (two digit codes) did not readily disaggregate into detailed commodity types (three digit codes) that would be considered solely hazardous but that would also include materials that were not hazardous. Similarly, the determination of flammable liquids was inaccurate. Detailed commodity information was not available at the state level.

1997 Commodity Flow Survey (CFS)

Census of Transportation, Communications and Utilities
U.S. Department of Commerce, Bureau of the Census.

The 1997 CFS provides the first comprehensive view of hazardous materials flows in the United States. Hazardous materials totaled 1.6 billion tons, or 14.1 percent of all commodities measured in the 1997 CFS, with 80 percent being flammable liquids. These data are identified by mode, hazard class, division, and selected identification numbers to serve as exposure measures for risk assessments. The hazardous materials data represent a major expansion in the availability of safety data, particularly in the air and highway modes.

For the 1997 CFS, approximately 100,000 domestic establishments were sampled from a universe of about 800,000 establishments in mining, manufacturing, wholesale, and selected retail industries. Also included were auxiliary locations (warehouses) of multi-establishment companies. The CFS does not cover farms, forestry, fisheries, governments, households, foreign establishments, and most establishments in retail and services. The sampling frame was the Standard Statistical Establishment List (SSEL) of business establishments with paid employees, maintained by the Census Bureau.

1987 and 1992 Truck Inventory and Use Survey (TIUS)

Census of Transportation
U.S. Department of Commerce, Bureau of the Census.

TIUS measures the operational characteristics of the nation's truck fleet. The study consisted of a mail survey of about 154,000 selected trucks including large trucks and small trucks (pickups and vans). Published information is reported as national totals and by state of registration. The unaggregated database is available as a microdata file. The information is a result of the number of trucks and truck-miles reported during 1992. TIUS reports only the number of vehicles used to transport various commodities rather than the amount of commodity moved over a distance (ton-miles for example). As well, the trucks reported may be used to transport more than one hazardous commodity.

The 1992 survey showed that two percent of all trucks including small trucks carried HMs. Of the HM carriers, 35 percent carried commodities that could be considered flammable liquids. Analysis showed that 18 percent of large trucks carried HMs and that 20 percent of them were placarded as flammable.

1997 Vehicle Inventory and Use Survey (VIUS)

Census of Transportation
U.S. Department of Commerce, Bureau of the Census.

This is formerly known as the Truck Inventory and Use Survey (TIUS). It contains data about vehicles--physical characteristics, including date of purchase, weight, number of axles, overall length, type of engine, and body type. Operational characteristics data include type of use, lease characteristics, operator classification, base of operation, gas mileage, annual and lifetime miles driven, weeks operated, commodities hauled by type, and hazardous materials carried. Less detailed physical characteristics data are collected for pickups, vans, minivans, and sport utility vehicles because they are relatively homogenous in design and use.

A mail-out/mail-back surveyed selected trucks. Large truck owners receive a standard form, and small truck owners (pickups, vans, minivans, and sport utility vehicles) receive a short form. A stratified random sample of registered trucks is selected from all 50 states and the District of Columbia. Samples are selected by state and stratified mainly by body type. Data collection is staggered as state records become available. Owners report data only for the vehicles selected.

Truck Transportation of Hazardous Materials: A National Overview

Transportation Systems Center
US DOT, December 1987.

The report presents and overview of HM transport on highways. Information and estimates of truck traffic divisions are derived from the U.S. Department of Commerce (Bureau of the Census). The report develops truck flows and traffic patterns using commodity and truck operating characteristics from the CFS and TIUS of 1977.

The study reported that HM commodities accounted for 17 percent of truck ton-miles. Of that, 28 percent of HM ton-miles could be considered flammable liquid movements.

Table A-2. Selected National Commodity Flow Statistics Commodity Statistics

	Hazardous Materials Percentage of total commodity	**Flammable Liquids** Percent of Hazmat commodity
1993 CFS		
Ton-miles (excludes petroleum products)	4.9	13.7
1992 TIUS		
All registered trucks (includes large and small trucks)	2.2	13.7
Large trucks	17.8	20.0
Truck-miles of HM	-	2.2
1987 TIUS		
All registered trucks (includes large and small trucks)	2.9	15.3
Large trucks	12.1	29.8
Truck-miles of HM	-	8.8
Truck Transportation of Hazardous Materials (1977)		
Ton-miles (factored volumes)	16.4	27.5

Appendix B

Database
Search Criteria

Appendix B
Database Search Criteria

Appendix B includes a set of tables that summarize the search criteria used to identify 1996 Class 3 truck shipments for each database. Since each database has its own field characteristics, Tables B-1 to B-6 each cover a single database.

Table B-1. HMIS

Field	HMIS Field Name and Criteria
Accident	ACCDR = YES
Source	HMIS
Interstate	Assumed Yes
Spill	Assumed Yes
Date	IDATE = */*/96
Time	ITIME
Accident Street	IROUTE
Accident City	ICITY
County	ICOUNTY
Accident State	IST = CA, CO, OR, IA, IN, MN, OH, PA
Carrier Name	CARRI
Census Number	CRPNO
Carrier State	CARST
HZMT Placards	Assumed Yes
HZMT Name	COMOD
HZMT Trade	TRADE
HZMT 4-Digit #	UNNUM
HZMT 1-Digit #	CMCL = 30 (Class 3)
Cargo	Cargo = Yes or No
# Fatalities	DEAD
# Injuries	INJURY: [MJING+MNING]
Phase	PHASE = 261 (Enroute Between Origin and Destination)
Others	VANTRL (= Yes or No)

Table B-2. Safetynet

Field	Safetynet Field Name and Criteria
Accident	Assumed Yes
Source	State
Interstate	Interstate (= Yes or No)
Spill	Hazardous Material Release of Cargo (= Yes or No)
Date	Accident Date/Year = 96; Accident Date/Month; Accident Date/Day
Time	Accident Time/ Hour : Accident Time/ Minute
Accident Street	Accident Street Location
Accident City	Accident/ City Name
County	Accident County Code
Accident State	Accident State
Carrier Name	Carrier Name
Census Number	Census Number
Carrier State	Carrier Address/ State
HZMT Placards	Hazardous Material Placard = Y
HZMT Name	Hazardous Material Name
HZMT Trade	N/A
HZMT 4-Digit #	Hazardous Material 4-Digit Number
HZMT 1-Digit #	Hazardous Material 1-Digit Number = 3
Cargo	Cargo Body Type
# Fatalities	Number of Fatalities
# Injuries	Number of Injuries
Phase	N/A
Others	Truck/Bus = t (truck)

Table B-3. California Highway Patrol

Field	California Highway Patrol Field Name and Criteria
Accident	Assuming Yes (Since all Property Use is Highway) [1]
Source	CA
Interstate	Cannot determine if Interstate or Intrastate [2]
Spill	Extent of Release and Release Factor
Date	Indate = */*/96
Time	Time Notified
Accident Street	Address
Accident City	City
County	County
Accident State	CA by default
Carrier Name	Not available
Census Number	Not available
Carrier State	Not available
HZMT Placards	Placards Required = -1 (Yes)
HZMT Name	Chemname
HZMT Trade	N/A
HZMT 4-Digit #	DOTID
HZMT 1-Digit #	DOT Hazard Class = 3
Cargo	Container Type
# Fatalities	Fatality
# Injuries	Injury
Phase	N/A
Others	Surrounding Area (Property Use Description) Property Use code = 961, 962, 963 (freeway, county/city road, private road)
	Mobile Property (Description) Code/mobile = 20, 99, 00 (Freight Vehicle/road, Other, Undetermined)
	Equipment Type (Description) Code, equipment = Not 97 (not Vehicle Fuel System)
	ConDescribe = not 1 (not fixed).
	Contype = not 41 (not vehicle fuel tank).
	Conlevel = not 40 (not below ground).

1. Assuming all records pulled are accidents since all occurred on highways.
2. Cannot determine if Interstate of Intrastate carrier.

Table B-4. Public Utilities Commission of Ohio (PUCO)

Field	PUCO Field Name and Criteria
Accident	Accident = Yes
Source	OH PUCO
Interstate	Interstate (= Yes, No, or Unknown)
Spill	Released (= Yes or No)
Date	Date = */*/96
Time	Time
Accident Street	Route/Milepost
Accident City	City
County	County
Accident State	OH by default
Carrier Name	Carrier name
Census Number	Not available
Carrier State	Carrier State
HZMT Placards	Not available – Assumed Yes
HZMT Name	Materials Involved
HZMT Trade	N/A
HZMT 4-Digit #	Not available
HZMT 1-Digit #	Not available [1]
Cargo	Cargo = Yes or Unknown and Packaging
# Fatalities	Fatalities
# Injuries	Injuries
Phase	N/A
Others	Enroute = Yes
	Gallons
	Carrier City

1. Materials Involved: Using the 1996 North America Emergency Response Handbook, the Materials Involved field was analyzed to see if was Class 3. If not Class 3, then the entry was deleted from the search.

Table B-5. Colorado State Patrol

Field	Colorado State Patrol Field Name and Criteria
Accident	Assuming Yes (Since all Property Use is Highway) [1]
Source	CoSP
Interstate	Can not determine if Interstate or Intrastate
Spill	Relfact: 71, 94, 98, or Is Null (Collision/Overturn, Fire/explosion, No Release, Null) [2]
Date	Incident Date (All 1996 records)
Time	Incident Time
Accident Street	Location
Accident City	City/Town
County	County
Accident State	CO by default
Carrier Name	Carriers/Facility Name
Census Number	Not available
Carrier State	Carr/Facil St
HZMT Placards	Placds Reqd = Y (1st & 2nd HZMT Entries)
HZMT Name	Chem/TradeName
HZMT Trade	N/A
HZMT 4-Digit #	DOT ID No (1st & 2nd HZMT Entries)
HZMT 1-Digit #	DOT HZRD Class = 3 (1st & 2nd HZMT Entries)
Cargo	Container Type
# Fatalities	Fatality: [responders killed + others killed]
# Injuries	Injury: [responders injured + others injured]
Phase	N/A
Others	Property Use = 961, 962, 963, 098 or Is Null (freeway, county/city road, private road, other or Null)
	Type of Incident = Transportation or Null
	Veh Type = 20 or Is Null (Freight Veh/Road)
	Container Type (1st & 2nd HZMT Entries)
	Extent of Release (1st & 2nd HZMT Entries)
	Car/Facil City
	US DOT #

1. Assuming all records pulled are accidents since all occurred on highways
2. Spill field manually entered as y/n based on Relfact field plus other information.

Table B-6. Trucks Involved in Fatal Accidents (TIFA)

Field	TIFA Field Name and Criteria
Accident	Assuming Yes
Source	TIFA
Interstate	Can not determine if Interstate or Intrastate [1]
Spill	Spill/Spill
Date	Date: [Accident Month, Accident Day, Accident Year]
Time	Time: [Accident Hour, Accident Minute]
Accident Street	Case Street
Accident City	Case City
County	Case County/ Name
Accident State	Case State/ ABBREV
Carrier Name	Not available
Census Number	Not available
Carrier State	Not available
HZMT Placards	HZMT Placard/ Has Placard
HZMT Name	Spec Cargo
HZMT Trade	N/A
HZMT 4-Digit #	Not available
HZMT 1-Digit #	Determined by User [2]
Cargo	V132/Cargo Body Type
# Fatalities	Fatalities
# Injuries	Injuries
Phase	N/A
Others	Hazardous Cargo = 1 PU HZMT Cargo/ PU Has Cargo 1T HZMT Cargo/ 1T Has Cargo 2T HZMT Cargo/ 2T Has Cargo 3T HZMT Cargo/ 3T Has Cargo

1. Cannot determine if Interstate or Intrastate carrier.
2. Looked up HZMT Name in 1996 North American Emergency Response Handbook to determine which HZMT Names were Class 3. Deleted non-class 3 entries and no placard entries.

Appendix C

Accident Information for Class 3, Class 2.1, and Class 8

Table C-1. 1996, Class 3, Accident Information for Colorado

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/03/96	Roadway Express Inc	N[1]	✓			Colorado 6 & Colorado 70	Not reported Clear Creek						✓	0	0												
01/08/96	Eveready Freight Service, Inc.	Y	✓			I-70 7600 BLK	Arvada Jefferson						✓	1	0												
01/19/96	Richard Stewart Transport	Y	✓			Colorado 40 & MP 249	Not reported Clear Creek						✓	1	0												
01/25/96	Eveready Freight Co	Y	✓			Colorado 70 & Exit 221	Not reported Clear Creek						✓	1	0												
01/28/96	Basin Western, Inc.	Y[2]	✓			Colorado 40 & MP 161	Not reported Grand						✓	0	0						✓	0	0				
01/30/96	Dooley Oil Transport, Inc.	Y	✓			Colorado I-25 & MP 293	Not reported Larimer						✓	0	0												
02/04/96	Monument Oil Company	Y	✓			Colorado 13 & MP 83	Not reported Moffat						✓	0	0												
02/17/96	Fleischli Oil Co., Inc.	Y	✓			RCR 27 MP 19	Hayden Routt	✓		0	0	✓		0	0					✓		0	0				
02/19/96	James, Inc.	Y	✓			Colorado 40 & MP 161	Not reported Grand					✓		1	0												
03/05/96	DSI Transports, Inc.	Y	✓			Brighton Rd & 77th Ave	Not reported Adams						✓	2	0												
03/05/96	NATCO Petroleum, Inc.	Y	✓			Colorado 285 & MP 5	Not reported Conejos						✓	2	0												
03/18/96	Groendyke Transport, Inc.	Y	✓			Colorado 25 & MP 188	Not reported Douglas						✓	10	0												
04/03/96	Sweitzer Oil, Inc.	Y			✓	Colorado 285 .3N MP 168	Not reported Park														✓	0	0				
04/05/96	Palmer Oil Company	Y			✓	C&K Oil Company Hwy 40	Cheyenne Wells Cheyenne													*	*	0	0				
04/19/96	J C Trucking, Inc.	Y	✓			US HWY 40 MP 162	Kremmling Grand	✓		0	0									✓		0	0				
04/30/96	Groendyke Transport, Inc.	Y	✓			Powers Blvd & W Bradley Rd	Not reported El Paso					✓		1	0					✓		1	0				

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[1] Van/Enclosed Box

[2] Colorado State Patrol says "tank", not cargo tank

Legend: Y = Yes; N = No; * Not reported

Table C-1. 1996, Class 3, Accident Information for Colorado (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
05/06/96	Monte Vista Coop	Y	✓			Colorado 96 & MP 203	Not reported Kiowa						✓	1	0												
06/10/96	Fleet Transport Co., Inc.	Y	✓			I-70 West 412 MN	Vona Kit Carson	✓		0	0	✓		2	0												
06/13/96	Thomas Bodkin	*	✓			7400 Blk Hwy 85	Commerce City Adams						✓	1	0												
06/22/96	Matlack, Inc.	Y	✓			US 40	Berthoud Falls Clear Creek	✓		0	0	✓		2	0												
07/09/96	Klein Frank C & Co., Inc.	Y	✓			I-70	Idaho Springs Clear Creek	✓		0	0	✓		0	0												
07/18/96	Bogue Construction Co	Y			✓	Colorado 70 EB .9E MP 146	Not reported Eagle														✓	0	0				
07/27/96	Texaco Trading & Transport	Y			✓	Weld CR 390 .2 N Weld CR 136	Not reported Weld													✓		0	0				
07/28/96	Harpel Oil Company, Inc.	Y	✓			I-70 & Colorado 121	Arvada Jefferson						✓	0	0												
07/29/96	Groendyke Transport, Inc.	Y	✓			E Quincy Ave & S Parker Road	Aurora Arapahoe						✓	0	0												
08/04/96	Total Petroleum	Y			✓	I-76 at MM 31	West of Hudson Weld													✓		0	0				
08/19/96	Loco, Inc.	Y	✓			Hwy 133	Paonia Delta	✓		0	0																
08/20/96	Groendyke Transport, Inc.	Y	✓			Colorado 76 & Colorado 25	Not reported Adams						✓	1	0												
09/01/96	Basin Western, Inc.	Y	✓			I-70 B & 31 ½ Road	Grand Junction Mesa	✓		0	0																
09/16/96	Steere Tank Lines, Inc.	Y	✓			I-25 & MP 205	Denver Denver					✓		1	0												
10/03/96	Arkansas Valley Coop	Y		✓		Colorado 10 & CR 22	Not reported Otero						✓	1	0												
10/09/96	Farmland Industries, Inc.	Y	✓			I-70 & MP 283	Aurora Adams						✓	0	0												
11/26/96	Iowa Tanklines, Inc.	Y	✓			Colorado 25 & Colorado 119	Not reported Weld						✓	1	0												
11/27/96	Wright Valley Oil, Inc.	Y	✓			Colorado 160 & MP 273	Not reported Costilla					✓		3	0					✓		0	0				
12/14/96	Ehnle Oil	Y	✓			Colorado 40 & Empire	Not reported Clear Creek						✓	0	0												

Legend: Y = Yes; N = No; * Not reported

Table C-1. 1996, Class 3, Accident Information for Colorado (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
12/16/96	James, Inc.	Y			✓	Colorado 25 .4 Ft N MP 239	Not reported Weld													✓		1	0				
12/17/96	Groendyke Transport, Inc.	Y	✓			6900 Blk I-25 & E Arapahoe	Greenwood Village Arapahoe						✓	1	0												
12/17/96	Iowa Tanklines, Inc.	Y	✓			3805 Kipling	Wheat Ridge Jefferson	✓		0	0																
12/17/96	Unknown	Y			✓	I-25 at Colorado 7	Not reported Adams																		✓	*	*
12/28/96	Peerless Tyre Co	Y	✓			S Sheridan Blvd & W Mississippi	Lakewood Jefferson						✓	0	0												
12/29/96	Basin Western, Inc.	Y	✓			MP 125 Co Hwy 9	Silverthorne Summit	✓		0	0	✓		1	0												

Legend: Y = Yes; N = No; * Not reported

Table C-2. 1996, Class 3, Accident Information for Ohio

								HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Ohio PUCO Impacts				Dialog Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/02/96	Penske Truck Leasing	Y	✓			MP 006.00	Denmark Township Ashtabula						✓	0	0												
01/03/96	B P Oil Co.	Y	✓			Rt 162	Chatham Medina	✓		0	0																
02/06/96	Preston Trucking Co.	N[1]	✓			2977 Brecksville Road	Richfield Henry	✓		0	0																
04/01/96	Advantage Tank Lines, Inc.	Y	✓			MP 073.00	Somerford Township Madison						✓	0	0												
04/15/96	Suttles Truck Leasing, Inc.	Y	✓			I-71 NB MM63	Columbus Fairfield	✓		0	0																
04/25/96	Dixieland Express	Y	✓			I-71	Symmes Hamilton													✓		0	0				
06/14/96	Consolidated Freightways Corp Del	N[1]	✓			I-71 Northbound	Mount Sterling Madison	✓		0	0																
06/30/96	Lykins Oil Co.	Y	✓			Rt 48 at I-71 Ramp	Not Available Warren	✓		0	0	✓		1	0					✓		0	0				
08/26/96	Safety Kleen	Y			✓	Rt 6/Wapakoneta Rd	Grand Rapids Wood														✓	2	1				
08/29/96	BMI Transportation, Inc.	Y	✓			Rt 519E	Franklin Columbiana	✓		1	0																
09/05/96	Not Available	Y			✓	Route 315	Columbus Franklin																		✓	2	0
09/23/96	Freight Sales, Inc.	Y	✓			MP 005.00	Moorefield Twp Harrison						✓	1	0												
10/29/96	Matlack, Inc.	Y	✓			I-70/MM 122	Kirkersville Licking	✓		0	0	✓		1	0					✓		1	0				
10/30/96	Columbia Oil Co.	Y	✓			State Route 73	Wilmington Clinton	✓		0	0																
11/06/96	Not Available	Y			✓	North Dixie Drive	Harrison Twp Not Available																	✓		1	0
11/07/96	Swifty Oil	Y	✓			Rt 25A	Dayton Montgomery													✓		0	0				
11/18/96	Sun Company	Y	✓			Ohio Turnpike/ MM 196	Mantua/Reenna Portage	✓		0	0									✓		0	0				
12/30/96	Premier Tank Lines	Y	✓			SR #138	Clarksburg Ross	✓		0	0	✓		1	0					✓		0	0				

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[1] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table C-3. 1996, Class 3, Accident Information for California

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/09/96	Pan Pacific Petroleum Co., Inc.	Y		✓		Rt 405/Normandie Ave	Torrance Not Available						✓	0	0												
01/10/96	Chevron USA, Inc.	Y		✓		Rt 118/Chatsworth	Los Angeles Not Available						✓	0	0												
01/12/96	HF Cox	Y	✓			Rt 118/Ruffner Ave	Los Angeles Not Available						✓	0	0												
01/20/96	Pearce Tank Line	Y		✓		Rt 405/Carson	Carson Not Available						✓	2	0												
01/21/96	H F Cox, Inc.	Y		✓		Rt 5/Rye Cyn	Los Angeles Not Available						✓	0	0												
01/23/96	Miller Roy Freight Lines, Inc.	N[1]	✓			Ferguson Road	Gilroy Santa Clara	✓		0	0																
01/30/96	Cool Transports, Inc.	*		✓		Rt 101 Nbon/R/ Pilgrimage	Los Angeles Not Available						✓	1	0												
02/08/96	Shell Oil Products Co.	Y		✓		Rt 17/Glenwood Cut/Off	Santa Cruz Not Available						✓	0	0												
02/24/96	Van Dyk Oil Co., Inc.	Y	✓			Rt 395/Osdick Rd	San Bernardino Not Available						✓	0	0												
02/25/96	Cox Oil Co., Inc.	Y	✓			Rt 91/Woodruff Av	Bellflower Not Available						✓	1	0												
02/26/96	Systems Transport	Y	✓			Rt 91/Orange Av	Long Beach Not Available						✓	0	0												
02/27/96	Cross Petroleum Inc.	Y	✓			Rt 99 Sboff/R/E Park Ave	Chico Not Available						✓	0	0												
03/05/96	Alta	Y	✓			Rt 710 Sbtrn/Rt 405	Long Beach Not Available						✓	1	0												
03/13/96	Atlas Bulk, Inc.	Y	✓			Rt 210/Madre	Pasadena Not Available						✓	0	0												
03/13/96	San Joaquin Helicopters	Y		✓		30 Av/Nevada Av	Kings Not Available					✓		1	0												
03/16/96	Golden Bear	Y	✓			Rt 405/Mulholland Dr	Los Angeles Not Available						✓	0	0												
03/19/96	Jose Toledo	Y	✓			Rt 5/Rt 223	Kern Kern					✓		1	1	✓		3	1								
03/22/96	United Oil Company	Y	✓			Rt 101/Echo Pk	Los Angeles Not Available						✓	0	0												

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[1] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table C-3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
03/24/96	Vasto Valley Farms	Y	✓			Rt 198/California Aquedct	Fresno Not Available						✓	5	0												
03/28/96	Crown Chemical	Y		✓		Rt 5/Las Flores	Carlsbad Not Available						✓	0	0												
04/03/96	Redwood Oil Company	Y		✓		Rt 101/San Antonio Rd	Sonoma Not Available						✓	1	0												
04/10/96	KEC Engineering	N[2]		✓		Rt 60/Gilman Spg Rd	Riverside Not Available						✓	0	0												
04/13/96	Not Available	Y			✓	Avenue 24 East of SR 99	Chowchilla Madera													✓		0	0				
04/22/96	Myers Tank Lines	Y		✓		Rt 8/Severin Dr	LaMesa Not Available						✓	0	0												
05/11/96	Yellow Freight Systems	N[2]	✓			Rt 105/Harris Av	Lynwood Not Available						✓	0	0												
05/13/96	Larry Dee Kothe	Y	✓			Rt 405/120	Los Angeles Not Available					✓		0	0												
05/23/96	R F White Co., Inc.	Y		✓		Main/Placentia Ln	Riverside Not Available						✓	0	0												
05/30/96	BC Stocking Distributing	N[2]		✓		Rt 680/Monument BL UC	Pleasant Hill Not Available					✓		0	0												
06/07/96	J W Myers, Inc.	Y		✓		Rd 16/Av 6	Madera Not Available						✓	0	0												
06/09/96	Arco Products Co.	Y	✓			Rt 5/Zoo Dr OC	Los Angeles Not Available					✓		1	0												
07/04/96	Atlas Bulk, Inc.	Y	✓			Rt 101	Petaluma Sonoma					✓		0	1	✓		0	1					✓		0	1
07/08/96	Atlas Bulk, Inc.	Y	✓			Rt 805/Adams Av OC	San Diego Not Available						✓	0	0												
07/15/96	Beneto, Inc.	Y	✓			Hwy 99 South	Mettler Kern	✓		0	0	✓		1	0												
07/18/96	Jack Griggs, Inc.	Y		✓		Cedar Av/Adams Av	Fresno Not Available						✓	0	0												
07/19/96	Casazza Trucking Co.	Y	✓			Rt 395/1.6 miles N of Buckeye Road	Bridgeport Mono	✓		0	0	✓		0	0					✓		0	0				
07/26/96	Trans Petro of California	Y	✓			Tuxford/San Fernando Road	Los Angeles Not Available						✓	1	0												
07/29/96	Not Available	Y			✓	I15	Ontario San Bernardino									✓		0	1								

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[2] Van/Enclosed Box

Legend: Y = Yes; N = No; * Not reported

Table C-3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
07/29/96	Toms Sierra Co., Inc.	N[1]	✓			Hwy 70 Exit	Oroville Butte	✓		0	0																
08/06/96	Redwood Oil Co.	Y		✓		Rt 116/Arnold Dr.	Sonoma Not Available						✓	5	0												
08/07/96	Not Available	Y			✓	S/B I-5 S/O Obrien	Uninc. Redding Shasta													*	*	0	0				
08/08/96	Marvin, Inc.	Y		✓		Aberdeen Dr/Rt 247	San Bernardino Not Available					✓		0	0												
08/13/96	Columbia Helicopters, Inc.	Y	✓			Rt 20/Walker Ridge Rd	Lake Not Available					✓		0	0												
08/16/96	Mobil Oil Corp.	Y		✓		Rt. 215/Mill UC	San Bernardino Not Available						✓	1	0												
08/30/96	Southwest Trails	Y		✓		Rt 101/Canoga Av.	Los Angeles Not Available						✓	0	0												
08/31/96	Dan Clark	Y		✓		Rt 46/Browns Material Rd	Kern Not Available						✓	0	0												
09/08/96	Desert Propane Service	Y		✓		Rt 91/Long Bch Bl	Long Beach Not Available						✓	0	0												
09/11/96	American Propane LP	Y	✓			Rt 5	Stanislaus Not Available						✓	0	0												
09/11/96	Williams Tank Lines	Y		✓		Rt 14/Puritan Mine Rd UC	Los Angeles Not Available						✓	0	0												
10/01/96	Van Dyk Oil Co., Inc.	*		✓		Rt 15/Rt 138	San Bernardino Not Available						✓	0	0												
10/02/96	Not Available	Y			✓	Rt 98	Not Available Monterey									✓		0	1								
10/08/96	BiState Petroleum	Y	✓			US Hwy 50	Not Available Not Available																	✓		0	0
10/15/96	Desert Propane Service	*		✓		Rt 110/Pico Bl	Los Angeles Not Available						✓	0	0												
10/20/96	Ueta of California, Inc.	Y		✓		Rt 94/Home AV OC	San Diego Not Available						✓	0	0												
10/21/96	H F Cox, Inc.	Y		✓		Rt 14/Placerita Cyn	Los Angeles Not Available						✓	1	0												
11/01/96	Beneto Tank Lines	Y		✓		Rt 15/Franklin OC	Riverside Not Available						✓	1	0												
11/01/96	Coastal Transport Co., Inc.	Y	✓			Rt 78/Town Palo Verde	Imperial Not Available						✓	1	0												
11/05/96	Cross Petroleum Transport, Inc.	Y	✓			Interstate 5 & O'Brien Exit	O'Brien Shasta	✓		0	0									*	*	0	0				
11/11/96	Ramos Oil Co., Inc.	Y		✓		Sievers Rd/Sparks Rch Rd	Solano Not Available						✓	0	0												

Legend: Y = Yes; N = No; * Not reported

Table C-3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
11/12/96	Flying J Transportation, Inc.	Y		✓		Worthington Rd/ McConnell Rd	Imperial Not Available						✓	4	0												
11/22/96	Not Available	Y			✓	Rt 78	Not Available Imperial									✓		0	1								
11/22/96	Arco Products Co.	Y	✓			Reservoir @ Philadelphia	Pomona Los Angeles	✓		0	0																
12/12/96	D L Peterson/West Shore Corp.	N^2		✓		Rt 5/Buena Vista Cnl Rd	Kern Not Available						✓	2	0												
12/14/96	Arco Products Co.	Y	✓			785 E Stanley Blvd	Livermore Alameda	✓		0	0																
12/16/96	Polyester Chemical Corp	N^2		✓		Rt 14/Escondido Cyn Rd	Los Angeles Not Available						✓	0	0												
12/22/96	Rinehart Oil, Inc.	Y			✓	Marina Vista and Shell Avenue	Martinez Not Available																	✓		0	0
12/24/96	Cosby Oil Company	Y		✓		Rt 5/Broadway Av	Los Angeles Not Available						✓	0	0												
12/29/96	Williams Tank Lines, Inc.	Y	✓			Rt 99/Carpenter Rd OC	Modesto Not Available						✓	0	0												
12/31/96	California Fresno Trans. Co.	Y	✓			Rt 41/McKinley Av UC	Fresno Not Available						✓	0	0												

Legend: Y = Yes; N = No; * Not reported

Table C-4. 1996, Class 3, Accident Information for Indiana

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/03/96	Ashland Chemical Co.	N[1]	✓			I-65 NB 12MM	Sellersburg	Clark						✓	1	0				
01/04/96	Oliver D. Adams	Y	✓			US-231	Cloverdale	Putnam						✓	1	0				
01/22/96	Stahly Cartage Co.	Y	✓			SR-3/SR-205	Laotto	DeKalb					✓		2	0				
01/26/96	Preston Trucking Co., Inc.	N[1]	✓			I-94 WB 29MM	Michigan City	Porter					✓		1	0				
04/05/96	Metropolitan Trucking, Inc.	N[1]	✓			Indiana Toll Rd 59.2MM	New Carlisle	LaPorte						✓	2	0				
04/23/96	Distribution Transportation System	N[1]	✓			US-36 and CR-200 West	Muncie	Randolph						✓	0	0				
05/01/96	R&D Transport, Inc.	Y	✓			US 136 at Dandy Trail	Clermont	Marion	✓		1	0								
05/14/96	Superior Carriers, Inc.	Y	✓			I 80 EB 12MM	Lake Station	Lake	✓		0	0								
06/05/96	Usher Transport, Inc.	Y	✓			I-64 EB 122.5MM	New Albany	Floyd	✓		0	0	✓		2	0				
07/29/96	Crystal Flash	Y	✓			SR-39 & SR-142	Monrovia	Morgan					✓		1	0				
08/26/96	FJ Schilling, Inc.	N[1]	✓			I-465 W 37BMM	Indianapolis	Marion						✓	1	0				
08/27/96	Montgomery Tank Lines	Y	✓			US-52 & US-28	Fickle	Tippecanoe						✓	0	0				
08/29/96	DC Trucking, Inc.	N[1]	✓			I-65 SB 53MM	Seymour	Jackson					✓		2	0				
09/04/96	Preston Trucking Co., Inc.	N[1]	✓			US-41 SB	Shelburn	Sullivan						✓	1	0				
09/07/96	Mid-States Express, Inc.	N[2]	✓			I-94 @ US Route 20	Burns Harbor	Porter	✓		0	0								
09/09/96	Howell Transportation Services, Inc.	Y	✓			I-69 72MM	VanBuren	Grant	✓		0	0	✓		2	0				
09/16/96	Premier AG Coop	Y	✓			SR-32 East of Casey	Westfield	Hamilton					✓		0	1	✓		0	1

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[1] Van/Enclosed Box

[2] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table C-4. 1996, Class 3, Accident Information for Indiana (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
09/24/96	Reis Trucking, Inc.	Y	✓			SR-350 & North Hogan Rd	Center Twp.	Dearborn						✓	2	0				
10/08/96	Matlack, Inc.	Y	✓			I-65 NB to I-80 WB	Calumet	Lake						✓	1	0				
10/09/96	Harvey Construction Co., Inc.	*	✓			5579 East 146th Street	Noblesville	Hamilton						✓	1	0				
10/21/96	American Freightways, Co., Inc.	N[2]	✓			Jefferson Blvd.	Fort Wayne	Allen	✓		0	0								
10/28/96	Fayette County Co-Op	Y	✓			SR-44 WB	Connersville	Fayette						✓	1	0				
10/29/96	R&D Transport	*	✓			I-65 SB 251MM	Merrillville	Lake						✓	0	0				
11/02/96	Ag One Co-Op	Y	✓			CR-500 N West of CR-300N	Lafayette Twp.	Madison						✓	2	0				
11/09/96	USF Holland, Inc.	N[1]	✓			Indiana Toll Rd 136.1MM WB	Orland	Steuben						✓	0	0				
11/20/96	Transwood, Inc.	Y	✓			I-65 NB N of 200MM	Remington	Jasper						✓	0	0				
11/22/96	American Freightways, Inc.	N[1]	✓			Tibbs & Minnesota	Indianapolis	Marion						✓	0	0				
11/27/96	Knox Co. Farm Bureau Co-Op Association, Inc.	Y	✓			Old US-41S	Vincennes	Knox						✓	1	0				
12/02/96	Midland Co-Op, Inc.	N[1]		✓		600 N Indiana Street	Greencastle	Putnam						✓	1	0				
12/12/96	Bork Transport, Inc.	Y	✓			N. Franklin Road & E 34th Street	Indianapolis	Marion						✓	2	0				
12/19/96	Johnson Oil Company, Inc.	Y	✓			I-456 SB 200' South of 42MM	Indianapolis	Marion						✓	4	0				
12/19/96	Luke Oil Company	Y	✓			I-90 WB 12.7MM	Gary	Lake						✓	0	0				
12/29/96	McDaniel Transportation	Y	✓			I-65S 98MM	Greenwood	Johnson					✓		0	0				

Legend: Y = Yes; N = No; * Not reported

Table C-5. 1996, Class 3, Accident Information for Oregon

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/20/96	Johnson Oil Company	Y	✓			.2E Woodson Road	Not Available	Columbia						✓	2	2				
01/23/96	Barnes Fuel Oil Service	Y		✓		Sunset St. & Alameda	Not Available	Douglas						✓	0	0				
01/30/96	Hayes, RW Co.	Y	✓			Not Available	Not Available	Lane						✓	0	0				
02/24/96	American Transport, Inc.	Y	✓			Chemaward	Not Available	Marion						✓	2	0				
03/20/96	Tarr, Inc.	Y	✓			2700 Block	Not Available	Washington						✓	1	0				
04/22/96	Staub, Ed & Sons Petroleum, Inc.	Y	✓			.3 N Co. Rd. 2-9	Not Available	Lake					✓		0	0				
05/18/96	Jackson Oil Trucking, Inc.	Y	✓			1.00 S Old Ritter Road	Not Available	Grant					✓		1	0				
05/22/96	Carson Oil Co., Inc.	Y	✓			Wilsonville Road	Not Available	Clackamas						✓	0	0				
06/26/96	Fossil Fuel, Inc.	Y		✓		Hwy 207	Not Available	Wheeler					✓		1	0				
07/18/96	Swift Transportation Co., Inc.	*	✓			.5W Hoyt Road	Not Available	Umatilla						✓	1	0				
07/22/96	Texaco Refining & Marketing	Y	✓			State Hwy 37 MP 13	Holdman	Umatilla	✓		1	0	✓		1	0				
07/30/96	Nationsway Transport Service, Inc.	*	✓			Not Available	Not Available	Union						✓	0	0				
07/31/96	USF Reddaway, Inc.	*	✓			1.5N Sunny Valley	Not Available	Josephine						✓	1	0				
08/21/96	Texaco Refining & Marketing	Y	✓			2.5 E US-30	Not Available	Baker					✓		1	0				
08/22/96	Texaco Refining & Marketing	Y	✓			E 1-84 near MP 289	North Powder	Union	✓		1	0								
08/30/96	Williams Tank Lines	Y	✓			13MM on Sprague River Hwy	Chiloquin	Klamath	✓		0	0								
09/05/96	Tosco Refining & Marketing Company	Y	✓			Broadway & 6th Street	Not Available	Multnomah						✓	0	0				
09/11/96	Rickreall Farm Supply, Inc.	Y	✓			.25 Hwy 22	Not Available	Polk						✓	1	0				
09/12/96	Oil Products, Inc.	Y	✓			Near I-5	Not Available	Marion						✓	0	0				
09/25/96	Viking Freight, Inc.	*	✓			Not Available	Not Available	Jackson					✓		1	0				
10/16/96	Chinkapin, Inc.	Y	✓			40 Ft W Dexter Road	Not Available	Lane						✓	1	0				
11/04/96	Alpha Owens Corning, LLC	*	✓			Barlow RD & Whiskey Hl	Not Available	Clackamas						✓	1	0				
11/05/96	Star Oil Company	Y	✓			Harold Street	Not Available	Multnomah						✓	1	0				

Legend: Y = Yes; N = No; * Not reported

Table C-5. 1996, Class 3, Accident Information for Oregon (continued)

									HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
11/19/96	American Transport, Inc.	Y	✓			Not Available	Not Available	Jefferson					✓		1	0				
11/19/96	The Oil House	Y	✓			Williams Hwy	Not Available	Jackson						✓	0	0				
11/20/96	Space Age Fuel, Inc.	Y	✓			Not Available	Not Available	Wasco						✓	0	0				
12/03/96	Werner Enterprises	N[1]	✓			I-84 Mile Post 333	Weatherby	Baker	✓		0	0								
12/23/96	Reese's Oil Co., Inc.	Y		✓		100 Ft S Park	Not Available	Clackamas					✓		4	0				
12/27/96	Harris Transportation Co.	Y	✓			Not Available	Not Available	Sherman						✓	1	0				
12/30/96	Cascade Transfer, LLC	Y		✓		Delta Hwy	Not Available	Lane						✓	1	0				

Legend: Y = Yes; N = No; * Not reported

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[1] Van Truck/Trailer

Table C-6. 1996, Class 3, Accident Information for Iowa

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/26/96	Solar Transport Co	Y	✓			B35 and Hwy 65	Mason City	Cerro Gordo						✓	0	0				
2/19/96	Denny Wessel Transport	Y	✓			Hwy 18 & N 60	Cylinder	Palo Alto	✓		0	0	✓		1	0				
2/23/96	Iowa Tanklines Inc	Y	✓			1 1/2 mi North of IA 546	Carlisle	Polk	✓		0	0								
2/23/96	Wynne Transport Service Inc	N[1]	✓			I 80 EB 187.75 MM	not available	Poweshiek						✓	1	0				
3/27/96	Farmland Industries	Y	✓			Army Post Rd Hwy 5	Des Moines	Polk						✓	0	1				
4/29/96	Adm Trucking Inc	Y	✓			I-30, NB Milemarker 46	Urbana	Benton	✓		0	0	✓		1	0				
8/09/96	Dougs Transfer	N[1]	✓			Hwy 65 1/2 mile South of Mason City	Cerro Gordo	Cerro Gordo						✓	3	0				
8/10/96	Wayne Transports Inc	Y	✓			Hwy 9 and 71,327 E Peoria Avenue	Spirit Lake	Dickinson						✓	1	0				
9/21/96	Transwood Inc.	Y	✓			Interstate 35 South	Story City	Story	✓		0	0	✓		1	0				
10/22/96	G & G Express Inc	N[2]	✓			Hwy 30	Grand Mound	Clinton	✓		0	0								

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[1] Van/Enclosed Box

[2] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table C-7. 1996, Class 3, Accident Information for Minnesota

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/15/96	Jebro, Inc.	Y	✓			Interstate 90 Mile Marker 35	Dewald	Nobles	✓		0	0								
2/08/96	Independent Diversified Transport	Y	✓			Co. Rd. 14 Co. Rd. 102	Miltona	Douglas	✓		0	0	*	*	1	0				
3/14/96	Dahlen Transport, Inc.	Y	✓			Madison Ave & River Front Drive	Mankato	Blue Earth	✓		0	0								
5/21/96	Jensen Transport Co., Inc.	Y	✓			Hwy 86 MP 4	Lakefield	Jackson	✓		0	0								
8/02/96	Dahlen Transport, Inc.	Y	✓			63 Northbound	Racine	Mower	✓		0	0					✓		1	1
8/23/96	Orton Transport	Y		✓		Hwy 2		Polk					✓		1	0				
8/29/96	Kane Transport Co.	Y	✓			Minnesota Hwy 7	New Germany	Carver	✓		2	0								
9/06/96	Mielke Oil Co.	Y	✓			Concord & 494	South St. Paul	Dakota	✓		0	0								
9/20/96	Roche Oil Co.	Y	✓			CSAH 102	Mountain Iron	St. Louis	✓		0	0								
10/19/96	Wayne Transports, Inc.	Y	✓			Hwy 88 & County LA	New Brighton	Ramsey	✓		0	0								
10/29/96	Dahlen Transport, Inc.	Y	✓			Hwy 101 NB @ Co. Rd. 42	Otsego	Wright	✓		0	0								
12/24/96	Yocum Oil Company	Y		✓		E Co. Rd. E	Vadnais Heights	Ramsey					*	*	1	0				

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/02/96	C A Leasing Inc	Y		T		Route 2004	Hamilton	Monroe					T		1	0				
01/02/96	Union Fuel Co.	Y		T		Pierce St	Easton	Northampton						T	1	0				
01/04/96	AIRCO Industries	Y	T			Route 0202	Upper Merion	Montgomery						T	0	0				
01/05/96	Agway Energy Products	Y	T			Route 1011	Oakland	Butler						T	0	1				
01/05/96	JJ Skelton Oil Co	Y		T		Route 1007	Silver Spring	Cumberland						T	2	0				
01/06/96	Box Gases	Y	T			East/West Turnpike	Penn	Westmoreland						T	1	0				
01/06/96	Brinkers Fuels Inc	Y	T			Perry Auger Rd	Nockamixon	Bucks						T	0	0				
01/06/96	Joanna Oil Company	Y	T			Zion Rd	Robeson	Berks						T	0	0				
01/09/96	Ferrell Gas	Y	T			Route 0472	Colerain	Lancaster						T	1	0				
01/09/96	H. L. Meyer Inc.	Y		T		Horseshoe Pk	South Annville	Lebanon						T	0	0				
01/09/96	Reed Oil	Y	T			Lakewood Rd	Hickory	Lawrence						T	1	0				
01/10/96	Exxon Co USA	Y	T			Interstate 0079	Cecil	Washington						T	1	0				
01/10/96	K L Lamborson Inc	Y	T			Pine St	Mt Union	Huntingdon						T	1	0				
01/10/96	Russell E Conrad Inc.	Y		T		Sander Al	Kutztown	Berks						T	0	0				
01/11/96	Boncosky Services Inc	Y	T			Lincolnway Rd	New Oxford	Adams						T	0	0				
01/11/96	Carninal USA Fuel	Y		T		Providence Rd	Nether Providence	Delaware						T	0	0				
01/11/96	Creamer Oil Company Inc	Y	T			Gabler Rd	Hamilton	Franklin						T	0	0				
01/11/96	Fanelli Bros Trking & Leasing	N[1]	T			Interstate 0078	Weisenberg	Lehigh					T		1	0				
01/11/96	Hutter Inc	Y	T			Walnut St	Lebanon	Lebanon						T	1	0				
01/11/96	Peters Gas & Oil Inc	Y		T		Route 0437	Fairview	Luzerne						T	0	0				
01/11/96	Seifert Enterprises Inc	Y	T			William Penn Hw	Whitehall	Lehigh						T	1	0				
01/12/96	Stahl Oil Co Inc	Y	T			Buffalo Pittsburgh	Croyle	Cambria						T	1	0				
01/12/96	Yellow Freight System Inc	N[1]	T			Interstate 0080	Marion	Centre						T	0	0				
01/13/96	Amerada Hess Corp	Y	T			Hanover Rd	Heidelberg	York						T	0	0				
01/13/96	Superior Carriers Inc.	N[2]	T			Interstate 0080	Greene	Clinton						T	1	0				

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[1] Van/Enclosed Box

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/14/96	J D Sales Inc	Y		T		Lower York Rd	Solebury	Bucks						T	0	0				
01/15/96	Joseph D Miller & Sons Inc	*	T			Ninth St	Philadelphia	Philadelphia						T	1	0				
01/15/96	Montour Oil Service Co	Y		T		Old Montoursvillrd	Loyalsock	Lycoming						T	0	0				
01/15/96	Spartan Express Inc	N^1	T			Seventh St	Emmaus	Lehigh						T	1	0				
01/16/96	Bruceton Farm Services Inc	Y	T			Route 0051	Perryopolis	Fayette						T	3	0				
01/16/96	Roadway Express Inc.	N^1	T			Interstate 0078	Greenwich	Berks					*	*	1	0				
01/17/96	Overnite Transportation Co	N^1	T			William Penn Hw	Greenwood	Perry						T	1	0				
01/18/96	Best Fuel Oil	Y	T			Route 0209	Polk	Monroe						T	0	0				
01/18/96	Supervalu Transportation	N^1	T			Route 0366	Washington	Westmoreland						T	1	0				
01/19/96	Baker Petroleum Trans Co	Y	T			Funk Rd	Hatfield	Montgomery						T	1	0				
01/20/96	Michael K Kowalski Incorp	Y	T			Union St	Corry	Erie						T	0	0				
01/22/96	Penndot	Y	T			Route 0026	Hopewell	Bedford						T	2	0				
01/23/96	Pjax	N^1	T			Route 0068	Oakland	Butler						T	0	0				
01/24/96	L K Burket & Brother	Y	T			Ithan Av	Radnor	Delaware						T	1	0				
01/25/96	D E Walker And Sons	Y		T		Sumneytown Pk	Lower Gwynedd	Montgomery						T	0	0				
01/26/96	Hillers Inc.	Y		T		Main St	So Williamsport	Lycoming						T	1	0				
01/27/96	New Penn Motor Express	N^1	T			East/West Turnpike	Rapho	Lancaster						T	0	0				
01/27/96	Praxair Inc.	Y	T			Interstate 0079	Jackson	Butler						T	2	0				
01/30/96	Moyer & Son	Y		T		Welsh Rd	Horsham	Montgomery						T	1	0				
01/31/96	Keroscene	Y		T		Roosevelt Bl	Philadelphia	Philadelphia						T	1	0				
02/09/96	Action Oil Co	Y	T			Route 3012	Georges	Fayette						T	0	0				
02/11/96	Titan Express	N^1	T			Interstate 0080	Clarion	Clarion						T	2	0				
02/12/96	Butler Petroleum Corporation	Y	T			Route 0224	Mahoning	Lawrence						T	0	0				
02/12/96	DBA Petroleum Heating Co.	*		T		Main St	Macungie	Lehigh						T	1	0				
02/12/96	U S Xpress Leasing Inc	N^2	T			Route 0062	Hermitage	Mercer						T	1	0				
02/12/96	Wilmington Oil Company Inc	Y	T			Benjamin Franklin HW	Mahoning	Lawrence						T	1	0				
02/13/96	Mckelvey Oil Co Inc	Y		T		Sr 0764 Sh	Allegheny	Blair						T	2	0				

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[2] Garbage/Refuse

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

									HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
02/14/96	Ho Wolding Inc	N[1]	T			Interstate 0080	Marion	Centre						T	0	0				
02/14/96	M Lynch Transportation Inc	Y	T			Susquehanna Tr	Penn	Snyder						T	0	0				
02/15/96	Hale Intermodal Trucking Co.	N[1]	T			East/West Turnpike	Bristol	Bucks						T	0	0				
02/19/96	Guttman Oil Co	Y	T			Route 0088	Speers	Washington						T	0	1				
02/20/96	Pro Oil Co Inc	Y	T			Route 62	Pine Grove	Warren	T		0	0	T		1	0				
02/20/96	Triangle Gasoline Co.	Y	T			Route 0038	Washington	Butler						T	0	0				
02/28/96	The Sico Co.	Y	T			Gap Newport Pk	New Garden	Chester						T	1	0				
03/02/96	Sank Inc.	*	T			Interstate 0095	Philadelphia	Philadelphia						T	0	0				
03/06/96	Heath Oil Inc	N[1,3]	T			I80	Mercer	Mercer	T		0	0		T	2	0				
03/06/96	Penn Mar Oil Co Inc	Y	T				Guilford	Franklin						T	0	0				
03/07/96	Atlantic Refining & Marketing Corp	*	T			McFarland RD	Mt Lebanon	Allegheny						T	0	0				
03/09/96	V J Belotti Inc	Y		T		Main St	Avoca	Luzerne						T	3	0				
03/11/96	Bahn Fuel Oil Co	Y		T		Snyder Hill Rd	Warwick	Lancaster						T	1	0				
03/12/96	Pitt-Ohio Express Inc	N[4]	T			Interstate 80	Milesburg	Centre	T		0	0								
03/12/96	Sun Refining & Marketing Co	*	T			Cheyney Rd	Concord	Delaware						T	1	0				
03/12/96	Zeke's Inc	Y		T		Telegraph Rd	West Caln	Chester						T	1	0				
03/13/96	Glassmere Fuel Service Inc	Y	T			Butler St	Etna	Allegheny						T	1	0				
03/13/96	Penske Truck Leasing Co	N[1]	T			Interstate 0078	Tilden	Berks						T	1	0				
03/13/96	Snapp Brothers	Y		T		Interstate 0099	Snyder	Blair						T	3	0				
03/16/96	Roberts Express Inc	Y	T				Penn Hill	Lancaster	T		0	0								
03/22/96	Herzog Brothers	Y	T			Route 0062	Pine Grove	Warren						T	1	1				
03/25/96	Crossett Inc	Y	T			Rt 770	Marshburg	Mckean	T		0	0	T		1	0				
04/4/96	Zappi Oil & Gas Co Inc	Y	T			Route 0088	Jefferson	Greene					T		1	0				
04/8/96	Joy Cone Co	N[1]	T				Findley	Mercer					T		0	1				
04/9/96	Aero Oil Co.	Y	T			East/West Turnpike	Lower Swatara	Dauphin						T	0	0				
04/9/96	Jack A Allen Inc	Y	T			Fourth Av	Coraopolis	Allegheny						T	1	0				

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[3] HMIS says yes cargo tank

[4] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
04/9/96	Philip Lynn Hershey	N[5]	T			Route 4011	Allegany	Potter					T		3	0				
04/10/96	Advanatge Tank Lines Inc.	Y	T				Robinson	Allegheny						T	0	0				
04/10/96	Qst Express	*	T			William Flinn Hw	Shaler	Allegheny					T		1	0				
04/15/96	Landis	Y	T			Lincoln Hw	Columbia	Lancaster						T	0	0				
04/17/96	Tolsdorf Oil Co	N[6]		T		Chester Rd	East Goshen	Chester						T	2	0				
04/22/96	G & G Transport Inc Petroleum	*		T		Chalmers Av	Philadelphia	Philadelphia						T	1	0				
04/23/96	Reilly & Sons Inc.	Y		T		Paoli Pk	West Goshen	Chester						T	1	0				
05/10/96	Ace Fast Freight	N[6]	T			City Line Av	Philadelphia	Philadelphia					T		1	0				
05/13/96	Gallagher Truck Salvage	N[6]		T		Route 0029	Plymouth	Luzerne					T		0	0				
05/14/96	Conewago Contractord	Y	T			Windsor Rd	Windsor	York						T	0	0				
05/15/96	Advantage Tank Line	Y	T			Bud Shuster Hw	Boggs	Centre						T	1	0				
05/15/96	Dave Hanly Inc	Y	T			Sumneytown Pk	Upper Gwynedd	Montgomery						T	1	0				
05/16/96	Paul C. Emery Co.	Y		T		Seven Stars Rd	East Vincent	Chester						T	0	0				
05/24/96	John Cheryl Inc	N[5]	T			Route 3006	Washington	Erie						T	1	0				
05/24/96	Ryder Truck Rental Inc	*	T			Interstate 0095	Chester	Delaware					T		1	0				
05/25/96	Consolidated Freightways Corp	N[1]	IT			322	Derry	Mifflin						T	0	1		T	1	1
05/29/96	Agway Inc	N[6]	T			Route 0449	Genesee	Potter						T	0	0				
06/03/96	Mauger And Co Inc	Y		T			Aston	Delaware						T	1	0				
06/04/96	Advantage Tank Lines	Y	T			Interstate 0079	South Strabane	Washington						T	1	0				
06/04/96	Carlos R Leffler Inc	Y	T			Millersville Pk	Lancaster	Lancaster						T	0	0				
06/05/96	Carlos R Leffler	Y		T		Main St	Palmyra	Lebanon						T	1	0				
06/11/96	Hampshire Distributors	Y	T			Route 0220	Cumberland Valley	Bedford						T	2	0				
06/18/96	Frenz Petroleum Corp	Y	T			Rt 422	New Castle	Lawrence	T		0	0	T		0	1	T		0	1
06/19/96	CCCarriers Inc	N[1]	T			Bernville Rd	Bern	Berks					T		3	0				
06/21/96	Deimler Trucking	Y	T			Enola Rd	East Pennsboro	Cumberland						T	0	0				

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[5] Dump

[6] Flatbed

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

									HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
06/24/96	Ashbridge Oil Co Inc	Y	T			Buffalo Pittsburgh	Adams	Cambria						T	1	0				
06/28/96	Bumgardner And Flasher Oil	Y		T		Water St	Mt Union	Huntingdon						T	0	0				
06/28/96	Sun Refining And Marketing Co	Y	T			Interstate 0076	Lower Merion	Montgomery						T	1	0				
07/06/96	Molnar Hauling Inc	Y	T			Route 0060	Brighton	Beaver						T	2	0				
07/08/96	Arentz Oil Service Inc	Y		T		Baltimore St	Penn	York						T	0	0				
07/13/96	C R Dampman Fuel & Concrete Inc	Y	T			Upper Ridge Rd	Marlborough	Montgomery						T	0	0				
07/13/96	Foster Oil Co.	Y	T			Route 0066	Farmington	Clarion						T	0	0				
07/15/96	Carlos R Leffler Inc	Y	T			Bud Shuster Hw	Pine Creek	Clinton						T	1	0				
07/15/96	Montour Oil Sservice Co	Y		T		Route 0220	Piatt	Lycoming						T	1	0				
07/16/96	New Penn Motor Express Inc	N^1	T			West End Bl	Richland	Bucks						T	1	0				
07/18/96	Russell Standard Corp	Y	T			Springfield Pk	Connellsville	Fayette						T	1	0				
07/19/96	Satterlee Leasing Co	Y	T			Route 0036	Eldred	Jefferson						T	0	0				
07/22/96	Joseph V Heenan Jr	N^5	T			Preston Rd	Conewango	Warren					T		1	0				
07/30/96	Gordon Sevig Trucking Co.	N^1	T			Route 0011	Liverpool	Perry					T		3	0				
07/30/96	Houff Transfer Inc.	N^1	T			Route 0011	Liverpool	Perry					T		3	0				
08/02/96	Timmons Oil Inc.	Y		T		Route 0533	Southampton	Franklin						T	0	0				
08/09/96	Cleveland Contract Carrier	N^1	T			Route 0512	Bushkill	Northampton						T	3	0				
08/09/96	Guttman Oil Co.	Y	T			Interstate 0070	Fallowfield	Washington					T		0	0				
08/12/96	Agway Petroleum Corp	Y	T			Route 0160	Stonycreek	Somerset						T	1	0				
08/12/96	The Sico Co.	Y		T		Furnace Hill Rd	Elizabeth	Lancaster						T	1	0				
08/17/96	Yellow Freight Systems Inc.	N^1	T			Interstate 0080	Washington	Jefferson						T	0	0				
08/19/96	Pjax Inc	N^1	T			Interstate 0079	Robinson	Allegheny						T	1	1				
08/23/96	Taylor Oil Co., Inc.	Y	T			Blair Mill Rd	Upper Moreland	Montgomery						T	0	0				
08/25/96	Molnar Inc	Y	T				New Stanton	Westmoreland	T		0	1	T		0	1	T		0	1
08/27/96	Amerada Hess Corp	N^6	T			Interstate 0083	Conewago	York						T	2	0				
09/04/96	Advantage Tank Lines Ohio	*	T			Steubenville Pk	Robinson	Allegheny						T	0	0				
09/05/96	International Petroleum Corp	*	T			Allegheny Avenue	Philadelphia	Philadelphia						T	0	0				
09/9/96	Eugene K Martin	*	T			Route 0419	Cornwall	Lebanon					T		0	0				

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
09/9/96	John Glemer Trucking	N[5]	T			Access Rd	Philadelphia	Philadelphia					T		1	0				
09/16/96	Compass Enterprises Inc.	N[1]	T			Marine Corps Leahw	Union	Union						T	0	0				
09/16/96	Petroleum Product Corp North	Y		T		Route 2004	Decatur	Mifflin						T	1	0				
09/17/96	Nittany Oil Company	Y	T			Route 0522	Beaver	Snyder						T	0	0				
09/17/96	Pitt Ohio Express Inc	N[1]	T			Interstate 0080	Mt Pleasant	Columbia						T	0	0				
09/20/96	Marshall Oil Company	Y	T			Bud Shuster Hw	Cumberland Valley	Bedford						T	0	0				
09/23/96	Castleman Enterprise	N[5]	T			Route 0281	Somerset	Somerset					T		1	0				
09/23/96	K L Harring	N[1]	T			Interstate 0081	South Middleton Twp	Cumberland						T	2	0				
09/24/96	J H Russell Inc	N[2]	T			Route 4039	Conemaugh	Somerset						T	0	0				
9/25/96	Seaboard Tank Lines	Y	T			Lincoln Hw	Manheim	Lancaster						T	3	0				
09/27/96	Heath Oil Inc	Y	T			Sr 173 @ T808 Pine Twp	Grove City	Mercer	T		0	0		T	4	0				
09/30/96	Abel Oil	Y	T			Airy St	Norristown	Montgomery						T	0	0				
09/30/96	Get Inc	Y	T			Saint Johns St	Titusville	Crawford						T	0	0				
10/04/96	Con-Way Trans Service Inc	N[1]	T			Interstate 0080	Liberty	Montour						T	2	0				
10/07/96	West Penn Laco Inc	N[6]		T		Fifth Av	Pittsburgh							T	2	0				
10/08/96	C & K Petroleum Products Inc.	Y	T			Route 4093	Allegheny	Westmoreland					T		1	0				
10/08/96	Jeviv Transportation	N[1]	T			Route 0309	Upper Dublin	Montgomery						T	0	0				
10/15/96	Viking Freight System Inc	N[1]	T			Interstate 0081	Antrim	Franklin						T	1	0				
10/19/96	K L L M Inc	N[1]	T			I-81 MM 105	Tremont	Fayette	T		0	0		T	0	0				
10/24/96	Earl Paddock Trans Inc	N[6]	T			Interstate 0083	Fairview	York						T	1	0				
10/24/96	Rob-Lu Oil Co., Inc.	Y	T				Neville	Allegheny						T	0	0				
10/27/96	Penske Trucking Company	N[1]	T			Route 0011	Reed	Dauphin					T		1	0				
11/01/96	Howard E Groff Co	Y		T		Beaver Valley Pk	Providence	Lancaster						T	1	0				
11/01/96	W L Roenigk	N[6]	T			Mayview Rd	Cecil	Washington					T		0	0				
11/04/96	Sun Company Inc	Y	T			Interstate 0076	Upper Merion	Montgomery					T		0	0				
11/06/96	Bernville Quality Fuel	Y		T		Seventeenth Halfst	Reading	Berks						T	0	0				
11/08/96	Fuchs	Y	T			Gap Newport Rd	London Grove	Chester						T	0	0				
11/08/96	Sun Refining & Marketing	Y	T			Marple Rd	Marple	Delaware						T	1	0				

Legend: Y = Yes; N = No; * Not reported

Table C-8. 1996, Class 3, Accident Information for Pennsylvania (continued)

									HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
11/09/96	Brinker Fuels Inc.	Y		T		Lower State Rd	Doylestown	Bucks						T	0	0				
11/11/96	Petro Chemical	Y	T			Grand Army Repub HW	Wayne	Erie						T	1	0				
11/11/96	R L Jehu Gulf Supply Inc	Y	T			Buffalo Pittsburgh	Henderson	Jefferson						T	2	0				
11/13/96	Chemical Leaman Tank Lines Inc	Y	T			Us Route 322 & 522	Lewistown	Mifflin	T		0	0	T		1	0				
11/14/96	Welles Mill Co Inc	Y	T			US Rte 87	Mehoopany	Wyoming	T		0	0								
11/15/96	Dana Transport Systems Inc	Y	T			Stenton Av	Philadelphia	Philadelphia						T	0	0				
11/16/96	R & W Oil Products	Y	T			Ohio Av	Glassport	Allegheny						T	1	0				
11/19/96	D J Witman Inc	Y	T			Antietam Rd	Lower Alsace	Berks						T	1	0				
11/23/96	Aero Oil Co	Y	T			Lincoln Hw	Jackson	York						T	1	1				
11/25/96	Boncosky Services Inc	Y	T			Interstate 0080	East Lackawannock	Mercer						T	1	0				
11/28/96	Berks Products	Y	T			West Shore BP	Cumru	Berks						T	0	0				
11/29/96	Diamond Materials	Y	T			Linfield Rd	Lower Pottsgrove	Montgomery						T	0	0				
11/30/96	BP Oil Co	Y	T			William Penn Hw	North Fayette	Allegheny						T	1	0				
11/30/96	Orris Fuel	Y	T			McCleland Rd	Indiana	Allegheny					T		1	0				
12/02/96	Ace Robbins Inc	Y	T			Route 4005	Mehoopany	Wyoming						T	0	0				
12/04/96	Camerson Coca Cola	N^1		T			O'Hara	Allegheny					T		1	0				
12/04/96	Stevers Trucking		T			Route 2021	Jenkins	Luzerne					T		0	0				
12/05/96	Agway Petroleum Corp	Y	T				Manheim	Lancaster						T	0	0				
12/06/96	Carlos R Leffler Inc	Y	T			Hogestown Rd	Silver Spring	Cumberland						T	0	0				
12/11/96	A S A Trucking Company	N^2	T			Turnpike Ramp Rd	Taylor	Lackawanna					T		1	0				
12/11/96	Good Oil Co.	Y		T		Skippack Pk	Whitpain	Montgomery						T	0	0				
12/13/96	R C Stahlnecker Co	Y		T		Route 0642	Valley	Montour						T	1	0				
12/17/96	Bolea Oil Products	Y	T			Montour St	Coraopolis							T	1	0				
12/17/96	Export Fuel Co Inc	Y	T			Route 0021	Masontown	Fayette						T	0	0				
12/24/96	Glassmere Fuel Service Inc	Y	T			Route 1013	West Deer	Allegheny						T	1	0				
12/27/96	Root Oil Co Inc	Y		T		Route 0414	Morris	Tioga						T	0	0				

Legend: Y = Yes; N = No; * Not reported

Table C-9. Class 2.1 Accident Information for Colorado

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	SAFETYNET Impacts				CO State Patrol Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
02/11/95	Propane Transport Inc.	Y	T			Colorado 550 & MP 83	Unknown/Ouray		T	0	0				
08/25/95	Sutton Petroleum Co.	Y	T			CR 7 & MP 5	Unknown/Moffat		T	1	7				
09/20/95	Sutherland Trucking	Y	T			Colorado 85 & WCR 18 ½	Unknown/Weld		T	4	0				
01/26/96	Basin Western, Inc.	Y	T			Colorado 139 & MP 72	Unknown/Rio Blanco		T	1	0				
02/06/96	Southwest Express, Inc.	Y	T			Colorado 96 & MP 23	Unknown/Custer		T	1	0				
02/28/96	United States Welding, Inc.	N[1]	T			Colorado 125 & MP 56	Unknown/Jackson		T	0	0				
07/21/96	Basin Western	Y	T			Road Bb 1.3 W Colo 666	Unknown/Montezuma		T	0	0		T	0	0
07/31/96	Comfurt Gas, Inc.	Y		T		Colorado 24 & MP 197	Unknown/Chaffee		T	1	0				
08/23/96	Reed Oil Co.	Y		T		215 Teresa Dr	Unknown/Clear Creek		T	0	0				
10/25/96	Groendyke Transport, Inc.	Y	T			Colorado 139 & MP 59	Unknown/Rio Blanco		T	1	0	T		1	0
12/02/96	Independent Propane	Y	T			Kerr Dr & Bardwell Rd	Unknown/Jefferson	T		1	0	T		0	0
12/06/96	Bob's LP Gas, Inc.	Y	T			Colorado 160 & MP 114	Unknown/Archuleta		T	0	0				
12/21/96	Basin Western, Inc.	Y	T			Hwy 550 & MP 68	Unknown/San Juan		T	1	0				
02/17/97	Matlack, Inc.	Y	T			Colorado 125 & MP 74	Unknown/Jackson		T	0	0				
03/12/97	Hankel Trucking	Y	T			US 6 & MP 226	Unknown/Clear Creek	T		1	0				
04/10/97	Suburban Propane LP	Y	T			Magnolia Dr & Co 119	Unknown/Boulder		T	1	0				
08/29/97	Roy Meier	Y	T			I-76 & WCR 59	Unknown/Weld	T		0	0				
11/06/97	Als Gas Service	Y		T		I-25 & MP 22	Unknown/Las Animas	T		0	0				
11/11/97	Ferrell Gas	Y		T		Cr 275 & CO 70	Unknown/Clear Creek		T	0	0				
12/01/97	Ferrellgas Lp	Y	T			W Lake Creek & Lake Creek	Unknown/Eagle		T	0	0				
12/02/97	Pease Oilfield Service, Inc.	Y		T		WCR 44 & WCR 47	Unknown/Weld		T	1	0				
12/15/97	Pelco Gas, Inc.	Y	T			CR T & CR 52	Unknown/Cheyenne		T	0	0				
12/16/97	Amerigas	Y	T			Elk River Dr & RCR 129	Unknown/Routt		T	0	0				

[1] Van/Enclosed Box

Legend: Y = Yes; N = No

Table C-10. Class 2.1 Accident Information for Ohio

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Ohio-PUCO Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/08/95	Unknown	N^{1}			T	6	Unknown/Sandusky										T	1	1												
01/23/95	Ferrel LP	Y	T			Sr0060R	Ruggles Township/ Ashland						T	0	0																
01/30/95	Propane, Inc.	Y		T		Quarry Ro	Bloom Township/ Wood						T	0	0																
02/13/95	Rutland Furniture Co.	Y	T			SR0588R	Raccoon Township/ Gallia						T	0	0																
01/12/96	Rutland Bottled Gas Co.	N^{1}			T	Unknown	Redtown/Unknown																	T		N/A	N/A				
03/11/96	Unknown	N^{1}			T	108	Unknown/Henry										T	0	1												
09/17/96	De's LP Gas Service, Inc.	Y			T	US 20 and SR 300	Gibsonburg/Sandusky														T	2	0	T		N/A	N/A				
09/27/96	James L Ridenour	Y	T			SR0160R	Wilkesville Township/ Hancock					T		0	0																
10/28/96	AGA Gas	N^{2}	T			SR 579	Northwood/Wood	T		0	0									T		2	1	T		N/A	N/A				
01/09/97	Valley National Gases, Inc.	Y	T			SR 83	Cumberland/ Guernsey					T		1	0					T		1	0	T		N/A	N/A				
01/22/97	Wilhelm's Bottled Gas	Y			T	SR 3 & SR 36, MP 3	Unknown/Knox														T	0	0								
02/03/97	Level Propane Gases, Inc.	N^{1}	T			10052 Jones Road	Litchfield/Medina	T		0	0																				
02/07/97	Auxier Gas, Inc.	N^{3}	T			CR0101	Sterling Township/ Brown						T	0	0																
03/07/97	Unknown	Y			T	Ohio #8 Exit Ramp	Akron/Unknown																						T	1	0
03/31/97	Level Propane	Y	T			MP021.00	Andover Township/ Ashtabula						T	2	0									T		N/A	N/A				
04/11/97	Youngstown Propane, Inc.	N^{3}	T			CR0108r	Newton Township/ Geauga						T	0	0																
06/16/97	Level Propane Gases, Inc.	Y	T			Piquad Ro	American Township/ Allen						T	1	0																
07/02/97	Mojac, Inc.	Y			T	US Route 22 @ Leist Road	Amanda/Fairfield													T		0	0	T		N/A	N/A	T		1	0

[1] Unknown
[2] Cylinders
[3] Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-11. Class 2.1 Accident Information for California

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/13/95	Lone Star Trucking	Y	T			RT 405/Lassen	Los Angeles/ Unknown						T	5	1																
02/05/95	Button Transportation, Inc.	N[1]	T			I580 & I80	Emeryville/ Alameda	T		6	1					T		3	1									T		10	1
02/09/95	Disalvo Trucking	N[2]	T			RT 5/Twisselman	Kern/Unknown						T	0	0																
02/14/95	Coteco Dist Co.	Y	T			RT 710/Imperial Hwy OC	Lynwood/Unknown						T	1	0																
02/24/95	Suburban Propane	N[3]	T			RT 41/Hodges Hill Dr	Madera/Unknown						T	0	0																
05/30/95	Amerigas Propane	N[1]	T			Santa Rosa Rd	Perris/Riverside	T		0	0																				
05/31/95	Viking Propane, Inc.	N[1]		T		County Rd 14/Rt 113	Yolo/Unknown						T	0	0																
08/25/95	Lone Star Trucking, Inc.	Y		T		RT 405/Van Ness Av	Torrance/Unknown						T	1	0																
09/13/95	Unknown	Y			T	Fox Rock	Unknown/ Mendocino										T	0	1												
10/10/95	Blue Star Gas	Y	T			Montgomery Rd/ Bodega Hwy	Sonoma/Unknown						T	0	0																
12/06/95	Amerigas Propane	N[1]	T			Trasition Rd 91 E to 710 N	Lakewood/ Los Angeles	T		0	0																				
02/06/96	Enron Gas Liquids, Inc.	Y	T			RT 166/Bull Cyn Rd	San Luis Obispo/ Unknown						T	1	0																
03/26/96	College Oak Towing	Y	T			RT 680/Lake Herman Rd	Solano/Unknown						T	0	0																
03/29/96	Bulk Transportation, Inc.	Y	T			RT 91/Atlantic Av	Long Beach/ Unknown						T	0	0																
05/14/96	Propane Transport, Inc.	N[1]	T			Elk Hills Rd	Tupman/Kern	T		0	0													T		N/A	N/A				
09/06/96	Coast Gas	N[2]		T		RT 193/Rt 49	El Dorado/Unknown					T		0	0																
10/19/96	Reliable Couriers, Inc.	Y		T		RT 5/Terra Bella	Los Angeles/ Unknown						T	0	0													T		0	0
10/29/96	Unknown	Y			T	70	Unknown/Butte										T	0	1												

[1] Unknown
[2] Van/Enclosed Box
[3] Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-11. Class 2.1 Accident Information for California (continued)

								HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				FHWA Media Impacts				Dialog Impacts			
Date	**Carrier Name**	**Cargo Tank**	**Interstate**	**Intrastate**	**Unknown**	**Accident Street**	**Accident City/ County**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**
05/04/97	D L Peterson Trust C/O Amerigas	Y		**T**		RT 1/Annapolis Road	Sonoma/Unknown						**T**	0	0																
05/07/97	Amerigas Propane	N[1]	**T**			Unknown	Gualala/Unknown																	**T**		N/A	N/A				
08/26/97	Jeffco Painting and Coating	Y	**T**			RT 101/ Robinson Oc	Mendocino/ Unknown					**T**		0	0																
08/28/97	Unknown	Y			**T**	US 101 N/B 4 Miles S/of Robins	Uninc/Mendocino													**T**		0	0								
09/27/97	Cal Gas Transport, Inc.	Y	**T**			RT 5/Basilone Rd	San Diego/Unknown						**T**	2	0																
10/28/97	Kamps Propane Service	Y	**T**			RT 120/Main	Manteca/Unknown						**T**	0	0																
11/24/97	Suburban Propane	Y	**T**			Columbia Av/ Lolita Av	Tehama/Unknown						**T**	4	0																

[1] Unknown

[2] Van/Enclosed Box

[3] Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-12. Class 2.1 Accident Information for Indiana

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
03/15/95	Silgas, Inc.	N[1]	T			I-80 EB 5MM	Gary/Lake						T	0	0								
04/28/95	Unknown	N[2]			T	57	Petersburg/Pike										T	1	1				
12/26/95	Grammer Industries, Inc.	Y	T			SR-5	Huntington/Huntington						T	1	0								
01/26/96	Amerigas Porpane LP/Propane Transport	Y	T			US-24 & Broadway	Huntington/Huntington						T	1	0								
05/03/96	United Parcel Service, Inc.	N[1]	T			I-65 SB @ SR-46	Columbus/Bartholomew						T	1	0								
08/22/96	East Side Gas Company	N[3]	T			E Michigan St & N Davidson	Indianapolis/Marion						T	1	0								
09/06/96	Praxair	Y	T			I-80 Tollroad 104MM WB	Bristol/Elkhart						T	2	0								
10/14/96	Pipeline Industries/Columbus Silgas	Y	T			SR-46 & CR-1125E	Hartsville/Bartholomew						T	1	0								
11/13/96	Level Propane Gases, Inc.	N[2]	T			ST RD 46 West	Nashville/Brown	T		0	0	T		0	0					T		N/A	N/A
11/18/96	East Side Gas Company, Inc.	Y		T		US-40 WB ¼ mile E of CR-550E	Greencastle/Putnam						T	1	0								
01/26/97	Styer Trans	N[1]	T			I-65 at 191MM	Brookston/White						T	1	0								
02/10/97	Baker Oil Co.	Y	T			CR-950E 3500' S of SR-64	Oakland City/Gibson						T	0	0								
03/25/97	Welder Services, Inc.	N[2]			T	Unknown	Huntington/Unknown													T		N/A	N/A
05/05/97	Jackson Jenning Farm Bureau Coop	Y	T			Franklin School Rd	Franklin/Washington						T	0	0								
05/28/97	Amerigas Propane LP	Y	T			East Lincolnway & Boston St	Laporte/Laporte						T	1	0								
05/30/97	Bergman Companies	N[2]	T			SR-912 SB & 180th Pl	Hammond/Lake						T	0	0								
05/31/97	Praxair, Inc.	Y	T			I-80 002-B	Hammond/Lake						T	0	0								
08/08/97	Star Gas Propane LP DBA Silgas	Y	T			Brownstown Rd East of US-31	Henryville/Clark						T	1	0								
08/28/97	Grammer Industries, Inc.	Y	T			US-41 At Crossing Dr	Terre Haute/Vigo						T	0	0								
09/10/97	Ferrellgas, Inc.	Y	T			Springville/Fayetteville Rd	Springville/Lawrence						T	1	0								
10/11/97	ABF Freights	N[1]	T			US-30 West 1326ft West Oday Rd	Fort Wayne/Allen					T		0	0								
11/25/97	Amerigas	Y	T			Tunnel Mill Rd	Charlestown/Clark						T	0	0								

[1] Van/Enclosed Box
[2] Unknown
[3] Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-13. Class 2.1 Accident Information for Oregon

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
03/22/95	Suburban Propane	Y	T			Unknown	Unknown/Josephine						T	0	0
05/22/95	Ferrell Gas, Inc.	N[1]	T			Wagner Creek Rd	Talent/Jackson	T		0	0		T	0	0
07/25/95	Amerigas Propane LP	Y	T			Unknown	Unknown/Umatilla						T	1	0
09/09/96	Morrow County Grain Growers, Inc.	Y	T			Unknown	Unknown/Morrow						T	1	0
11/15/96	Pacific Airgas, Inc.	N[2]	T			W 11th	Unknown/Lane						T	3	0
12/06/96	Suburban Propane LP	N[1]	T			Unknown	Unknown/Clackamas						T	0	0
12/18/96	Pacer Portland Propane LLC	N[1]		T		Union Mills Rd	Unknown/Clackamas						T	0	0
02/03/97	Cenex Land O Lakes Agronomy Compa*	N[1]	T			Sherrod Rd	Unknown/Wallowa						T	0	0
07/09/97	Ferrell Gas, Inc.	N[1]	T			Hwy 99	Winston/Douglas	T		0	0				
08/26/97	Eastern Oregon Fast Freight, Inc.	N[1]	T			3.12 E Big Lake Rd	Unknown/Jefferson						T	0	1

[1] Unknown
[2] Flatbed

Legend: Y = Yes; N = No

Table C-14. Class 2.1 Accident Information for Iowa

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/12/95	SM Service Co.	Y		T		Devils Glen Road	Bettendorf/Scott					T		0	0
01/26/95	Moore LP Gas, Inc.	Y		T		US 18 and T38	Unknown/Floyd						T	2	0
02/14/95	National Propane Corp.	N[1]	T			North Dakota Road	Ames/Story	T		0	0				
01/23/96	Farmers Oil Co.	Y		T		IA 136	Dyersville/Dubuque						T	1	0
07/09/96	B & B Oil Company	N[1]		T		5th Ave NE	Waverly/Bremer						T	1	0
11/29/96	Clarence Cooperative Co.	N[1]	T			Unknown	Anamosa/Jones	T		0	0				
12/30/96	North Central Farm Service	Y		T		2669 Baxter Ave	Eagle Grove/Wright						T	0	0
01/17/97	C & J Service	Y		T		140th St/410th Av	Andover/Clinton						T	0	0
03/26/97	Sully Transport	Y	T			Higginsport Road	Unknown/Dubuque						T	1	0

[1] Unknown

Legend: Y = Yes; N = No

Table C-15. Class 2.1 Accident Information for Minnesota

								HMIS Impacts			
Date	**Carrier Name**	**Cargo Tank**	**Interstate**	**Intrastate**	**Unknown**	**Accident Street**	**Accident City/County**	**Spill — Yes**	**Spill — No**	**Injury**	**Fatality**
11/30/95	Ferrel Gas, Inc.	N[1]	**T**			HWY 29	Alexandria/Douglas	**T**		0	0

[1] Unknown

Legend: N = No

Table C-16. Class 2.1 Accident Information for Pennsylvania

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/18/95	Farm & Home Oil Company	Y	T			Marine Corps Leahw	Kelly/Union						T	0	0								
01/21/95	Molnar Hauling	Y	T			Interstate 0079	Jackson/Butler						T	1	0								
02/20/95	Amerigas Propane, Inc.	Y	T			Buttermilk Falls Rd	Smithfield/Monroe						T	0	0		T	N/A	N/A		T	N/A	N/A
02/23/95	Agway Energy	N[1]	T			RT 23 & I-176	Morgantown/Berks	T		0	0		T	0	0								
02/24/95	Amerigas Propane	N[1]	T			Delmont-Slickville Rd	Slickville/Westmoreland	T		0	0												
03/08/95	E L Heard & Son, Inc.	Y		T		Grand Army Repubhw	Leboeuf/Erie						T	0	0								
04/11/95	Merk Trucking, Inc.	N[2]	T			Route 0030	East Providence/Bedford					T		1	0								
08/02/95	Chowns Communications, Inc.	N[1]		T		Rosedale Rd	Milford/Bucks						T	0	0								
08/05/95	Gunthers Transport Inc	N[1]	T			Lewis Av	Jeannette/Westmoreland					T		0	0								
09/17/95	Carlos Leffler	Y	T			Route 0034	Carroll/Perry					T		0	0								
09/22/95	Ferrellgas LP	N[1]	T			Island Av	Stowe/Allegheny						T	0	0								
10/03/95	Oliver Oil Co., Inc.	Y	T			Trindle Rd	Silver Spring/Cumberland						T	0	0								
10/17/95	Gasoline Transport MC 306	Y	T			Route 0981	Derry/Westmoreland						T	0	1								
10/27/95	Advantage Tank Lines	Y	T			Route 0028	Buffalo/Butler						T	1	0								
11/09/95	Agway Petroleum Corp.	Y	T			Route 0196	Mt Pocono/Monroe						T	0	0								
11/13/95	Crossett, Inc.	Y	T			Grand Army Repub Hw	Hamilton/McKean						T	1	0								
12/01/95	M G Industries	N[1]	T			Taft Rd	St Marys/Elk	T		0	0	T		1	0								
12/04/95	P & H Transportation, Inc.	Y	T			Route 0136	Hempfield/Westmoreland						T	1	0								
12/09/95	Mit Trasportation, Inc.	Y	T			Route 0309	Upper Dublin/Montgomery						T	1	0								
12/12/95	Columbia Propane Corp.	Y	T			Twin Hills Rd	Franklin/York						T	1	0								
12/14/95	Francis L Werley, Inc.	Y		T		Interstate 0078	Windsor/Berks						T	1	0								
12/27/95	Kehm Oil Co.	Y	T			Interstate 0376	Pittsburgh/Allegheny						T	1	0								
01/02/96	Littles Gas Service, Inc.	Y	T			Unknown	Straban/Adams						T	0	0								
01/10/96	Ryder,Truck, Rental, Inc.	Y	T			Route 0187	Terry/Bradford						T	1	0								
01/16/96	Valley Propane Co.	N[1]		T		Route 0093	Sugarlo/Luzerne						T	1	0								

[1] Unknown
[2] Van/Enclosed Box
[3] Flatbed
[4] Garbage/Refuse

Legend: Y = Yes; N = No; N/A = not available

Table C-16. Class 2.1 Accident Information for Pennsylvania (continued)

								HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/17/96	Orris Fuel	Y	T			Pittsburgh St	Cheswick/Allegheny						T	1	0								
02/07/96	Trexler & Haines, Inc.	Y	T			Route 0100	Washington/Berks						T	2	0								
02/13/96	Bolus Freight Systems, Inc.	N[1]	T			Keyser Av	Taylor/Lackawanna					T		2	0								
02/28/96	Beers Trucking	Y		T		Route 0191	Buckingham/Wayne						T	0	0								
02/28/96	Gress Gas Company	Y	T			Easton Rd	Plumstead/Bucks						T	1	0								
03/01/96	Advantage Tank Lines	Y	T			Unknown	Conewango/Warren						T	0	0								
03/08/96	Ferrellgas LP	N[1]	T			Round Top Rd	Athens/Bradford						T	1	0								
05/31/96	Consolidated Freightways Corp of Del.	N[2]	T			Marine Corps Leahw	Kelly/Union						T	0	0								
07/09/96	Ferrell Gas	Y	T			Route 0118	Sugarloaf/Columbia						T	1	0								
07/23/96	Tioga Petroleum Co., Inc.	Y		T		Seventh St	Mansfield/Tioga						T	1	0								
07/24/96	Walter J Styer, Inc.	Y	T			Route 2023	West Whiteland/Chester						T	1	0								
08/12/96	Carlos Leffler Propane, Inc.	N[3]	T			Furnace Hill Pk	Elizabeth/Lancaster						T	2	0								
08/16/96	Scully Welding Supply	N[3]	T			Essington Av	Eddystone/Delaware						T	0	0								
08/16/96	Sun Company, Inc.	Y	T			Blandon Rd	Ruscombmanor/Berks						T	1	0								
09/27/96	Goss Gas Products	N[1]	T			Twentyeighth Divhw	Paint/Clarion						T	0	0								
11/14/96	Wynds Express, Inc.	N[2]	T			Route 9302	Armagh/Mifflin					T		1	0								
12/23/96	American Propane Transport Intl	Y	T			Route 0100	Pottstown/Montgomery						T	2	0								
12/24/96	American Gas	Y	T			Valley Green Rd	Newberry/York						T	1	0								
12/31/96	ELT, Inc.	Y	T			Liberty St	Franklin/Venango					T		2	0								
01/08/97	Pennzoil Products Co.	Y	T			Route 0008	Shaler/Allegheny						T	0	0								
01/18/97	Bell Mills Trading Post, Inc..	Y		T		Route 2025	Pine Creek/Jefferson						T	1	0								
01/22/97	Linden Bulk	Y	T			Interstate 0080	Spring/Centre						T	2	0								
02/08/97	Crosset, Inc.	Y	T			Interstate 0080	Boggs/Centre						T	0	0								

[1] Unknown
[2] Van/Enclosed Box
[3] Flatbed
[4] Garbage/Refuse

Legend: Y = Yes; N = No; N/A = not available

Table C-16. Class 2.1 Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
02/27/97	Hillardale Farms, Inc.	N[2]	T			Route 0366	Murrysville/Westmoreland					T		0	0								
03/15/97	Decker Transportation Co., Inc.	N[2]	T			Interstate 0080	Pine Creek/Jefferson						T	2	0								
06/10/97	Unknown	Y			T	I95	Unknown/Delaware										T	1	1				
08/11/97	Wilke Trucking	N[4]	T			Route 0413	Bristol/Bucks						T	1	0								
08/21/97	Amerada Hess Corporation	Y	T			Route 1010	Hampden/Cumberland						T	0	0								
08/28/97	Carlos R. Leffler Propane, Inc.	N[3]		T		Route 3014	Penbrook/Dauphin						T	0	0								
10/08/97	Sea Board Tank Lines	Y	T			Route 0029	Upper Milford/Lehigh						T	1	0								
11/18/97	Yetters Gas Service, Inc.	Y	T			Route 3002	Mifflintown/Juniata						T	0	0								
12/16/97	Allied Signal Canada, Inc.	Y	T			Route 0011	Monroe/Snyder						T	1	0								
12/30/97	Mon Valley Petroleum Co.	Y	T			Interstate 0079	Collier/Allegheny						T	0	0								

[1] Unknown
[2] Van/Enclosed Box
[3] Flatbed
[4] Garbage/Refuse

Legend: Y = Yes; N = No; N/A = not available

Table C-17. Class 8 Accident Information for Colorado

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
03/01/95	South Park Motor Lines, Inc.	Y	T			I-25 & Cimarron Street	Colorado Springs/ El Paso					T		1	0												
12/14/95	Cast Transportation, Inc.	Y	T			Colorado 9 & SCR 1004	Unknown/Summit						T	1	0												
01/19/96	Autozone	N[1]	T			I-25 & S Washington	Denver/Denver						T	0	0												
06/29/96	United Parcel Service	N[1]	T			Unknown	Commerce City/Adams													T		N/A	N/A				
01/27/97	DPC Industries, Inc.	Y	T			Colorado 70 & MP 210	Unknown/Summit						T	0	0												
04/25/97	Andrews Transport, Inc.	Y	T			CO 70 & MP 444	Unknown/Lake						T	0	0												
07/17/97	Halliburton Energy Services	N[1]	T			I-70 W @ Mile Marker 71	Parachute/Garfield	T		0	0	T		1	0												
08/10/97	J & C Trucking	Y	T			CO 285 & MP 76	Unknown/Saguache						T	1	1		T	1	1								
09/04/97	Slt Express, Inc.	N[2]	T			CO 70 at CO 225	Denver/Denver						T	0	0												
10/29/97	H V H Transportation, Inc.	N[3]	T			I-25	Pueblo/Pueblo	T		0	0													T		0	1
12/15/97	Nationsway Transport Service	N[3]	T			I 25 NB @ Hwy 66	Longmont/ Boulder	T		0	0																

[1] Unknown
[2] Van/Enclosed Box
[3] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-18. Class 8 Accident Information for Ohio

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				Ohio-PUCO Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
08/28/95	Laking Trucking	Y	T			Rumbaughro	Jackson Township/ Allen						✓	2	0												
09/07/95	ABF Freight System, Inc.	N[1]	T			I 75 91 Mile Marker	Sidney/Shelby	T		0	0					T		0	1								
12/11/95	Knight Marketing Corp.	N[1]	T			Rte 6	Sandusky/Erie	T		0	0					T		0	0								
12/14/95	Rush Package Delivery, Inc.	N[2]	T			I-70, EB, MP 180	Unknown/Guernsey										T	0	0								
05/10/96	Blanks Agri Service	Y		T		MP005.00	Pleasant Township/ Adams						T	3	0												
07/01/96	MC Tank Transport	N[3]			T	Unknown	Evendale/Hamilton													T		N/A	N/A				
07/22/96	Envirite Corp	N[3]	T			US Route #23	Chillicothe/Ross	T		0	0					T		0	0	T		N/A	N/A				
07/27/96	Roadway Express Inc	N[3]			T	Unknown	Harrison/Hamilton																				
07/30/96	Unknown	N[3]			T	I480	Unknown/Unknown													T		N/A	N/A	T		1	0
10/17/96	Refiners Transport & Terminal	N[3]			T	Unknown	Ashland/Ashland													T		N/A	N/A				
10/18/96	Refiners Transport & Terminal Corp	Y	T			I-71 N, MP 192	Ashland/Ashland									T		0	0								
11/11/96	Detrex Corp	N[3]	T			Rte 11 S of Mile Marker 167	Ashtabula/Ashtabula	T		0	0					T		0	0								
11/21/96	R & L Transfer, Inc.	N[2]			T	I-275	Unknown/Hamilton										T	0	0								
12/31/96	Montgomery Tank Lines	Y	T			I-76 to I-71 Ramp	Unknown/Medina										T	0	0								
01/05/97	Anderson Trucking Service	N[4]	T			MP003.00	Goshen Township/ Mahoning						T	0	0												
01/15/97	Towne Air Freight	N[2]	T			SR 83	Otsego/Muskingum									T		0	0								
03/12/97	Coast Midwest Transport, Inc.	N[2]	T			Route 271 S, MP 1	Unknown/Medina										T	0	0								
03/19/97	Ryder Truck Rental Inc	N[4]	T			CR0210	Shalersville Township/Crawford						T	2	0												

[1] Van/Trailer/Flatbed
[2] Boxes/Bags/Drums
[3] Unknown
[4] Van/Enclosed Box

Legend: Y = Yes; N = No; N/A = not available

Table C-18. Class 8 Accident Information for Ohio (continued)

								HMIS Impacts				SAFETYNET Impacts				Ohio-PUCO Impacts				FHWA Media Impacts				Dialog Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
03/20/97	Pjax Inc	N[1]	T			Maulhauser Road	Fairfield/Butler	T		0	0																
03/28/97	Safeway Chemical Transportation	N[2]	T			Route 24, MP 15	Defiance/Unknown									T		0	0								
03/29/97	Safeway Chemical Transport Inc	N[1]	T			Route 24 – East	Defiance/Defiance	T		0	0																
04/24/97	Werner Enterprises	N[3]	T			Unknown	Bellville/Richland													T		N/A	N/A				
05/03/97	Transcontinental Refrigerated	N[1]	T			I-76 W	Girard/Trumbull	T		0	0																
06/17/97	MC Tank Transport, Inc.	Y	T			MP007.00	Ellsworth Township/ Mahoning						T	1	0												
06/21/97	Cheeseman Trucking, Inc.	N[4]	T			MP030.00	Wabash Township/ Darke						T	1	0												
08/04/97	Ashland Chemical	N[2]	T			I-71 SB, MP 27	Unknown/Warren										T	0	0								
08/19/97	Manfredi Motor Transit Co.	Y	T			Camp Perro	Erie Township/Clark						T	9	6												
08/29/97	Lindsey Motor Express, Inc.	N[3]	T			I-75 NB Entrance Ramp	Springboro/Warren	T		0	0																
12/10/97	Erickson Tank Lines Corp.	Y	T			I-70 WB, MM 62	Unknown/Clark						T	0	0		T	0	0								

[1] Van/Trailer/Flatbed
[2] Boxes/Bags/Drums
[3] Unknown
[4] Van/Enclosed Box

Legend: Y = Yes; N = No; N/A = not available

Table C-19. Class 8 Accident Information for California

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				FHWA Media Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/03/95	West Coast Intermodal	Y	**T**			RT 5/RT 145	Fresno/ Unknown						**T**	2	0												
01/05/95	Ranger Transportation, Inc.	N[1]	**T**			RT 99/7 Standard Road	Kern/Unknown						**T**	0	0												
03/04/95	Unknown	N[2]			**T**	E/B SR-58 W/of SR-223	Unic./Kern													**T**		0	0				
06/03/95	Imperial West Chemical	Y	**T**			RT 15/Halloran Spg Road	San Bernardino/ Unknown						**T**	1	0												
07/07/95	West Coast Intermodal, Inc.	N[3]			**T**	Unknown	Colfax/Placer																	**T**		N/A	N/A
07/20/95	Vickie Canty Backhoe	N[1]		**T**		RT 5/RT 152	Merced/ Unknown					**T**		1	0									**T**		N/A	N/A
08/10/95	GNB Battery Technologies	N[1]	**T**			RT 395/Shingl Mlls Cmpgrd	Mono/Unknown					**T**		1	0												
09/05/95	Imperial West Chemical	Y	**T**			RT 14/RT 58	Kern/Unknown						**T**	1	0												
10/17/95	Unknown	Y			**T**	Solano Avenue under SR-4	Uninc./Contra Costa													**T**		0	0				
10/19/95	G & E Commercial Warehouse, Inc.	N[1]	**T**			RT 20/Houghton Rch Road	Nevada/ Unknown						**T**	0	0												
10/30/95	Unknown	Y			**T**	SR/60 W/B from Mountain Avenue	Ontario/San Bernardino													**T**		0	0				
01/02/96	GNP Battery Technologies	N[1]	**T**			RT 10/Motor Avenue	Los Angeles/ Unknown						**T**	0	0												
02/25/96	Teco Express, Inc.	N[1]	**T**			RT 58/Sand Cyn Road UC	Kern/Unknown					**T**		0	0												
02/26/96	Unknown	N[3]			**T**	Unknown	Tehachapi/ Unknown																	**T**		N/A	N/A
04/22/96	Unknown	N[3]			**T**	I-80 E/B Antelope Scales	Uninc./ Sacramento																		**T**	N/A	N/A
05/06/96	Chemical Leamon Tank	Y	**T**			RT 10/Rt 15 OC	Ontario/ Unknown						**T**	0	0												

[1] Van/Enclosed Box
[2] Drum/Box/Bag
[3] Unknown
[4] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-19. Class 8 Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				FHWA Media Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
06/28/96	Intl Trucking Rental	Y	**T**			RT 15/Mercy Road UC	San Diego/ Unknown						**T**	0	0												
07/17/96	BJ Services	N[3]	**T**			Unknown	Ventura/Ventura																	**T**		N/A	N/A
08/28/96	Chemical Transfer Co., Inc.	N[1]	**T**			RT 12/RT 160	Sacramento/ Unknown						**T**	0	1		**T**	1	1								
01/21/97	Wiegand Button Motor Express	N[4]	**T**			Highway I-S North Bound	Los Banos/ Merced	**T**		0	0																
02/25/97	Kemwater North America	N[3]	**T**			State Hwy 58	Boron/Kern	**T**		0	0	**T**		1	0												
03/04/97	Conway Western Express	N[4]	**T**			Interstate 5 Waterloo Exit	Visalia/Tulare	**T**		0	0													**T**		N/A	N/A
03/05/97	Pressure Vessel Service, Inc.	Y		**T**		RT 2/Oak Glen Pl	Los Angeles/ Unknown						**T**	0	0												
05/05/97	Unknown	N[2]			**T**	SR 60 S/B E of Central Avenue	Chino/San Bernardino													**T**		0	0				
06/11/97	Unknown	N[2]			**T**	I 580 W/B W of Santa Rita Road	Pleasanton/ Alameda													**T**		0	0				
08/29/97	Unknown	N[3]			**T**	N/B I 5 S/of Clairemont Mesa B	San Diego/ San Diego													**T**		0	0				
10/12/97	Bulk Transportation, Inc.	Y	**T**			RT 15/Kenwood Avenue UC	San Bernardino/ Unknown						**T**	0	0												
10/21/97	Unknown	Y			**T**	I 5 SB N of Gibson Road	Lakehead/ Shasta													**T**		0	0				
10/27/97	Unknown	N[2]			**T**	N/B SR 99 at Turner Road	Lodi/ San Joaquin													**T**		0	0				

[1] Van/Enclosed Box
[2] Drum/Box/Bag
[3] Unknown
[4] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-20. Class 8 Accident Information for Indiana

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality
01/07/95	Equity Transportation Co. Inc.	N[1]	T			I-80WB 1MM	Hammond/Lake						T	1	0												
04/21/95	Usher Transportation, Inc.	Y	T			SR-11	Mauckport/Harrison					T		1	0												
07/06/95	Waddell Battery Co., Inc.	N[1]	T			I-65 NB	Seymour/Jackson						T	1	0												
07/13/95	United Parcel Service	N[2]	T			Unknown	Bloomington/Monroe													T		N/A	N/A				
11/16/95	C A Transportation, Inc.	N[1]	T			I-70 122MM	Spiceland/Henry						T	0	0												
12/20/95	Country Wide Truck Services	N[1]	T			I-465W 51MM	Indianapolis/Marion						T	1	0												
01/23/96	Jevic Transportation, Inc.	N[1]	T			SR-56 East of Whiskey Hollow	Vevay/Switzerland					T		0	0												
01/30/96	Yellow Freight System, Inc.	N[1]	T			SR-630& 1780 South	Clinton/Vermillion						T	1	0												
02/26/96	Liquid Transport Corp.	Y	T			US-421 Jct Mich Road	Madison/Jefferson						T	1	0												
03/19/96	Slay Transportation	Y	T			SR-37 Six Miles North	Tell City/Perry						T	1	0												
03/20/96	Overnite Transportation Co.	N[1]	T			I-65 NB at 107MM	Indianapolis/Marion					T		0	0												
09/17/96	Frontier Transport Corp.	N[3]	T			Shadeland Ave/I-70 E B Ramp	Indianapolis/Marion	T		0	0									T		N/A	N/A				
12/03/96	McKinley Trucking Co., Inc.	Y	T			I-94 WB Rest Park 43MM	Michigan City/La Port						T	0	0												
01/09/97	Biokem	N[1]	T			US-30 at Grovertown Truckstop	Grovertown/Starke						T	1	0												
01/29/97	Ulrich Chemical, Inc.	Y	T			US-52 near Wyandotte Rd.	Lafayette/ Tippecanoe						T	0	0												
02/25/97	Jones Chemical, Inc.	N[1]	T			1918 W Sycamore	Kokomo/Howard					T		1	0												
03/20/97	Arnold Brothers Transport, Inc.	N[1]	T			I-80/94 EB 300' W of 3MM	Hammond/Lake						T	4	0												
04/07/97	GNB Battery Technologies	N[1]	T			US-40 E of Masten Road	Stilesville/Hendricks						T	1	0												

[1] Van/Enclosed Box
[2] Unknown
[3] Van/Flatbed/Trailer

Legend: Y = Yes; N = No; N/A = not available

Table C-20. Class 8 Accident Information for Indiana (continued)

								HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality
05/10/97	Overnite Transportation Co.	N[1]	**T**			I-65 SB Near 45MM	Seymour/Jackson					**T**		0	0												
07/08/97	USF Holland, Inc.	N[1]	**T**			SB US-41 at R.R Tracks	Evansville/ Vanderburgh						**T**	0	0												
08/06/97	McKinley Trucking Co.	N[2]	**T**			I-94, MM 29	Michigan City/LaPorte	**T**		0	0	**T**		0	1	**T**		0	1	**T**		N/A	N/A	**T**		0	1
09/26/97	Unknown	N[2]			**T**	Unknown	LaPorte/Unknown																		**T**	1	0
09/30/97	Rogers Cartage Company	Y	**T**			Nucor Steel Compound	Crawfordsville/ Montgomery						**T**	0	0												
11/15/97	Eaglebrook Transport, Inc.	N[1]	**T**			I-80 WB at 9 MM	Gary/Lake						**T**	3	0												
12/12/97	USF Holland Motor Express, Inc.	N[1]	**T**			2700 North Clinton Street	Fort Wayne/Allen						**T**	1	0												
12/19/97	U S Cartage Co. of Indianapolis	N[3]	**T**			Interloop I65 North	Indianapolis/Marion	**T**		0	0	**T**		1	0												

[1] Van/Enclosed Box
[2] Unknown
[3] Van/Flatbed/Trailer

Legend: Y = Yes; N = No; N/A = not available

Table C-21. Class 8 Accident Information for Oregon

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	SAFETYNET Impacts			
								Spill — Yes	Spill — No	Injury	Fatality
02/12/95	Arrow Transportation Co.	Y	T			Unknown	Unknown/Washington		T	0	0
03/08/95	Genuine Parts Company	N[1]	T			Unknown	Unknown/Lane		T	0	0
08/27/95	Roehl Transport, Inc.	N[1]	T			.1 S McLain Avenue	Unknown/Douglas	T		1	0
09/12/95	T N T Reddaway Truck Line, Inc.	N[1]	T			Unknown	Unknown/Marion		T	0	0
10/11/95	T N T Reddaway Truck Line, Inc.	N[1]	T			.3 N Exit 73	Unknown/Josephine		T	2	0
01/02/97	National Carriers, Inc.	N[1]	T			9 E Steamboat Cr Road	Unknown/Douglas		T	0	0
01/21/97	Nelson, Walter E Co.	N[1]	T			69th Street	Unknown/Washington		T	2	0
07/06/97	Arrow Transportation Co.	Y	T			Unknown	Unknown/Marion		T	0	0
10/17/97	All Pure Chemical Co.	Y	T			.5 S 14th Street	Unknown/Tillamook		T	0	0
11/05/97	North Star Transport, Inc.	N[1]	T			.09 E Millican Road	Unknown/Pawnee	T		0	0

[1] Unknown

Legend: Y = Yes; N = No

Table C-22. Class 8 Accident Information for Iowa

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
06/28/95	Consolidated Freightways of Del	N[1]	T			I380 SB off Ramp to I80 WB	Coralville/Johnson						T	0	0
12/06/95	Magnum Ltd	N[1]	T			I29	Harrison/Unknown						T	0	0
01/04/96	Ryder Dedicated Logistics	N[1]	T			Army Post Road	Des Moines/Polk						T	1	0
02/07/96	Montgomery Tank Lines, Inc.	Y	T			US Highway 67 N	Davenport/Scott						T	1	0
07/18/96	Tnt Holland Motor Express, Inc.	N[1]	T			Hwy 63 4 3/4 No of Lourdes	Howard Center/ Howard						T	0	0
07/25/96	Vulcan Materials Chemicals Div	Y	T			1 29 MB 11 NB	Unknown/Fremont						T	2	0
07/17/97	Clark Bros Transfer Co.	N[2]	T			Unknown	Unknown/Polk						T	0	0
12/03/97	Huling Ken Trucking	N[2]	T			Clover Leaf Hwy 61 & 30	De Witt/Clinton	T		0	0				

[1] Van/Enclosed Box
[2] Unknown

Legend: Y = Yes; N = No;

Table C-23. Class 8 Accident Information for Minnesota

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
05/28/95	Schneider Nat'l Bulk Carriers	N[1]	**T**			HWY 61	Grand Marais/Cook	**T**		0	0				
02/04/97	Roughrider Transportation, Inc.	Y	**T**			9	Riverton/Clay					**T**		0	0
08/28/97	Quest Transfer, Inc.	N[2]	**T**			20948 County Road 2	Silver Lake/Martin	**T**		0	0				

[1] Unknown
[2] Van/Trailer/Flatbed

Legend: Y = Yes; N = No

Table C-24. Class 8 Accident Information for Pennsylvania

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality
01/21/95	Yellow Freight Systems	N[1]	T			Interstate 0080	Tunkannock/ Monroe						T	1	0												
02/15/95	Chemical Leaman Tank Lines, Inc.	Y	T			Constitution Bl	Darlington/Beaver						T	1	0												
02/17/95	Dana Transport Co.	Y	T			Cochecton & Greard	Herrick/ Susquehanna						T	1	0												
04/17/95	Ww Transport, Inc.	N[1]	T			East/West Turnpike	Allegheny/ Somerset					T		1	0												
05/05/95	Mason Dixon	N[2]	T			Lincoln Hw	Springettsbury/York						T	3	0												
06/29/95	P Jax, Inc.	N[1]	T			Route 0030	West Providence/ Bedford						T	1	0												
07/19/95	Textile Chemicle Co., Inc.	N[1]	T			William Penn Hw	Oliver/Mifflin						T	2	0												
10/25/95	W W Transport, Inc.	N[1]	T			Interstate 0081	East Hanover/Lebanon					T		1	0												
11/08/95	Consolidated Freightways Corp.	N[1]	T			N.E. Extension	Plymouth/Montgomery						T	0	0												
11/13/95	McTank Transport, Inc.	Y	T			Beaver Valley Ex	Findlay/Allegheny						T	1	0												
11/13/95	Roeder Cartage Co., Inc,	Y	T			William Penn Hw	North Fayette/Allegheny						T	1	0												
11/14/95	MCB Delivery	N[1]	T			Interstate 0080	Sugarloaf/Luzerne						T	0	0												
11/14/95	Stevens Transportation	N[1]	T			N.E. Extension	Washington/Lehigh						T	1	0												
11/26/95	Robert Hansen Trucking	N[1]	T			Interstate 0076	Lower Merion/Montgomery						T	0	0												
12/19/95	Consolidated Freightways	N[1]	T			East/West Turnpike	Monroeville/Allegheny						T	1	0												
12/27/95	JMG Enterprises	Y	T			William Penn Hw	Murrysville/Westmoreland						T	0	0												
01/09/96	Roadway Express, Inc.	N[1]	T			Interstate 0080	Marion/Centre						T	0	0												
01/16/96	Eastern America	N[1]	T			Interstate 0380	Coolbaugh/Monroe						T	0	0												
01/24/96	Roadway Express	N[1]	T			Interstate 0080	Jackson/Monroe						T	2	0												
02/28/96	Yellow Freight Systems	N[1]	T			Interstate 0080	Shenango/Mercer						T	1	0												

[1] Van/Enclosed Box
[2] Flatbed
[3] Unknown
[4] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-24. Class 8 Accident Information for Pennsylvania (continued)

								HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality
03/07/96	Robert Hansen Trucking, Inc.	N[1]	T			Interstate 0080	Spring/Centre						T	1	0												
03/14/96	Harold Marcus Limited	Y	T			Interstate 0081	New Milford/ Susquehanna						T	1	0												
04/06/96	Chemical Leaman Tank Line Inc	Y	T			Commodore Barry Br	Chester/Delaware						T	0	0												
05/11/96	Con-Way Trans Services Inc	N[1]	T			Unknown	Sandy/Clearfield						T	2	0												
05/20/96	Trans States Lines, Inc.	N[1]	T			Moselem Spring Road	Perry/Berks						T	1	0												
06/06/96	Grace Atlantic Corporation	Y	T			Route 0300	East Hempfield/Lancaster						T	1	0												
06/19/96	Buckmans, Inc.	N[2]	T			Wissahickon Ave	Philadelphia/Philadelphia						T	1	0												
07/02/96	American Tank Trans., Inc.	Y	T			N.E. Extension	Plymouth/Montgomery						T	3	0												
08/06/96	Wonder Chemical Corp.	N[3]	T			Intersection of Canal & N Bold	Fairless Hills/Bucks	T		0	0																
09/11/96	Road Scholar Transport	N[1]		T		Interstate 0081	Dunmore/Lackawanna						T	0	0												
10/04/96	Trans Carrier, Inc.	N[1]	T			Route 0222	Richmond/Berks						T	2	0												
10/09/96	Eagle Chemical Co..	N[1]	T			Albert St	Allentown/Lehigh						T	1	0												
10/14/96	Liquid Cargo Lines	N[3]	T			Rte 248	Lehigh/Northampton	T		0	0									T		N/A	N/A	T		0	0
10/16/96	Fleet Transportation Comp., Inc.	Y	T			First Avenue	Pittsburgh/Allegheny						T	0	0												
10/28/96	Chemical Leaman Tank Lines, Inc.	Y	T			Interstate 0076	Upper Merion/ Montgomery						T	1	0												
10/31/96	Superior Carriers, Inc.	N[3]	T			Unknown	Swiftwater/Monroe													T		N/A	N/A				
11/08/96	Kramer Chemical	N[1]	T			Easton Road	Bedminster/Bucks						T	0	0												
11/25/96	Douglas Battery Mfg., Co.	N[1]	T			William Flinn Hw	Middlesex/Butler						T	2	0												
11/26/96	Overnite Transportation, Inc.	N[1]	T			East/West Turnpike	East Cocalico/Lancaster						T	0	0												
12/01/96	Bradley Caldwell, Inc.	N[1]	T			Interstate 0080	Marion/Centre						T	1	0												

[1] Van/Enclosed Box
[2] Flatbed
[3] Unknown
[4] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Table C-24. Class 8 Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				FHWA Media Impacts				Dialog Impacts			
								Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality	Spill – Yes	Spill – No	Injury	Fatality
12/18/96	Melburn Truck Lines, Inc.	N^1	T			Interstate 0084	Dunmore/Lackawanna						T	8	0												
01/09/97	Transport Corp. of America	N^1	T			Route 0080	Stroudsburg/Monroe						T	0	0												
01/24/97	Carman Supply & Equip Co.	N^1	T			Second Street	Charleroi/Washington						T	0	0												
01/27/97	Textile Chemical PA	N^1	T			Route 2007	Horsham/Montgomery						T	1	0												
01/28/97	Stevens Transport, Inc.	N^1	T			Route 9202	Dorrance/Luzerne						T	3	0												
02/12/97	Matlack, Inc.	N^3	T			Route 879 North	Clearfield/Clearfield	T		0	0																
03/25/97	Baggett Transportation	N^1	T			Route 0061	Ontelaunee/Berks						T	0	0												
04/22/97	Piedmont Transportation Company	N^3	T			Kensington Avenue	Philadelphia/Philadelphia						T	0	0												
04/29/97	Betz Laboratories, Inc.	N^1	T			Route 0422	Amity/Berks						T	0	1		T	1	1								
05/12/97	Oriole Chemical Carriers, Inc.	N^3	T			East/West Turnpike	West Nantmeal/Chester						T	1	0												
05/27/97	Interstate Chemical Co., Inc.	Y	T			Route 0060	Chippewa/Beaver						T	0	0												
07/07/97	Berkley Products	N^1	T			Route 2003	Springettsbury/York						T	0	0												
08/18/97	Yellow Freight System, Inc.	N^1	T			East/West Turnpike	Hempfield/Westmoreland						T	1	0												
09/11/97	Riley Leasing Corp.	N^3	T			Interstate 0084	Dunmore/Lackawanna						T	1	0												
09/12/97	Aduie Pyle, Inc.	N^1	T			Route 0222	Lower Macungie/Lehigh						T	1	0												
09/16/97	Best Bro Paint Mfg	N^1	T			Route 0422	Cleona/Lebanon						T	0	0												
09/17/97	Decker Transport Co., Inc.	N^4	T			I-78 W	Hamburg/Berks	T		0	0	T		2	1												
12/06/97	Lakeway Trucking, Inc.	N^1	T			Unknown	Pine Grove/Schuylkill						T	0	1												

[1] Van/Enclosed Box
[2] Flatbed
[3] Unknown
[4] Van/Trailer/Flatbed

Legend: Y = Yes; N = No; N/A = not available

Appendix D

Natural Resource Damages Settlements

Appendix D
Natural Resource Damages Settlements

Table (D-1) presents 30 natural resource settlements from sites around the country. The settlements are representative of the magnitude of settlement characteristic of sites where environmental damage has occurred. The settlements are often the result of complex environmental damage that would likely be more serious than that anticipated from a HM spill after cleanup has occurred. However the damages provide a useful conservative estimate of damage associated with specified acreage.

Table D-1. Natural Resource Damage Settlements by Habitat Type and Location

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Bay & estuary (saline)	WA: central Puget Sound	Elliott Bay, Seattle, WA	Seattle (city and metropolitan area)	5189	$24,000,000	$4,625	ac.	Cr, Cd, Cu, Pb, Zn, & PCBs in sediments
Bay & estuary (saline)[a]	WA: southern Puget Sound	Commencement Bay	Port of Tacoma; Simpson Tacoma Kraft Co.	37.9	$13,300,000	$350,923	ac.	variety of hazardous substances
Dune & swale	IN: northern	Midco I & II	Midco	?	$304,567	?	ac.	VOCs, PCBs, & metals
Estuary sediments (saline)	MA: Achushnet River, near Buzzards Bay	New Bedford Harbor	5 companies	18000	$20,200,000	$1,122	ac.	PCBs & heavy metals in biota & sediments
Grassland & oldfield	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	150	$200,000	$1,333	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Grassland & oldfield[f]	IN: St. Joseph Co., Mishawaka	Douglas Road/Uniroyal, Inc. Landfill	Uniroyal, Inc.	19	$163,035	$8,581	ac.	hydrocarbons in groundwater
Grassland & oldfield[f]	IN: Whitley Co., Columbia City	Wayne Reclamation & Recycling	Wayne Waste Oil division of Wayne Reclamation & Recycling, Inc.	35	$73,474	$2,099	ac.	VOCs: benzene, TCE, vinyl chloride, & toluene
Grassland with wetlands; dump in river floodplain	IN: Allen Co., Fort Wayne in floodplain of Maumee River	Fort Wayne Reduction Dump	Fort Wayne Reduction; National Recycling Corp.; Service Corp. of America	35	$5,000	$143	ac.	VOCs, PCBs, PAHs, phenols, & heavy metals in soil & groundwater
Industrial site	PA: Crawford Co., Saegertown	Saegertown Industrial Area	General American Transfer; Saegertown Mfg. Co.; Spectrum Control, Inc.; Lord Corp.	100	$94,510	$945	ac.	VOCs & PAHs in soil and pond sediments
Industrial site in floodplain of river	PA: Berks Co., near Shoemakersville in flood-plain of Schuylkill River	Brown's Battery Breaking	Brown's Battery Breaking	14	$24,217	$1,730	ac.	Pb, Ni, Zn

Table D-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Industrial site with stream	PA: Mifflin Co., Maitland; Jacks Creek flows through site	Jacks Creek/ Sitkin Smelting & Refining, Inc.	Joseph Krentzman and Son, Inc.; C.I.T. Corp.; Alabama Bankruptcy Court	115	$136,465	$1,187	ac.	PCBs & heavy metals (primarily Pb) in soil and water
Industrial site with streams and wetlands	PA: Adams Co., Fred Shealer Property	Hunterstown Road	several local corporations	3	$3,000	$1,000	ac.	VOCs in surface & ground water; heavy metals and asbestos in soil
Industrial site; peregrine falcons nest near site	PA: Philadelphia Co., Southeast Philadelphia	Publicker Industries	Bruga Corp.; AAA Warehousing, Inc.; Publicker Industries; Cuyahoga Wrecking/ Overland Corp.	40	$547,000	$13,675	ac.	toxic, flammable, & reactive gases; PCBs; VOCs; asbestos
Ocean floor	CA: offshore Los Angeles Co.	"Montrose" Offshore Los Angeles County	10 industrial companies	?	$42,200,000	?	ac.	DDT & PCBs in soil & sediments
River (fish spawning & rearing habitat)	OR: North Fork of John Day River; north-central OR	John Day River	Thatcher Trucking Co.	?	$275,000	?	mi.	hydrochloric acid
River (trout fishery)	CA: Sacramento River near Dunsmuir	Cantara Loop	?	42	$14,000,000	$333,333	mi.	herbicide metam sodium
Stream (salmon rearing habitat)	ID: Panther Creek Water-shed; Salmon Nat'l Forest	Blackbird Mine	PRPs associated with Haynes Stellite Adit	37	$4,700,000	$127,027	mi.	Au, Cu, & Co in streams
Wetland & upland[c]	MA: Massachusetts Military Reservation	Massachusetts Military Reservation[d]	National Guard Bureau	3,900	$500,000	$128	ac.	VOCs: TCA, TCE, & dichloroethylene
Wetland (forested)	MA: Dartmouth	Bristol County Board of Corrections[d]	Commonwealth of MA & Dimeo Construction Co.	11.5	$150,000	$13,043	ac.	wetland filled in for construction
Wetland (forested)	MN: north of Bemidji	Kummer Sanitary Landfill	Kummer Sanitary Landfill	6.7	$22,000	$3,284	ac.	chlorinated organics

Table D-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Wetland (prairie)	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	8	$16,000	$2,000	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Wetland (river)	DE: 1.3 mi. NW of Cheswold	Cokers Sanitation Service Landfills	Cokers Sanitation Service	25	$80,000	$3,200	ac.	acrolein, ethylbenzene, & Zn from latex sludge
Wetland (saline to brackish marsh)	TX: Harris Co.	French Limited	French Limited Task Group	25	$60,000	$2,400	ac.	PCBs & heavy metals in groundwater & subsoil
Wetland (saline)	NY: Nassau Co.; peninsula off Long Island Sound	Applied Environmental Services Site	Shore Realty	?	$50,000	?	ac.	PCBs & VOC (toluene)
Wetland (saline, intertidal)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	17	$67,022	$3,942	ac.	acidic process water from fertilizer plant
Wetland (stream) & reservoir	IN: Finley Creek Watershed & Eagle Creek Reservoir, Boone Co.	Envirochem, Sanitary Landfill, & Asphalt Sites	Envirochem Corp., Northside Sanitary Landfill, Inc., Great Lakes Asphalt	?	$80,730	?	mi.	VOCs, PCBs, & metals
Wetland (stream)[b]	DE: New Castle Co.;Army Creek tributary to Delaware River	Army Creek Landfill	New Castle County	225	$600,000	$2,667	mi.	landfill leachate
Wetland (stream, freshwater)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	16	$63,080	$3,943	ac.	acidic process water from fertilizer plant

(a) Includes vegetated shallows, mudflats, tidal marshes and creeks, off-channel sloughs and lagoons, naturalized stream channels, and adjacent upland buffer areas

(b) Also includes 60 ac. uplands and 1.5 mi. stream habitat

(c) Percent upland versus wetland not stated

(d) From EPA (1955) Enforcement Report

(e) COC = contaminants of concern

(f) Acreage listed is area where material was dumped, not the area contaminated, which may be larger

Appendix D

Natural Resource Damages Settlements

Appendix D
Natural Resource Damages Settlements

Table (D-1) presents 30 natural resource settlements from sites around the country. The settlements are representative of the magnitude of settlement characteristic of sites where environmental damage has occurred. The settlements are often the result of complex environmental damage that would likely be more serious than that anticipated from a HM spill after cleanup has occurred. However the damages provide a useful conservative estimate of damage associated with specified acreage.

Table D-1. Natural Resource Damage Settlements by Habitat Type and Location

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Bay & estuary (saline)	WA: central Puget Sound	Elliott Bay, Seattle, WA	Seattle (city and metropolitan area)	5189	$24,000,000	$4,625	ac.	Cr, Cd, Cu, Pb, Zn, & PCBs in sediments
Bay & estuary (saline)[a]	WA: southern Puget Sound	Commencement Bay	Port of Tacoma; Simpson Tacoma Kraft Co.	37.9	$13,300,000	$350,923	ac.	variety of hazardous substances
Dune & swale	IN: northern	Midco I & II	Midco	?	$304,567	?	ac.	VOCs, PCBs, & metals
Estuary sediments (saline)	MA: Achushnet River, near Buzzards Bay	New Bedford Harbor	5 companies	18000	$20,200,000	$1,122	ac.	PCBs & heavy metals in biota & sediments
Grassland & oldfield	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	150	$200,000	$1,333	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Grassland & oldfield[f]	IN: St. Joseph Co., Mishawaka	Douglas Road/Uniroyal, Inc. Landfill	Uniroyal, Inc.	19	$163,035	$8,581	ac.	hydrocarbons in groundwater
Grassland & oldfield[f]	IN: Whitley Co., Columbia City	Wayne Reclamation & Recycling	Wayne Waste Oil division of Wayne Reclamation & Recycling, Inc.	35	$73,474	$2,099	ac.	VOCs: benzene, TCE, vinyl chloride, & toluene
Grassland with wetlands; dump in river floodplain	IN: Allen Co., Fort Wayne in floodplain of Maumee River	Fort Wayne Reduction Dump	Fort Wayne Reduction; National Recycling Corp.; Service Corp. of America	35	$5,000	$143	ac.	VOCs, PCBs, PAHs, phenols, & heavy metals in soil & groundwater
Industrial site	PA: Crawford Co., Saegertown	Saegertown Industrial Area	General American Transfer; Saegertown Mfg. Co.; Spectrum Control, Inc.; Lord Corp.	100	$94,510	$945	ac.	VOCs & PAHs in soil and pond sediments
Industrial site in floodplain of river	PA: Berks Co., near Shoemakersville in flood-plain of Schuylkill River	Brown's Battery Breaking	Brown's Battery Breaking	14	$24,217	$1,730	ac.	Pb, Ni, Zn
Industrial site with stream	PA: Mifflin Co., Maitland; Jacks Creek flows through site	Jacks Creek/ Sitkin Smelting & Refining, Inc.	Joseph Krentzman and Son, Inc.; C.I.T. Corp.; Alabama Bankruptcy Court	115	$136,465	$1,187	ac.	PCBs & heavy metals (primarily Pb) in soil and water

Table D-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Industrial site with streams and wetlands	PA: Adams Co., Fred Shealer Property	Hunterstown Road	several local corporations	3	$3,000	$1,000	ac.	VOCs in surface & ground water; heavy metals and asbestos in soil
Industrial site; peregrine falcons nest near site	PA: Philadelphia Co., Southeast Philadelphia	Publicker Industries	Bruga Corp.; AAA Warehousing, Inc.; Publicker Industries; Cuyahoga Wrecking/ Overland Corp.	40	$547,000	$13,675	ac.	toxic, flammable, & reactive gases; PCBs; VOCs; asbestos
Ocean floor	CA: offshore Los Angeles Co.	"Montrose" Offshore Los Angeles County	10 industrial companies	?	$42,200,000	?	ac.	DDT & PCBs in soil & sediments
River (fish spawning & rearing habitat)	OR: North Fork of John Day River; north-central OR	John Day River	Thatcher Trucking Co.	?	$275,000	?	mi.	hydrochloric acid
River (trout fishery)	CA: Sacramento River near Dunsmuir	Cantara Loop	?	42	$14,000,000	$333,333	mi.	herbicide metam sodium
Stream (salmon rearing habitat)	ID: Panther Creek Water-shed; Salmon Nat'l Forest	Blackbird Mine	PRPs associated with Haynes Stellite Adit	37	$4,700,000	$127,027	mi.	Au, Cu, & Co in streams
Wetland & upland[c]	MA: Massachusetts Military Reservation	Massachusetts Military Reservation[d]	National Guard Bureau	3,900	$500,000	$128	ac.	VOCs: TCA, TCE, & dichloroethylene
Wetland (forested)	MA: Dartmouth	Bristol County Board of Corrections[d]	Commonwealth of MA & Dimeo Construction Co.	11.5	$150,000	$13,043	ac.	wetland filled in for construction
Wetland (forested)	MN: north of Bemidji	Kummer Sanitary Landfill	Kummer Sanitary Landfill	6.7	$22,000	$3,284	ac.	chlorinated organics
Wetland (prairie)	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	8	$16,000	$2,000	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Wetland (river)	DE: 1.3 mi. NW of Cheswold	Cokers Sanitation Service Landfills	Cokers Sanitation Service	25	$80,000	$3,200	ac.	acrolein, ethylbenzene, & Zn from latex sludge
Wetland (saline to brackish marsh)	TX: Harris Co.	French Limited	French Limited Task Group	25	$60,000	$2,400	ac.	PCBs & heavy metals in groundwater & subsoil
Wetland (saline)	NY: Nassau Co.; peninsula off Long Island Sound	Applied Environmental Services Site	Shore Realty	?	$50,000	?	ac.	PCBs & VOC (toluene)

Table D-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Wetland (saline, intertidal)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	17	$67,022	$3,942	ac.	acidic process water from fertilizer plant
Wetland (stream) & reservoir	IN: Finley Creek Watershed & Eagle Creek Reservoir, Boone Co.	Envirochem, Sanitary Landfill, & Asphalt Sites	Envirochem Corp., Northside Sanitary Landfill, Inc., Great Lakes Asphalt	?	$80,730	?	mi.	VOCs, PCBs, & metals
Wetland (stream)[b]	DE: New Castle Co.;Army Creek tributary to Delaware River	Army Creek Landfill	New Castle County	225	$600,000	$2,667	mi.	landfill leachate
Wetland (stream, freshwater)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	16	$63,080	$3,943	ac.	acidic process water from fertilizer plant

(a) Includes vegetated shallows, mudflats, tidal marshes and creeks, off-channel sloughs and lagoons, naturalized stream channels, and adjacent upland buffer areas

(b) Also includes 60 ac. uplands and 1.5 mi. stream habitat

(c) Percent upland versus wetland not stated

(d) From EPA (1955) Enforcement Report

(e) COC = contaminants of concern

(f) Acreage listed is area where material was dumped, not the area contaminated, which may be larger

Appendix E

Class 2.1 Releases

Appendix E
Class 2.1 Releases

Class 2.1 represents liquefied petroleum gases. The most common materials are Liquefied Petroleum Gas (LPG) and Liquefied Natural Gas (LNG). LPG is predominately propane and LNG is predominately methane. Propane can be shipped as a liquid under pressure without refrigeration. At 70°F its vapor pressure is about 120 psig. The gas cylinder for the common barbecue grill is liquefied propane.

LPG

A transportation accident involving LPG can result in four scenarios that can have major consequences.

1. The LPG can be released into a pool which evaporates and disperses without ignition. A simple energy balance shows that about 40 percent of the released liquid immediately flashes into vapor. The resultant liquid pool on the ground is only 60 percent of the size of a pool associated with spilling a similar quantity of gasoline. While the size of the pool is smaller, the damage to the environment will be severe because all the vegetation will be frozen. The temperature of the liquid pool of propane will be –44 °F.
2. Secondly, the LPG can be released and if the flammable cloud contacts an ignition source, the flame front can flash back and set the liquid pool on fire. For the quantities of LPG shipped by truck, the vapor cloud explosion would not be a major concern.
3. A boiling liquid expanding vapor explosion (BLEVE) can occur. For a BLEVE to occur, the tank containing the LPG must be engulfed in a fire and the rate of pressure buildup in the tank must exceed the capacity of the relief valve. This scenario is more likely to occur during rail transportation where the released fuel from one car can form a burning pool that engulfs another.
4. As a result of the accident, the tank ruptures and rockets away from the accident scene and ignites.

Of these four scenarios, the second and the fourth are most likely to result in significant consequences, the second if there are a large number of people trapped in the immediate vicinity of the accident and the fourth if the tank that rocketed from the accident scene lands in a populated area. It should be pointed out that because the LPG is stored under pressure, the probability the tank will rupture in an accident is much lower than the probability a tank carrying Class 3 liquids will rupture.

LNG

LNG must be shipped as a refrigerated liquid since its critical temperature, the highest temperature at which it can exist in the liquid state at any pressure, is –117°F. Its normal boiling point is –260°F. The LNG is being loaded into the double walled highly insulated transport vessel at atmospheric pressure. Thus the temperature of the LNG immediately after filling is –260°F. The temperature of the LNG is maintained at this temperature by evaporation of the boiling liquid and venting of the evaporated material. The vent must be closed for shipment. Thus, during shipment the pressure in the tank will gradually build and the temperature of the liquid will rise as the boiling point rises with pressure. The cryogenic tanks are rated based on the pressure buildup over a specified period of time. A typical cryogenic tank rating is 75 psig pressure rise over a 100 hour time period. Thus, if a typical transport distance were 500 miles at an average speed, considering stops, of 40 mph, the pressure in the tank at the end of the run would be approximately 10 psig. Given the amount of insulation associated with the cryogenic tanks, the carrier probably does not wait for equilibrium to be attained. Thus, the pressure buildup will probably be higher than 10 psig over the time the LNG is being shipped. For purposes of this analysis, it will be assumed that the average pressure in the LNG tank is 30 psig. The temperature of the LNG at a pressure of 30 psig is –230°F, an increase of 30 degrees from its normal boiling point. In the case of the LNG, approximately 30% will flash into vapor when released.

The same scenarios considered for the LPG can be considered for LNG. Because of the amount of insulation on the tank, the BLEVE will be more likely for LNG. Basically what would have to happen is for an accident to occur between two trucks, one carrying gasoline and the other LNG. The gasoline would have to spill and burn, fully engulfing the LNG tank. The fire would then have to last over an hour. There are really two competing phenomena occurring. At some point, probably below 300 psig, the relief valve will rise and slow the rate of pressure buildup. The second phenomenon is the weakening of the walls of the tank by heating. BLEVE failures occur in the upper region of the tank in an area not cooled by the boiling LNG remaining in the tank.

In term of likelihood of a release, the double walled construction of the LNG tank will reduce the likelihood of a release when compared to a LPG tank. However, once released, the consequences of the two releases will be similar. The area covered by released liquid will be killed by exposure to very low temperatures. There is really not much difference between the effects of –40 and –260 °F. Direct exposure to either temperature will kill anything living.

Since the one year profile will probably not have any of these serious accidents, most of the above discussion will be relevant to the section addressing catastrophic, less likely accident scenarios.

Appendix F

Impact Case Examples

Appendix F
Impact Case Examples

This appendix presents impact summaries for actual Class 3, Division 2.1, and Class 8 accidents. These three categories were selected because of their importance within HM accident impacts. The three categories together account for almost 78 percent of the total impacts from accident/incidents for the portrait year. These examples provide an indication of the range of impacts from Class 3 accidents. Field values were obtained from newspaper clippings and different Federal and state databases. However, estimations of some impact costs were added when data was unavailable. These values are annotated with an asterisk. For example, if a tractor and trailer were destroyed, an estimated value for the equipment was added even if HMIS reported the value as $0. The case examples indicate that there is considerable variability among particular accidents, but that serious injuries can dominate the cost, even in the case of the Kirkersville, Ohio, accident, where impact delay costs were high because a major interstate was affected. A similar situation applies to the Northwood, Ohio, accident, which is dominated by the single fatality, although 100 people were evacuated. Tables F-1 to F-8 provide a summary of the impacts for each case.

October 29, 1996, 4:50 a.m., Near Kirkersville, OH. A tanker truck, traveling eastbound on I-70, went into the median and rolled onto its side. The cargo tank was carrying 6,800 gallons of acetone. Less than 100 gallons of the hazardous cargo was released through the tank's pressure relief valve. The driver apparently had fallen asleep and lost control of the vehicle. He was taken to the hospital for injuries. Both the east- and westbound lanes of I-70 were closed starting at 5 a.m. and were expected to open by 2 p.m. An environmental contractor was called to clean up the spill.

Table F-1. Kirkersville, OH.

	Field	Value*
HM Information	Commodity	Acetone
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	Less than 100 gallons
Accident Information	Location	I-70 Eastbound, 122 MM, East of SR158, near Kirkersville, OH (Rural community)
	Fatalities	0
	Injuries	1 person $400,000
	Evacuation	0
Damages	Product Loss	$500
	Carrier Damage	$2,000
	Public/Private Property Damage	$0
	Decontamination/ Cleanup	$1,500
	Incident Delay	$83,025
	Environmental Damage	$88
Total Estimated Cost		$487,113

* Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

Thursday, March 14, 1996, 12:00 p.m., Mankato MN. A tractor-semi-tanker, carrying 8,500 gallons of gasoline, tipped while turning off Riverfront Drive onto Madison Avenue. The tanker was punctured, spilling approximately 235 gallons of gasoline onto Riverfront Drive. Approximately 25 gallons went into a stormsewer, while none appeared to flow into the river or contaminate any ground or soil. Although the driver was only traveling at 10 mph, speed may have been a factor in the accident. Parts of Riverfront Drive and Madison Avenue were closed from noon to 10 p.m. Several businesses and families were evacuated along the 700, 800 and 900 blocks of Riverfront Drive and one side of 2nd Street for approximately six hours. The only injury involved the driver, who was treated at the scene of the accident. An environmental contractor was called to drain the remaining fuel from the tanker. The city billed the trucking company $13,212 for the spill clean up, which included police and fire personnel hours, equipment and supplies. The trucking company paid this bill in May of 1996.

Table F-2. Mankato, MN.

	Field	Value*
HM Information	Commodity	Gasoline
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	235 gallons
Accident Information	Location	Riverfront Dr. and Madison Ave., Mankato, MN (Suburban community)
	Fatalities	0
	Injuries (Minor)	1 person $4,000
	Evacuation	75 people for 6 hours $75,000
Damages	Product Loss	$425
	Carrier Damage	$60,000
	Public/Private Property Damage	$1,000
	Decontamination/ Cleanup	$6,000
	Other Damages	$13,212 City bill
	Incident Delay	$12,000
	Environmental Damage	$208
Total Estimated Cost		$171,846

* Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

June 22, 1996, 5:15 a.m., Berthoud Falls, CO. A tanker truck traveling along U.S. 40 and carrying 8,200 gallons of diesel fuel ran off the road and rolled approximately ¾ times, before catching fire. The first person at the scene, a passerby, was able to pull the two injured passengers from the tractor before flames engulfed it. The tanker melted due to the heat of the fire. The spilled fuel and fire traveled down the roadside ditch and proceeded to burn out a car and home; fortunately there were no injuries due to the spreading fire. The fire continued to burn 50 – 60 yards of the surrounding area. Approximately 50 residents were evacuated from the rural community, and the road was closed for approximately 2 hours. Colorado State Highway Patrol noted that the road surface was wet from rain and that the driver's condition appeared normal. The truck was reported as traveling at 35 mph. An environmental contractor was called to clean up the spill.

Table F-3. Berthoud Falls, CO.

	Field	**Value***
HM Information	Commodity	Diesel Fuel
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	8,200 gallons
Accident Information	Location	U.S. 40 & milepost 249, Berthoud Falls, CO (Rural community)
	Fatalities	0
	Injuries	2 people $400,000
	Evacuation	50 people $50,000
Damages	Product Loss	$8,000
	Carrier Damage	$107,000 (assumes total damage)
	Public/Private Property Damage	$60,000
	Decontamination/ Cleanup	$30,000
	Incident Delay	$46,125
	Environmental Damage	$3,597 (assumes half of leaked cargo burned)
Total Estimated Cost		$704,722

* Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

Saturday, September 7, 1996, 3:30 p.m., Burns Harbor, IN. A tractor-trailer rig was exiting I-94 onto U.S. 20 via a full circular exit ramp, traveling at 30 mph, when the contents of the trailer shifted to the left, causing the tractor-trailer to roll over onto its left side. The trailer contained ten, 600-gallon containers of a flammable resin solution. Three of the containers ruptured at the seams, spilling 1,200 gallons of the resin solution. No other vehicles were involved in the accident, however, the driver of the vehicle and his two children traveling with him were hospitalized for minor injuries and released Saturday evening. The resin solution was also thought to be toxic if inhaled in large quantities. Thus, three homes and a fireworks warehouse were evacuated shortly after the spill. Evacuees were allowed to return late Sunday afternoon. The resin solution spilled onto U.S. 20, closing the road from Ind. 149 to just east of the I-94 interchange until 5 p.m. on Sunday. The solution also contaminated some of the surrounding land. By nightfall a dump truck with sand was brought to the site to construct a dike to contain the resin, which had been covered with foam. At least 30 firefighters, hazardous materials experts and paramedics remained at the scene through Saturday night. To remove the containers and tractor-trailer from the highway, the vehicle's owner hired an environmental contractor.

Table F-4. Burns Harbor, IN.

	Field	Value*
HM Information	Commodity	Resin Solution
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	1,200 gallons
Accident Information	Location	U.S. Route 20 at I-94, Burns Harbor, IN (Rural community)
	Fatalities	0
	Injuries	3 people $96,000
	Evacuation	Three households and a fireworks warehouse.
Damages	Product Loss	$1,200
	Carrier Damage	$28,419
	Public/Private Property Damage	$0
	Decontamination/ Cleanup	$74,059
	Other Damages	$2,179
	Incident Delay	$46,875
	Environmental Damage	$1,053
Total Estimated Cost		$265,785

* Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

February 5, 1995, 9:00 a.m., Emeryville, CA. A tanker truck carrying more than 8,000 gallons of liquefied petroleum gas was trying to change lanes from I-80 to the MacArthur Maze when it skidded out of control and crashed into the center divide at the Cypress Street off-ramp. Sparks ignited the gas gushing form the ruptured tanker. A fireball, estimated at more than a hundred feet across, engulfed the truck and cars on the connector ramp between westbound I-80 and eastbound I-580 (MacArthur Maze). The driver of the truck died when the tractor plunged off the interstate. Authorities closed the Cypress Street off-ramp and the ramp between westbound I-80 and eastbound I-580, creating a massive traffic jam that persisted through most of Sunday. At least six people were treated for first- and second-degree burns, and flying debris and fire damaged seven cars. A crane took an hour on the afternoon of Sunday, February 5th, to lift the wreckage of the tanker. CALTRANS workers spent Sunday and early Monday clearing a debris trail that stretched approximately an eighth of a mile. The explosion damaged electrical wires that run along the road, destroyed three signs spanning the highway, and ripped away a section of guardrail from its concrete moorings, leaving a gaping hole. A 40-member repair team was on the job all night repairing the roadway. The connector ramp was reopened at 5:04 a.m. on Monday, in time for rush hour. However, there was still a lot of work to be done along the highway.

Table F-5. Emeryville, CA

	Field	Value*
HM Information	Commodity	Liquefied Petroleum Gas
	Class	Flammable Compressed Gas
	Quantity Spilled	1,100 CFT
Accident Information	Location	I-580 and I-80, Emeryville City, Alameda County, CA
	Fatalities	1 person $2,800,000
	Injuries	6 people $1,200,000
	Evacuation	0
Damages	Product Loss	$3,500
	Carrier Damage	$95,000
	Public/Private Property Damage	$120,000
	Decontamination/ Cleanup	$3,870
	Incident Delay	$498,000
	Environmental Damage	$4,200
Total Estimated Cost		$4,724,570

*Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

October 28, 1996, 8:28 a.m., Northwood, OH. A flatbed truck carrying cylinders of dissolved acetylene was in an accident at SR 579 and Williston Road, a rural agricultural area. Due to a spill and vapor cloud of the hazardous material, an evacuation of 100 people occurred. There were no road closures noted. However, there were two injuries and one fatality.

Table F-6. Northwood, OH

	Field	Value*
HM Information	Commodity	Dissolved Acetylene
	Class	Flammable Compressed Gas
	Quantity Spilled	370 CFT, plus a vapor
Accident Information	Location	SR 579 and Williston Rd, Northwood City, Wood County, OH
	Fatalities	1 person $2,800,000
	Injuries	2 people $400,000
	Evacuation	100 people $100,000
Damages	Product Loss	$60
	Carrier Damage	$60,000
	Public/Private Property Damage	$4,000
	Other Damage	$11,900
	Decontamination/ Cleanup	$40,000
	Incident Delay	$9,375
	Environmental Damage	$398
Total Estimated Cost		$3,425,773

*Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

October 14, 1996, 9:00 a.m., Lehigh, PA. A tanker truck, traveling on Route 248, separated from its tractor and skidded 30 feet, causing a leak from a valve. The tanker was carrying 8,000 gallons of an ammonia solution (approximately 30 percent ammonia and 70 percent water). A leak trickled from a valve, while simultaneously causing a hazardous ammonia vapor to form. An estimated 5 to 10 gallons of the load leaked from the tanker. Shortly after the accident, firefighters started evacuating homes; 10 to 15 homes within a half-mile radius were evacuated, causing 35 people to leave the area. Timberline Road and Route 248 between Routes 946 and 145 were immediately closed. An employee from the tanker filling station arrived in a self-contained suit within 15 minutes of the accident and stopped the leak. By noon, the trucking companies hazardous materials team arrived to transfer the chemical onto another tanker. By 5:30 p.m., the chemical was transferred to the other truck, the roads were opened and the residents were allowed to go home. No one was injured or killed. In all, 130 fire and emergency personnel responded.

Table F-7. Lehigh, PA

	Field	Value*
HM Information	Commodity	Ammonia Solutions 10-35%
	Class	Corrosive Material
	Quantity Spilled	5-10 gallons, plus a vapor
Accident Information	Location	Route 248, Lehigh City, Northampton County, PA
	Fatalities	0
	Injuries	0
	Evacuation	35 people $35,000
Damages	Product Loss	$0
	Carrier Damage	$4,500
	Public/Private Property Damage	$0
	Other Damages	$13,500
	Decontamination/ Cleanup	$0
	Incident Delay	$15,938
	Environmental Damage	$0
Total Estimated Cost		$55,438

*Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

August 6, 1997, 2:00 p.m., Michigan City, IN. An auto carrier truck slammed into the back of a tanker truck stopped in congested traffic on the eastbound lane of I-94. The tanker truck was carrying sodium hydroxide (50 percent solution); 3,000 – 4,000 gallons of the corrosive chemical spilled from the tanker as a result of the accident. All six lanes of I-94 were closed, starting a little after two o-clock along a nine-mile stretch between Chesterton and Michigan City. The three westbound lanes were reopened on Wednesday, August 6th, around 5:30 p.m. At 11:00 p.m. on Wednesday, the center and left lanes of the eastbound side were reopened; the right hand lane was still closed well into Thursday. About 500 to 1,000 gallons of sodium hydroxide remained in the tanker after the accident and was transferred to another tanker. Cleanup of the accident included removing all contaminated soil along the side of the interstate. Two tractor-trailer loads of soil had already been removed by 3:30 p.m., and the cleanup was still underway. Water samples were also taken from a small creek to check for any contamination. OSI Environmental conducted the cleanup; the Porter County Hazardous Materials Team and the Indiana Department of Environmental Management oversaw the cleanup. The tank truck company was said to be responsible for the payment of the cleanup. The sodium hydroxide, which will burn skin on contact, affected three people who received minor burns when some of the chemical spilled on them. The auto carrier truck veered to the right after the collision, crashed through a guardrail, overturned, and burst into flames. The driver of the auto carrier died of multiple injuries. Firefighters came from three neighboring township volunteer fire departments.

Table F-8. Michigan City, IN

	Field	Value*
HM Information	Commodity	Sodium Hydroxide Solution
	Class	Corrosive Material
	Quantity Spilled	3,000 – 4,000 gal.
Accident Information	Location	Mile marker 29 on I-94, Michigan City, La Porte County, IN
	Fatalities	1 person $2,8 00,000
	Injuries	3 people minor injuries $12,000
	Evacuation	0
Damages	Product Loss	$35,000
	Carrier Damage	$107,000
	Public/Private Property Damage	$2,300
	Other Damage	$11,940
	Decontamination/ Cleanup	$13,500
	Incident Delay	$83,025
	Environmental Damage	$3,063
Total Estimated Cost		$3,067,828

*Dollar values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

Appendix G

References

Appendix G
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Hydraulic Performance of Geosynthetic Clay Liners in a Landfill Final Cover

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Hydraulic Performance of Geosynthetic Clay Liners in a Landfill Final Cover

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Abstract: Percolation from a landfill final cover containing a geosynthetic clay liner (GCL) as the hydraulic barrier is described. The GCL was covered with 760 mm of vegetated silty sand and underlain with two gravel-filled lysimeters to monitor percolation from the base of the cover. Higher than anticipated percolation rates were recorded in both lysimeters within 4–15 months after installation of the GCL. The GCL was subsequently replaced with a GCL laminated with a polyethylene geofilm on one surface (a "composite" GCL). The composite GCL was installed in two ways, with the geofilm oriented upwards or downwards. Low percolation rates (2.6–4.1 mm/year) have been transmitted from the composite GCL for more than 5 years regardless of the orientation of the geofilm. Samples of the conventional GCL that were exhumed from the cover ultimately had hydraulic conductivities on the order of 5×10^{-5} cm/s. These high hydraulic conductivities apparently were caused by exchange of Ca and Mg for Na on the bentonite combined with dehydration. The overlying and underlying soils likely were the source of the Ca and Mg involved in the exchange. Column experiments and numerical modeling indicated that plant roots and hydraulic anomalies caused by the lysimeters were not responsible for the high hydraulic conductivity of the GCL. Despite reports by others, the findings of this study indicate that a surface layer 760 mm thick is unlikely to protect conventional GCLs from damage caused by cation exchange and dehydration. Accordingly, GCLs should be used in final covers with caution unless if cation exchange and dehydration can be prevented or another barrier layer is present (geomembrane or geofilm).

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CE Database subject headings: Geosynthetics; Clay liners; Landfills; Hydraulic conductivity; Dewatering.

Introduction

This case history describes the hydrologic performance of a final cover for a coal ash landfill where the barrier layer consisted of a conventional geosynthetic clay liner (GCL) or a composite GCL in lieu of a compacted clay layer. The site, which is located in southwestern Wisconsin, receives 892 mm of precipitation and has a potential evapotranspiration (PET) of 838 mm annually, on average. The conventional GCL was installed in 1996 when the cover was first constructed. The composite GCL was installed later to address problems related to excessive percolation, as described subsequently.

The cover profile consists of a 760-mm-thick vegetated surface layer (silty sand), the GCL, and a 150-mm-thick layer of interim cover soil (silty sand) placed over the ash. The conventional GCL that was installed initially (Claymax 200R, CETCO, Arlington Heights, IL) contained 3.6 kg/m^2 of granular Na–bentonite and was encased between a woven slit-film polypropylene geotextile and a lightweight spunlace polyester geotextile. Bentonite was placed in the overlaps at a rate of 0.4 kg/m. The composite GCL installed subsequently (Claymax 600 CL) contained 3.6 kg/m^2 of granular bentonite, was encased between nonwoven and woven geotextiles, and was laminated with a polyethylene geofilm (0.1 mm thick). The composite GCL was installed using similar methods as the conventional GCL.

Because GCLs had been used infrequently in Wisconsin when the cover was constructed, two 4.3 × 4.9 m pan lysimeters were installed beneath the cover to monitor the percolation rate (discharge from the base of the cover). A schematic of the lysimeter is shown in Fig. 1 and percolation rates from the lysimeters are shown in Fig. 2. The lysimeters were filled with pea gravel and drained to a still well, which was periodically pumped to determine the volume of water collected by the lysimeter. Henceforth, these lysimeters are referred to as Lysimeters 1 and 2.

Percolation rates measured in both lysimeters were low (<13 mm/year) within the first month after installation of the GCL, but increased to as much as 299 mm/year over the next 4–7 months. These rates were much higher than expected. For example, a GCL having a typical hydraulic conductivity of 2×10^{-9} cm/s would be expected to transmit less than 1 mm/year of percolation if steady saturated flow occurred continuously under unit gradient conditions. Alternatively, if the phreatic surface was maintained at the surface of the cover continuously and no head loss occurred in the soils above the GCL [a very conservative scenario, given that unsaturated conditions and upward gradients occur during most of the year in earthen covers (Khire et al. 1997)], the percolation rate still would be less than

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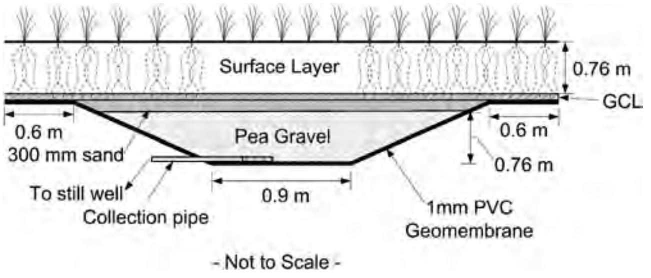

Fig. 1. Schematic of lysimeter used to monitor percolation from the base of the cover

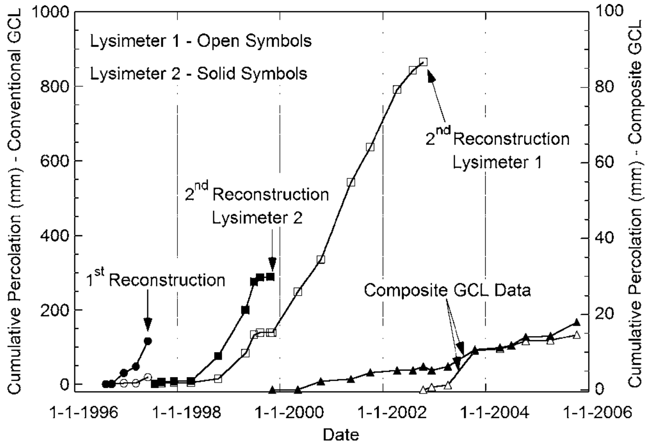

Fig. 2. Percolation rates for Lysimeters 1 and 2. Left-hand ordinate is percolation for conventional GCL; right-hand ordinate is for composite GCL.

50 mm/year. Because the observed percolation rates were much higher than expected based on reasonable computations, an inference was made that the hydraulic conductivity of the GCL had changed significantly during its relatively short service life.

There was concern that gravel particles in the lysimeter may have caused stress concentrations, making the GCL thinner and more permeable. Consequently, the cover was removed in the vicinity of each lysimeter, a 150-mm-thick layer of medium quartz sand was placed on top of the gravel, and the cover was reinstated consistent with the original profile, but with a new GCL (Claymax 200R). Percolation rates measured in the lysimeters remained low for 9–15 months after the reconstruction, but then began climbing again, with peak percolation rates as large as 450 mm/year (Fig. 2).

Lysimeter 2 was rebuilt again 24 months after the first reconstruction, except a composite GCL was installed instead of the conventional GCL. During this reconstruction, the conventional GCL in the vicinity of Lysimeter 2 was exhumed and inspected. The GCL was intact, the exposed seams had appropriate overlaps, and no construction defects were observed within or outside the perimeter of the lysimeter. Shrinkage cracks in the bentonite were not readily apparent, but the bentonite easily broke into small peds when the GCL was flexed. However, bentonite placed in the overlaps had numerous shrinkage cracks [Fig. 3(a)]. Fine roots also penetrated the GCL [Fig. 3(b)].

The composite GCL installed over Lysimeter 2 was placed with the geofilm downward. A second reconstruction of Lysimeter 1 was conducted 49 months after the first reconstruction using the same type of composite GCL employed for the second reconstruction of Lysimeter 2, except the geofilm was placed upward. Monitoring of both lysimeters has continued since the last reconstruction. Percolation rates less than 18 mm/yr have been recorded since the composite GCLs were installed (65 months for Lysimeter 2 and 28 months for Lysimeter 1), with the average percolation rate being 2.6 mm/yr in Lysimeter 1 and 4.1 mm/year in Lysimeter 2 (Fig. 2).

During the second reconstruction efforts of Lysimeters 1 and 2, samples of the GCL, the cover soils, and the cover vegetation were collected for laboratory testing and analysis to ascertain why the cover system transmitted much more percolation than anticipated. Potential causes that were considered included dehydration of the GCL caused by surface evaporation and root water uptake, cation exchange, root penetration through the GCL, and the unnatural boundary condition imposed by the lysimeter. This paper describes the analyses that were conducted and the inferences that were made regarding mechanisms that may have contributed to the excessive percolation rates.

On-Site Materials Characterization

Geosynthetic Clay Liner

GCL samples were collected during reconstruction of both Lysimeters 1 and 2 for this study. A sample of new Claymax 200R was also obtained for comparative testing. Two samples from each lysimeter were collected during reconstruction of Lysimeter 2 in November 1999 corresponding to locations within and outside the perimeter of the lysimeter. Four additional samples were collected in the vicinity of Lysimeter 1 during the reconstruction of this lysimeter in November 2002. Two of these 2002 samples were collected within the perimeter of Lysimeter 1 and two were collected outside the perimeter of the lysimeter. No samples were collected from Lysimeter 2 in 2002 because the composite GCL installed over this lysimeter was functioning satisfactorily. Samples were collected by excavating test pits to a depth near the GCL using a backhoe. The remaining cover soil was removed by hand to prevent damage to the GCL. Once the GCL was exposed, samples were cut using a razor knife, transferred onto a rigid sheet of plastic, and sealed in plastic to prevent desiccation.

Bentonite removed from each sample was tested to determine the water content, swell index, and the abundance of exchangeable Na, K, Ca, and Mg. Cation exchange capacity (CEC) was also determined for the new GCL. Water content was measured using ASTM D 2216 and swell index was measured using ASTM D 5890. The exchange complex was determined as the difference between soluble salts extracted using the fixed-ratio extract method with deionized (DI) water (Rhoades 1982b) and the total exchangeable cations extracted by the ammonium acetate method (Thomas 1982). CEC was determined by the ammonium acetate method (Rhoades 1982a). Chemical analysis of the extracts was conducted using flame atomic absorption spectrometry in accordance with USEPA Method 200.7. The quantities of exchangeable cations and the CEC are summarized in Tables 1 and 2.

Hydraulic conductivity tests were conducted on specimens trimmed from the exhumed GCL samples and the new GCL. The hydraulic conductivities are summarized in Tables 3 and 4 along with the water content and swell index data. DI water, 0.01 M $CaCl_2$ solution, and synthetic percolate were used as permeant liquids. DI water was used as a control for which no cation ex-

Fig. 3. (Color) Observations made during second reconstruction of Lysimeter 2: Desiccated and cracked bentonite (a); roots penetrating to underside of GCL (b)

change would occur during the hydraulic conductivity tests. The 0.01 M $CaCl_2$ solution is the standard solution recommended in ASTM D 5084 in regions with hard tap water (e.g., Madison, Wis.) and is similar to the solution used by Lin and Benson (2000) (0.012 M $CaCl_2$) to study the effects of wet–dry cycling on the hydraulic conductivity of GCLs. Their solution was selected after studying the ionic composition of pore water extracts from vegetated cover soils in Wisconsin.

The synthetic percolate was created by collecting effluent from a hydraulic conductivity test conducted on an undisturbed block sample from the overlying soils (see discussion of sampling in the next section). The specimen was permeated with rainwater for a period of one month to simulate the infiltration that might occur during the wet spring period in Wisconsin. The percolate had an ionic strength of 0.0089 M and an RMD of 0.0033 $M^{1/2}$. RMD is a measure of the relative abundance of monovalent and polyva-

Table 1. Summary of GCL Chemical Analysis Using Samples Collected during Lysimeter 2 Reconstruction (1999)

Sample	Lysimeter	Location	CEC ($\mathrm{cmol}^+/\mathrm{kg}$)	Exchangeable cations ($\mathrm{cmol}^+/\mathrm{kg}$) K	Na	Ca	Mg
New GCL	—	—	69.2	0.25	55.2	2.20	4.25
Exhumed GCL	1	Inside	—	0.90	1.90	26.40	7.35
	1	Outside	—	1.65	1.75	23.60	14.05
	1	Inside	—	0.75	1.65	21.30	12.70
	2	Outside	—	1.00	1.80	22.00	11.50

lent cations in a permeant liquid and is defined as $M_m/M_d^{1/2}$, where M_m=total molarity of monovalent cations and M_d=total molarity of polyvalent cations (Kolstad et al. 2004). The synthetic percolate has similar ionic strength as the solution used by Lin and Benson (2000) and the 0.01 M $\mathrm{CaCl_2}$ solution recommended in ASTM D 5084, but has slightly higher RMD (both of the other solutions have RMD=0). The following cations in the synthetic percolate had a concentration of at least 1 mg/L: K (4.9 mg/L), Na (8.6 mg/L), Ca (71.7 mg/L), Mg (23.8 mg/L), and Mn (1.5 mg/L).

GCL test specimens for the hydraulic conductivity tests were prepared using a steel cutting ring and a razor knife following the procedure in Jo et al. (2005). To prevent loss of bentonite along the edge of the specimen, the bentonite was hydrated locally by applying a small amount of permeant liquid along the inner circumference of the ring prior to trimming. After trimming, the ring and excess GCL were removed, geotextile fibers remaining along the edge of the specimen were trimmed with a scissors to prevent preferential flow (Petrov and Rowe 1997), and a thin layer of bentonite paste was applied to the perimeter of the specimen as an extra measure against preferential flow and sidewall leakage.

Permeation was conducted using the falling-headwater constant-tailwater procedure in ASTM D 5084. An average hydraulic gradient of 100 and an effective stress of 15 kPa were applied. Backpressure was not used to simulate field-satiated conditions and the stress was selected to mimic the overburden pressure in the field. The hydraulic gradient is higher than that in the field, but is typical of hydraulic gradients used when testing GCLs. Because GCLs are thin, relatively high hydraulic gradients can be used without the large increases in effective stress that are encountered when testing compacted clays with high hydraulic gradients (Shackelford et al. 2000).

To verify that sidewall leakage and preferential flow were not occurring, rhodamine WT dye (5 mg/L) was added to the influent of exhumed GCL specimens that had high hydraulic conductivities ($>10^{-6}$ cm/s). Rhodamine WT dye readily stains flow paths bright red (Jo et al. 2001). No sidewall leakage or preferential flow was evident in any of the tests. The effluent lines were also inspected visually for bentonite particles that may have piped from the GCL. No bentonite particles were observed in the effluent.

Soils

Grab samples were collected from the soils above and below the GCL. Undisturbed samples of the surface layer were collected as 200-mm-diameter blocks. Particle size distribution, exchangeable Na, K, Ca, and Mg, and hydraulic conductivity were measured for each soil. Particle size analysis was conducted following ASTM D 422. Methods used to determine exchangeable cations and soluble salts were the same as those used for the bentonite from the GCL samples. Properties of the overlying and underlying soils are summarized in Tables 5 and 6. The overlying surface layer classifies as SM in the Unified Soil Classification System. The underlying soil that was within the perimeter of the lysimeter is poorly graded medium sand that classifies as SP. Outside the lysimeter, the underlying soil is the same as the surface layer. Ca and Mg are more abundant than Na and K in the exchange complex of the surface layer and the underlying sand.

Hydraulic conductivity of the surface layer was measured in flexible-wall permeameters on specimens trimmed from the undisturbed samples. The falling-headwater constant-tailwater method in ASTM D 5084 was followed. Backpressure was not used to simulate field-satiated conditions. A hydraulic gradient of 15 and an effective stress of 15 kPa were applied to simulate the stress in the cover while also ensuring reasonable test times and good contact between the membrane and the test specimen. Hydraulic conductivity of the coarse-grained underlying soil was determined using the constant head method in ASTM D 2434. A Mariotte bottle was used to apply the constant head.

Root Distribution

Root samples were obtained from inside and outside Lysimeter 1 and outside of Lysimeter 2 to determine the distribution of root biomass, which was needed for simulations of variably saturated flow within and around the lysimeters. Samples were collected using the Weaver-Darland box method (Böhm 1979) using a sample box having inside dimensions of 100 mm × 200 mm × 850 mm. The sampling procedure is analogous to that used for collecting block samples for geotechnical testing. A trench was excavated through the overlying cover soils, the outline of the box was inscribed on the trench wall, and hand tools were used to expose a monolith slightly larger than the inside dimensions of the sampling box [Fig. 4(a)]. Trimming continued until the box just fit over the monolith, and then the monolith was separated from the adjacent soil with a clay spade. Excess soil was trimmed away so that the sample fit inside the box [Fig. 4(b)].

The distribution of root density with depth was obtained following the procedure in Liang et al. (1989). Each root sample was separated into increments that were washed with tap water over a

Table 2. Summary of Exchangeable Cations for Samples Collected during Lysimeter 1 Reconstruction (2002); All Samples Collected from the Vicinity of Lysimeter 1

Location	Exchangeable Cations ($\mathrm{cmol}^+/\mathrm{kg}$) Ca	Mg	Na	K
Inside-1	31.8	6.5	0.9	1.3
Inside-2	20.0	4.9	0.3	0.7
Outside-1	29.4	8.2	1.3	0.7
Outside-2	25.7	6.6	0.6	1.5

Table 3. Summary of Physical Properties of GCL for Samples Collected during Lysimeter 2 Reconstruction (1999)

Sample	Lysimeter	Location	Field water content (%)	Swell index (mL/2 g)	Hydraulic conductivity (cm/s): Rainwater percolate	Hydraulic conductivity (cm/s): 0.01 M $CaCl_2$	Hydraulic conductivity (cm/s): DI water
New GCL	—	—	—	24	7.8×10^{-9}	5.1×10^{-9} 4.4×10^{-9}	2.7×10^{-9}
Exhumed GCL	1	Inside	67	15	1.0×10^{-8}	1.7×10^{-8} 4.9×10^{-8}	8.5×10^{-9}
	1	Outside	59	9	1.3×10^{-7}	4.2×10^{-8} 2.1×10^{-8}	1.3×10^{-8}
	2	Inside	48	7	1.1×10^{-5}	1.6×10^{-5} 9.6×10^{-6}	3.6×10^{-5}
	2	Outside	42	8	2.3×10^{-5}	9.4×10^{-6} 8.7×10^{-6}	2.4×10^{-5}

U.S. No. 20 sieve to separate the roots from the soil. The roots were dried at 70°C for 48 h and weighed. The root density distributions are shown in Fig. 5. Roots penetrated to the bottom of the profile in each case, which is consistent with the observation of roots penetrating the GCL [Fig. 3(b)]. Moreover, similar root density distributions were obtained for both lysimeters and within and outside the area associated with Lysimeter 1.

Discussion of GCL Properties

Hydraulic Conductivity

Very similar hydraulic conductivities were obtained for the GCLs exhumed from Lysimeter 2 in 1999 (Table 3). The hydraulic conductivities fall within a narrow range (from 8.7×10^{-6} to 2.4×10^{-5} cm/s), regardless of the permeant liquid that was used. These hydraulic conductivities are more than three, and in some cases nearly four orders of magnitude higher than those for the new GCL, which ranged between 2.7×10^{-9} cm/s (DI water) and 7.8×10^{-9} cm/s (rainwater percolate).

Lower hydraulic conductivities were obtained for the GCLs exhumed in 1999 from Lysimeter 1 when Lysimeter 2 was being reconstructed. These GCLs from Lysimeter 1 had hydraulic conductivities ranging between 8.5×10^{-9} cm/s (DI water) and 1.3×10^{-7}/cm s, which is a factor of 1.1–48 times higher than the hydraulic conductivity of the new GCL. The differences between the hydraulic conductivities of the GCLs exhumed from Lysimeters 1 and 2 are consistent qualitatively with the differences in cumulative percolation in the lysimeters at the time of sampling, as well as differences in the timing of the percolation record. Lysimeter 2 had transmitted 288 mm of percolation since the first reconstruction in 1997, whereas Lysimeter 1 had transmitted 139 mm of percolation. The increase in percolation rate (change in slope in Fig. 2) also occurred later in Lysimeter 1 than in Lysimeter 2.

Because similar hydraulic conductivities were obtained for the GCLs exhumed from Lysimeter 1 using rainwater percolate or 0.01 M $CaCl_2$ solution (Table 3), the GCLs exhumed from Lysimeter 1 in 2002 were only permeated with 0.01 M $CaCl_2$ solution. The hydraulic conductivities of these GCLs range between 1.4×10^{-6} and 9.1×10^{-5} cm/s, and average 4.8×10^{-5} cm/s (Table 4). These hydraulic conductivities are 11–5,350 times higher than the hydraulic conductivities of samples collected from Lysimeter 1 in 1999, but on average are remarkably similar to the average hydraulic conductivity of the GCL removed from Lysimeter 2 in 1999 (5.0×10^{-5} cm/s). The large difference in hydraulic conductivity of the GCL samples collected from Lysimeter 1 in 1999 and 2002 suggests that the GCL degraded significantly during the sampling events. The high hydraulic conductivities measured in 2002 are also consistent qualitatively with the large quantity of percolation collected in Lysimeter 1 between the 1999 and 2002 reconstruction events.

Hydraulic conductivities were also computed from the slope of the cumulative percolation curves shown in Fig. 2 assuming unit gradient downward flow. The computations were made for the periods between April 1998–November 1999 (Lysimeter 2) and November 1999–November 2002 (Lysimeter 1), with the slopes defined using linear least-squares regression. During each of these periods, percolation accumulated at a relatively constant rate for both lysimeters. The computations yielded a hydraulic conductivity of 6.4×10^{-7} cm/s for Lysimeter 1 (203 mm/year) and 8.3×10^{-7} cm/s for Lysimeter 2 (262 mm/year). These hydraulic conductivities are approximately two orders of magnitude higher than those measured for a new GCL (i.e., from 2.7×10^{-9} to 7.8×10^{-9} cm/s), and are 65 times lower, on average, than the hydraulic conductivities measured in the laboratory in 1999 and 2002.

The large difference between the hydraulic conductivities computed from the field percolation rates and the measured hydraulic conductivity of the new GCL is consistent qualitatively with the change in percolation rate over time for both lysimeters (Fig. 2), and indicates that conditions within the cover adversely affected the GCL. The difference between hydraulic conductivi-

Table 4. Summary of GCL Physical Properties for Samples Collected during Lysimeter 1 Reconstruction (2002); All Samples Collected from the Vicinity of Lysimeter 1

Location	Swell Index (mL/2 g)	Field water content (%)	Hydraulic conductivity (cm/s)
Inside-1	15	32	9.1×10^{-5}
Inside-2	7	20	1.7×10^{-5}
Outside-1	8	29	1.4×10^{-6}
Outside-2	9	26	8.1×10^{-5}

Table 5. Summary of Exchangeable Cations for Cover Soils

			Exchangeable cations ($cmol^+/kg$)			
Sample	Lysimeter	Location	Ca	Mg	Na	K
Surface layer	1	Outside	16.77	2.43	0.65	0.29
Surface layer	1	Outside	20.61	3.76	0.77	0.33
Surface layer	2	Inside	5.69	1.32	0.11	0.14
Sand beneath GCL	2	Inside	2.35	0.33	0.11	0.05
Sand beneath GCL	2	Outside	2.54	0.49	0.07	0.07

Table 6. Physical Properties of Cover Soils

			Particle size fraction (%)		
Layer	Saturated hydraulic conductivity (cm/s)	USCS classification	Gravel	Sand	Fines
Surface layer	1.7×10^{-4}–3.4×10^{-3}	SM	3–8	48–72	20–49
Sand beneath GCL in lysimeter	0.013–0.089	SP	3	96	1
Lysimeter gravel	0.10[a]	GP	94	5	1

[a] Estimated using Hazen's equation.

ties computed from the field percolation rate and the hydraulic conductivities of the exhumed GCLs (measured in the laboratory) is also expected. Downward gradient conditions (assumed in the computations) exist for only short time periods in the field. Most of the time, the gradient is upward in response to evapotranspirative demand (Khire et al. 1997). If the gradient could be defined more accurately (which is not possible with the data available), much higher hydraulic conductivities probably would have been computed from the field percolation rates. For example, if unit gradient downward flow was assumed to occur for one in every 5 days, which is a reasonable assumption for the humid climate in southwestern Wisconsin, the computed field hydraulic conductivities would be nearly identical to the average hydraulic conductivity measured in the laboratory.

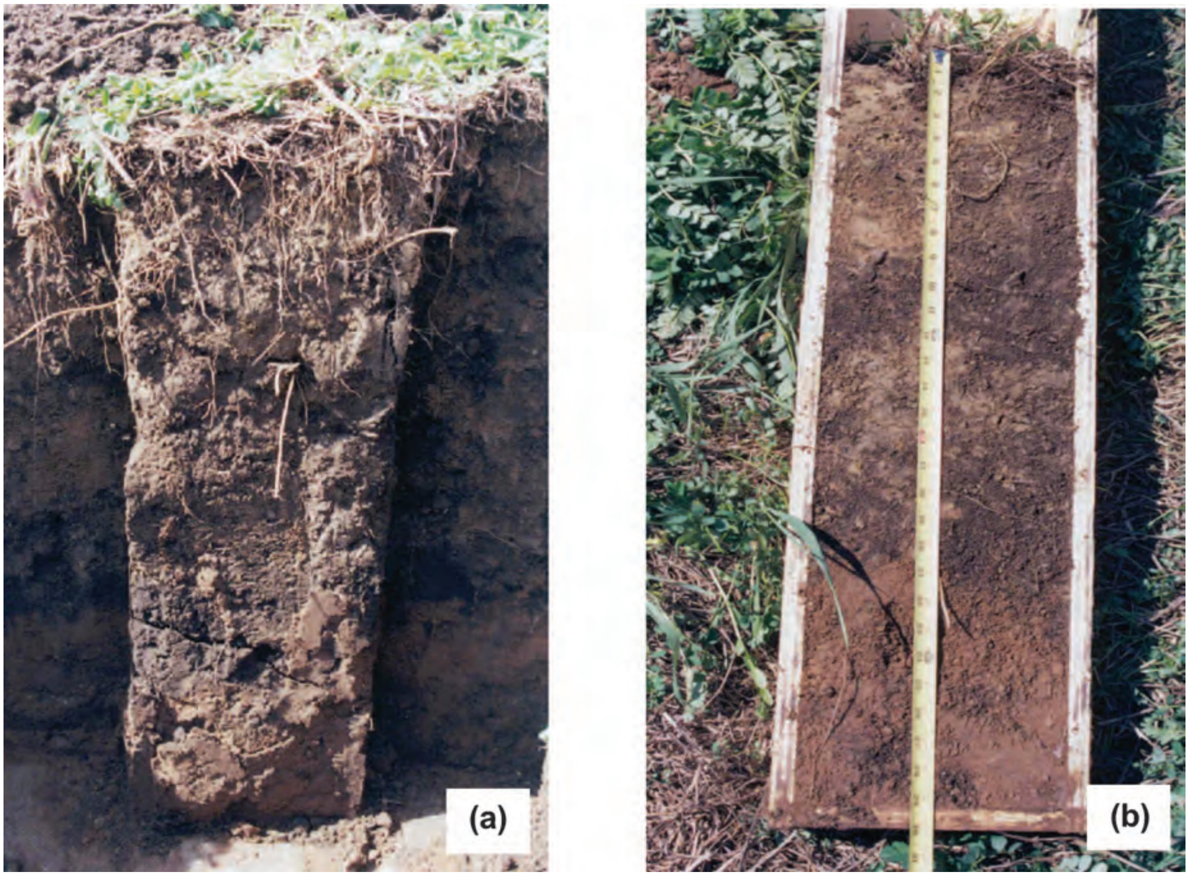

Fig. 4. (Color) (a) Soil-root monolith on the wall of trench; (b) monolith trimmed into sample box. Surface of GCL is visible at the bottom of the trench in (a).

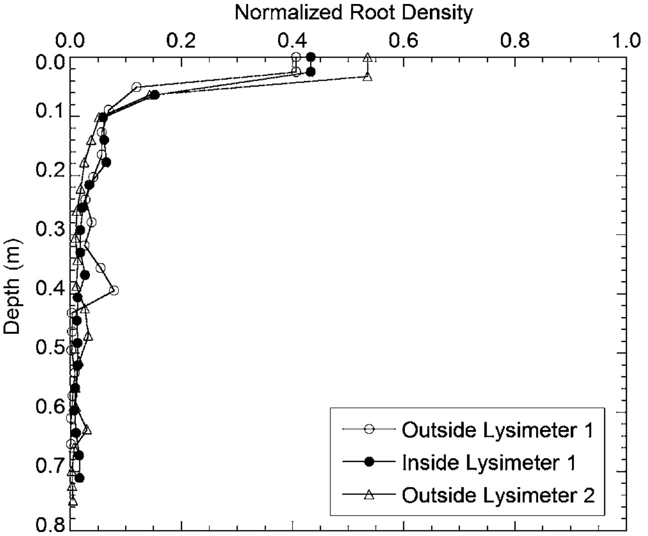

Fig. 5. Normalized root density profiles for Lysimeters 1 and 2. Normalization conducted by dividing the mass of roots in a given increment by the total mass of roots in the profile.

Exchangeable Cations and Swell Index

One factor that can result in increased hydraulic conductivity is exchange of the monovalent Na cation initially on the montmorillonite surface with divalent cations such as Mg and Ca (Egloffstein 2001; Shackelford et al. 2000; Jo et al. 2001, 2005; Jo and Edil 2004). Ca and Mg cations typically are the predominant cations in natural soils at the near surface (Sposito 1989), and other case studies have indicated that exchange of Ca–Mg for Na occurs in cover systems (James et al. 1997; Melchior 1997, 2002; Egloffstein 2001). Moreover, exchange of Ca–Mg for Na is known to be thermodynamically favorable (Sposito 1981). Thus, exchange of Ca–Mg for Na will occur if Ca and Mg are in the pore water unless there is a much larger abundance of Na in the pore water as well.

The exchange complex data in Tables 1 and 2 suggest that extensive cation exchange occurred in the GCLs. For example, the new GCL contained 55.2 $\mathrm{cmol}^+/\mathrm{kg}$ of exchangeable Na, whereas the exchangeable Na in the GCLs exhumed in 1999 was between 1.65 and 1.90 $\mathrm{cmol}^+/\mathrm{kg}$. That is, nearly all of the Na cations were replaced with other cations. Ca and Mg cations were largely responsible for the exchange (Tables 1 and 2), although a charge balance indicates that other cations probably were involved in the exchange as well.

Percolation from the overlying soils was the likely source of the Ca and Mg cations involved in the exchange. As indicated in Table 5, Ca and Mg are the dominant cations in the exchange complex of the surface layer soil and in the rainwater percolate (see previous discussion). The RMD of the percolate ($0.0033\ \mathrm{M}^{1/2}$) is also very low, indicating that the percolate is dominated by divalent cations (Kolstad et al. 2004). Upward diffusion of cations from the underlying sand may also have been important, as Ca and Mg are the dominant exchangeable ions present in the underlying sand too (Table 5).

Swell index of the bentonite from the exhumed GCLs is consistent with the exchange of Ca–Mg for Na (Tables 3 and 4). Bentonite from the new GCL had a swell index of 24 mL/2 g, whereas the GCLs exhumed in 1999 and 2002 had swell indices ranging between 7 and 15 mL/2 g, with six of the eight measurements falling within 7–9 mL/2 g. The swell indices of the exhumed GCLs are consistent with swell indices associated with Ca bentonite (Egloffstein 1995; Jo et al. 2001; and Edil 2004) and Mg bentonite (Jo et al. 2001; Kolstad et al. 2004), which typically range between 8 and 10 mL/2 g.

The dominance of Ca and Mg in the exchange complex indicates that cation exchange did occur and the swell index data indicate that exchange resulted in a marked reduction in the swelling capacity of the bentonite. However, cation exchange probably was not the only factor contributing to the large increases in the hydraulic conductivity of the GCL. For example, long-term hydraulic conductivity tests conducted by Egloffstein (2001) and Jo et al. (2005) using dilute Ca solutions (10 mM) that are similar to the rainwater percolate indicate that the long-term equilibrium hydraulic conductivity of bentonite to such solutions (i.e., after complete ion exchange) is approximately 2×10^{-8} cm/s. This hydraulic conductivity is similar to the hydraulic conductivity of the GCLs exhumed from Lysimeter 1 in 1999, but is much lower than the hydraulic conductivity of the GCLs exhumed in 1999 from Lysimeter 2 and those exhumed in 2002 from Lysimeter 1.

Water Content

Bentonites have low hydraulic conductivity when osmotic swelling occurs during hydration of the interlayer space between the montmorillonite lamella. Accumulation of water in the interlayer space causes the bentonite granules to swell, thereby reducing the size and conductance of the intergranular pores that act as the primary flow paths in GCLs (Jo et al. 2001, 2006). Osmotic swelling occurs when monovalent cations are the predominant cations in the exchange complex during hydration, but does not occur when polyvalent cations dominate the exchange complex (Norrish and Quirk 1954). This is the primary reason why Na bentonites have lower hydraulic conductivity than Ca or Mg bentonites.

When Na bentonite is hydrated and permeated with a solution dominated by polyvalent cations, cation exchange is inevitable because the exchange reaction is thermodynamically favorable. However, because cation exchange in the interlayer space is diffusion controlled, the rate at which exchange occurs depends directly on the concentration of polyvalent ions in the permeant liquid (Jo and Edil 2006). In contrast, hydration of the interlayer space occurs rapidly regardless of concentration due to the high affinity of dry bentonite for water molecules. For example, when permeating a GCL with a dilute salt solution (e.g., <20 mM), swelling from hydration is nearly complete within 1-3 pore volumes of flow (PVF). However, ion exchange can persist for hundreds of PVF (Jo et al. 2005). In contrast, hydration and ion exchange can both occur within several PVF if a concentrated salt solution (e.g., >500 mM) is used as the permeant liquid.

The relative rates at which hydration and cation exchange occur affect the hydraulic conductivity after exchange is complete, as illustrated in Fig. 6. In this case, specimens of a new GCL were permeated with the same procedures described previously, but with CaCl_2 solutions having concentrations between 5 and 500 mM. Permeation continued until the Na concentration in the effluent was below the detection limit (0.2 mg/L). Analysis of the exchange complex after testing showed that complete Ca–Na exchange occurred in each test (Jo et al. 2004). Hydraulic conductivities between 2.0×10^{-8} and 3.2×10^{-8} cm/s were obtained when the CaCl_2 permeant solution had a concentration $\leqslant 20$ mM, which is similar to the hydraulic conductivity Egloffstein (2002) reports (2×10^{-8} cm/s) for long-term tests on a GCL permeated

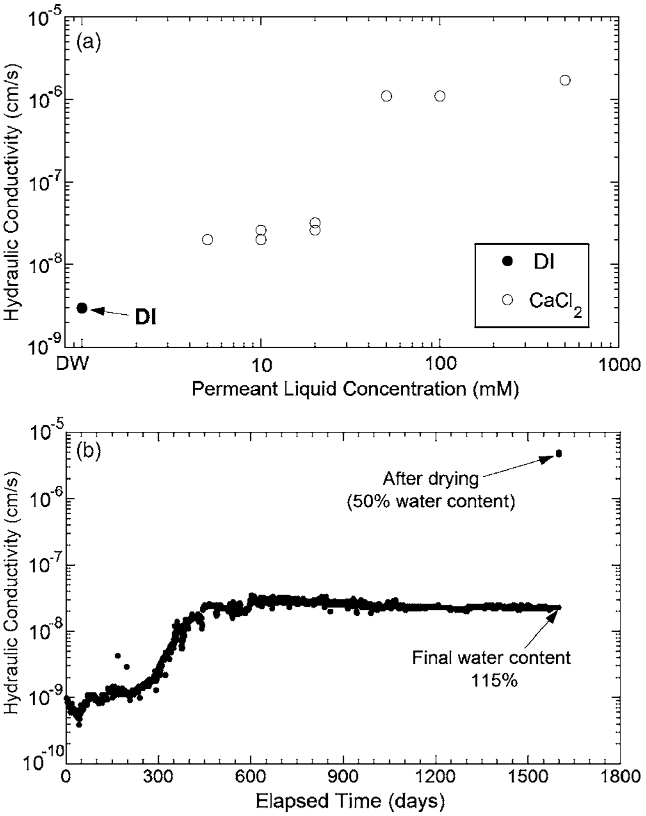

Fig. 6. Hydraulic conductivity of new GCL permeated with (a) DI water or Ca solutions having concentrations between 5 and 500 mM; (b) 0.125 M Ca solution for 1,599 days, dehydrated to 50% water content, and then re-permeated. Specimens were not prehydrated with deionized water.

with a "dilute" Ca solution (the Ca concentration was not reported). In contrast, permeant solutions having a concentration $\geqslant 50$ mM resulted in hydraulic conductivities between 1.1×10^{-6} and 1.7×10^{-6} cm/s. Equilibrium was achieved with these more concentrated solutions in less than 45 pore volumes of flow, whereas more than 287 PVF was required to reach equilibrium for concentrations $\leqslant 20$ mM.

The final water content (determined by oven drying) also varied with concentration. Water contents between 98.9 and 102% were obtained for specimens permeated with $CaCl_2$ solutions having concentration $\leqslant 20$ mM, whereas solutions having a concentration $\geqslant 50$ mM resulted in final water contents between 72.3 and 76.1%. The GCL permeated with DI water had a water content of 127%. The higher water contents associated with lower $CaCl_2$ concentrations suggest that more water remains bound to the bentonite when ion exchange occurs slowly, and that the presence of this bound water results in lower hydraulic conductivity when ion exchange is complete (i.e., due to sustained swelling of the granules, resulting in narrower and tortuous intergranular flow paths). The reason why this water remains bound is not clear, but strong adsorptive forces between the mineral surface and polar water molecules are a likely cause. These forces apparently are stronger than the osmotic forces tending to drive water molecules out of the interlayer in response to cation exchange (Jo et al. 2004).

These findings are relevant to GCLs used in covers without an overlying geomembrane. In such applications, hydration is likely to occur rapidly due to contact with moist adjacent soils and water percolating through the cover profile, and exchange is likely to occur slowly because the pore water is dilute. Consequently, high hydraulic conductivities compared to those observed in this case history should only occur if mechanisms exist to dehydrate the bentonite and remove the bound interlayer water, such as evaporation and/or root water uptake substantially. Desiccation cracking may also occur as a result of dehydration of the bentonite, and these cracks may contribute to higher hydraulic conductivity due to the lower swell potential of Ca–Mg bentonites relative to Na-bentonite (Lin and Benson 2000). In contrast, if dehydration is prevented, lower hydraulic conductivities should be realized.

The combined effects of cation exchange and dehydration are illustrated in Fig. 6(b). A new GCL was permeated with a 0.0125 M $CaCl_2$ solution for 1,599 days using the conditions described previously, with the hydraulic conductivity at the end of this period being 2.3×10^{-8} cm/s and the water content=115%. Analysis of the exchange complex also showed that complete exchange of Ca for Na occurred. The GCL specimen was then allowed to dry until the water content was 50%, which is comparable to the field water content of the GCL from Lysimeter 2 that was exhumed in 1999. An overburden stress of 15 kPa was applied during drying to simulate the stress existing in the field. The hydraulic conductivity was then measured again and determined to be 4.9×10^{-6} cm/s, an increase of more than two orders of magnitude due to dehydration. Thus, dehydration after ion exchange has a dramatic effect on the hydraulic conductivity.

For this case history, cation exchange and dehydration both occurred, and probably caused the large increase in hydraulic conductivity that was observed. In situ water contents of the exhumed GCL (20–67%, Tables 3 and 4) were much lower than the post-test water content of the new GCL permeated with 0.01 M $CaCl_2$ solution (127%, Table 3), a condition representative of complete hydration. Moreover, the exhumed GCLs with the lowest hydraulic conductivity (exhumed from Lysimeter 1 in 1999, Table 3) had the highest in situ water contents (59–67%), whereas the exhumed GCLs with highest hydraulic conductivities (exhumed from Lysimeter 2 in 1999, Table 3, and Lysimeter 1 in 2002, Table 4) had the lowest in situ water contents (20–48%). These data suggest that a relatively low hydraulic conductivity ($\approx 10^{-8}$ cm/s) may have been maintained even with cation exchange if dehydration had been prevented.

Onset of Change

The data were examined to explain why changes in the percolation rate and the hydraulic conductivity of the GCL occurred later in Lysimeter 1 than Lysimeter 2. No reason for this difference could be determined from the data that were collected. Location was also considered as a potential cause, but was eliminated because both lysimeters are located in a similar area of the top deck of the facility on similar slope with similar orientation. Nevertheless, a systematic reason probably exists, because the percolation rate for Lysimeter 1 increased several months after that of Lysimeter 2 after the initial construction and after the first reconstruction.

Effect of Root Intrusion

Laboratory column experiments were conducted to directly assess whether root intrusion may have been responsible for the large increase in hydraulic conductivity. Each column was constructed with clear acrylic tubing 100 mm in diameter (Fig. 7) and consisted of an upper portion (760 mm long) and a lower portion

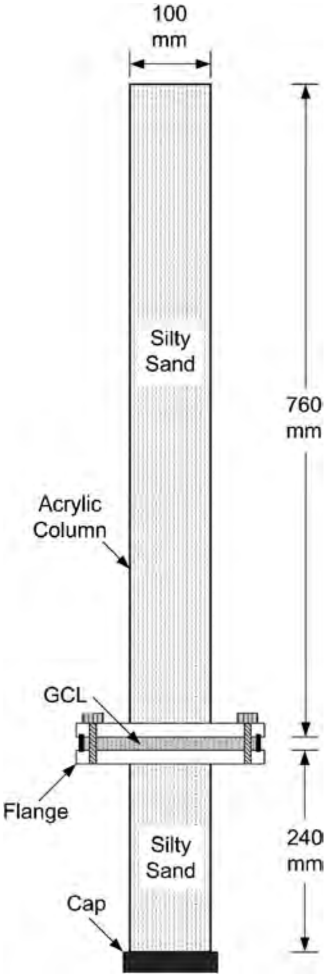

Fig. 7. Schematic of column used to evaluate effects of root intrusion. Cap at base permitted drainage while retaining soil.

(240 mm long). Both portions of the column were filled with silty sand. The GCL was fixed between the upper and lower sections with a bolt-and-flange mechanism that also held the top and bottom sections of the column together. The exchange complex for the silty sand used in the column was as follows: Ca—11.5 cmol^+/kg, Mg—4.9 cmol^+/kg, Na—0.7 cmol^+/kg, and K—0.7 cmol^+/kg.

Eleven column tests were conducted. Five of the columns were seeded with grasses and six were not seeded. All columns were irrigated twice weekly by applying 200 mL of tap water. Chemical analysis of the tap water indicated that the following cations had an average concentration of at least 1 mg/L: K (3.7 mg/L), Na (28.9 mg/L), Ca (35.9 mg/L), and Mg (11.2 mg/L). Excess water in the cover soil drained from a weep hole above the GCL near the flange on the upper section of the column. The cap at the bottom of the column permitted drainage while also retaining the soil.

Light was provided by a set of metal halide and sodium vapor lamps illuminated 14 h/day. The temperature was maintained at 27°C when the lights were illuminated and 13°C when the lights were off. Aluminum foil was placed around the columns to shield the soil and roots from light. Height of the grass was maintained less than 300 mm by trimming on a biweekly basis and the columns were inspected periodically to monitor root growth.

The columns were observed for 8 months, by which time a significant mass of roots was visible in the lower compartment of each seeded column (roots had penetrated the GCL). None of the columns were covered or sealed during this period. The combined effects of irrigation, evaporation, and transpiration probably resulted in hydration and dehydration of the GCLs in the seeded and unseeded columns. However, water contents within the GCL were not monitored during the test period. The GCLs were removed at the end of the 8-month period to determine their hydraulic conductivity as well as the water content, swell index, and cation exchange complex of the bentonite. The test data are summarized in Table 7. The swell indices were found to be very similar. Thus, only one measurement of the cation exchange complex was conducted per test configuration.

Much lower water contents were measured in the GCLs with grass (17.5–34.3%) relative to GCLs from the columns without grass (59.1–68.9%). The lower water contents of the GCLs with grass may have been due to root water uptake. Otherwise, similar results were obtained for all of the columns regardless of the presence of grass. Hydraulic conductivity of the GCLs varied between 1.8×10^{-5} and 6.9×10^{-5} cm/s (average of 5.0×10^{-5} cm/s) for the columns without grass and between 3.9×10^{-5} cm/s and 5.0×10^{-5} cm/s (average of 4.4×10^{-5} cm/s) for the columns with grass. Similarly, the swell index ranged

Table 7. Swell Index, Cation Exchange Complex, Water Content, and Hydraulic Conductivity of GCLs from Columns with and without Vegetation

Test condition	Swell index (mL/2 g)	Solid phase concentration (cmol^+/kg)				Water content (%)	Hydraulic conductivity (cm/s)
		Ca	Mg	Na	K		
No grass	8.0	50.1	24.6	1.4	1.7	61.0	1.8×10^{-5}
	8.0					59.5	3.5×10^{-5}
	7.5					62.9	6.9×10^{-5}
	8.0					63.9	5.6×10^{-5}
	8.0					68.9	6.2×10^{-5}
	8.0					59.1	6.1×10^{-5}
Grass	9.0	51.4	24.5	0.3	0.7	17.5	3.9×10^{-5}
	8.0					26.4	4.8×10^{-5}
	8.0					19.0	4.1×10^{-5}
	8.5					19.9	4.1×10^{-5}
	7.5					24.3	5.0×10^{-5}

Table 8. Hydraulic Properties Used for HYDRUS-2D

Layer	θ_r	θ_s	α (1/m)	n	K_s (cm/s)
Surface layer, soil beneath GCL outside lysimeter	0.067	0.45	2.0	1.4	1.8×10^{-3}
GCL	0.068	0.60	0.001	2.0	5.8×10^{-9} 4.5×10^{-8} 5.0×10^{-5}
Sand	0.045	0.43	14.5	2.7	0.051
Lysimeter gravel	0.045	0.43	56.0	3.2	0.10
Fly ash	0.034	0.46	1.6	1.4	7.0×10^{-5}

Note: θ_r=residual volumetric water content; θ_s=saturated volumetric water content; α and n=van Genuchten's parameters; and k_s=saturated hydraulic conductivity.

between 7.5 and 8.0 mL/2 g (average 7.9 mL/2 g) for the columns without grass and between 7.5 and 9.0 mL/2 g (average 8.2 mL/2 g) for the columns with grass. These swell indices are typical of Ca and Mg bentonites, as noted previously. The exchange complex data (Table 7) confirm that exchange of Ca and Mg for Na was nearly complete by the time the tests were conducted.

The average properties of the GCLs from the column tests are remarkably similar to those of the GCLs exhumed from Lysimeter 2 in 1999 and Lysimeter 1 in 2002. The hydraulic conductivity is approximately 5×10^{-5} cm/s, the swell index is approximately 8 mL/2 g, and the exchange complex is dominated by Ca and Mg. Water contents of the GCLs from the columns with grass are slightly lower than the water contents of the GCLs exhumed from Lysimeter 1 in 2002 (Table 4), whereas the GCLs from the columns without grass had water contents comparable to those of the GCL exhumed from Lysimeter 1 in 1999 (Table 3).

The similarity of the properties of the GCLs from the column tests conducted with and without grass and the properties of the GCLs exhumed from the field suggests that preferential flow due to root intrusion was not the cause of the increase in hydraulic conductivity observed in the field. This finding is consistent with the tests conducted on the exhumed GCLs, which showed no indication of preferential flow despite visible roots in the GCL. Cation exchange combined with hydration and dehydration appears to be the more important factor, and roots probably contributed to dehydration of the bentonite in both column tests and the field.

Effect of the Lysimeter

The testing program indicated that GCLs exhumed within and outside the perimeter of the lysimeters had comparable properties (Tables 1–4). Thus, hydraulic anomalies associated with the lysimeters probably did not affect the GCLs. In fact, the capillary break afforded by a lysimeter probably resulted in more water being retained within the cover soils and the GCL (Khire et al. 2000), reducing the potential for dehydration. Despite these considerations, concern still existed that the lysimeter may have permitted the surface layer to drain more readily than would normally occur, exaggerating dehydration of the GCL.

Because water contents within the cover soils were not monitored, this concern could not be assessed directly. Thus, an indirect assessment was conducted by simulating variably saturated flow within and around the lysimeter using HYDRUS-2D, a software package for simulating water movement in two-dimensional variably saturated media (Šimůnek et al. 1999). The program uses the finite-element method to solve a modified Richards' equation for unsaturated water flow with root water uptake by plants. The model was used to simulate the geometry of the lysimeter shown in Fig. 1. The coal ash layer was assumed to be 4 m thick and the breadth of the domain was set at 10 m.

Hydraulic properties assigned to the materials are summarized in Table 8. These properties include the saturated hydraulic conductivity and the van Genuchten parameters used to describe the soil water characteristic curve and the unsaturated hydraulic conductivity function. Saturated hydraulic conductivities of all of the materials were based on measurements conducted in this study (Tables 3, 4, and 6), except for the coal ash, which was assumed to have a saturated hydraulic conductivity similar to silt (Carsel and Parrish 1988). The van Genuchten parameters α and n, the residual water content (θ_r), and the saturated water content (θ_s) for the surface layer were assigned using the HYDRUS-2D catalog for silty sand. Parameters for bentonite reported by Sivakumar Babu et al. (2002) were used for the GCL. Parameters for the sand and gravel were estimated from the particle size distribution curves using the method in Chiang (1998). The fly ash was assumed to have van Genuchten parameters comparable to silt (Carsel and Parrish 1988). For all layers, the pore interaction term was assumed to be 0.5.

The upper surface of the model was assigned as an atmospheric boundary that permits infiltration during precipitation events and evaporation when precipitation is not occurring. The vertical sides of the domain were assigned no flux boundaries so that flow would be predominantly one dimensional, as anticipated in the field. The base was assigned a free drainage boundary, allowing for deep drainage within the coal ash. The geomembrane used to line the lysimeter was assigned a no flux boundary and the collection pipe in the lysimeter was assigned as a circular seepage face boundary having a diameter of 150 mm.

Daily meteorological data were obtained from an agricultural research station located 24 km from the site. These data were used as input to HYDRUS-2D and to compute PET using the Penman-Monteith method (Campbell and Norman 1998). Potential evaporation and potential transpiration input to HYDRUS-2D were computed from PET using the Ritchie-Burnett-Ankeny equation described in Chadwick et al. (1999) and a leaf area index of 4.5, which is typical of Wisconsin prairie grasses (Brye et al. 2002). The wilting point was set at 1500 kPa and the limiting point at 200 kPa (Kirkham 2005). The root distribution function measured inside Lysimeter 1 (Fig. 5) was input to HYDRUS-2D to distribute transpiration demand throughout the profile.

Simulations were conducted with the saturated hydraulic conductivity of the GCL set at 5.8×10^{-9} cm/s (new condition), 4.5×10^{-8} cm/s (partly weathered condition), and 5.0

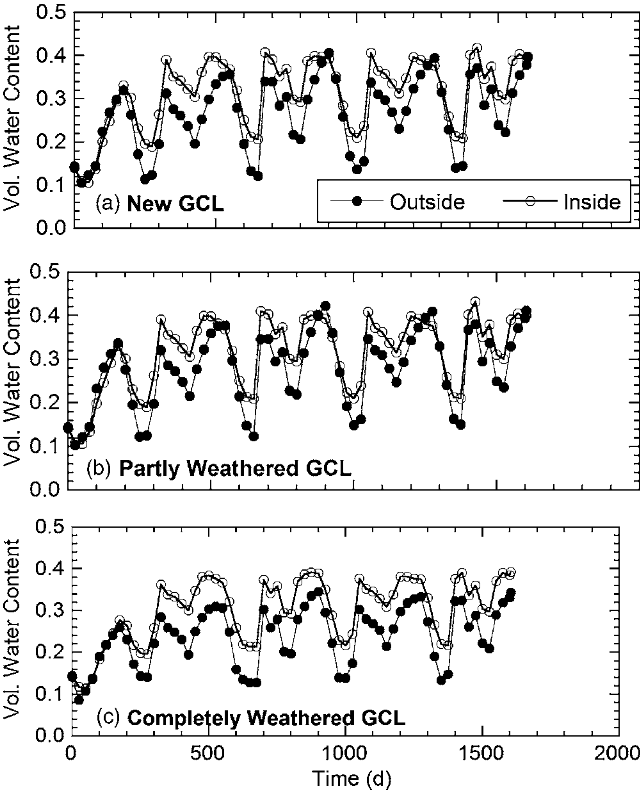

Fig. 8. Average volumetric water content in the root zone predicted by HYDRUS-2D for 1996–2000: (a) New GCL; (b) partly weathered GCL; and (c) completely weathered GCL. Points shown are output from HYDRUS-2D at 25 day intervals. Start date=January 1, 1996.

$\times 10^{-5}$ cm/s (completely weathered condition). These hydraulic conductivities correspond to the average hydraulic conductivities of the new GCL and the GCLs exhumed in 1999 that were permeated with rainwater percolate and 0.01 M $CaCl_2$ (Table 3). Average volumetric water contents in the surface layer are shown as a function of time in Fig. 8 for the period between Jan 1, 1996 and May 18, 2000 for the three GCL conditions that were simulated. Solid symbols correspond to conditions outside the lysimeter and open symbols correspond to conditions within the lysimeter.

Seasonal variations in water content are evident in all three cases, including the water deficit that occurs in Wisconsin in late summer each year. Comparison of Figs. 8(a) and (c) shows that increasing the hydraulic conductivity of the GCL results in lower peak water contents, slightly less variation in water content over time, and more gradual changes in water content, which reflect greater transmission of water through the GCL when its hydraulic conductivity is higher. More importantly, for all three cases, the volumetric water content of the surface layer is higher within the lysimeter than outside the lysimeter due to the capillary break provided by the lysimeter. Thus, the lysimeter probably did alter the hydrology of the cover, but this alteration probably resulted in less dehydration of the GCL than occurred outside the lysimeter. This finding is also consistent with the water contents of the exhumed GCLs. With the exception of one sample, all of the GCLs outside the perimeter of the lysimeter had lower water content than the GCLs within the perimeter of the lysimeter.

Comparison with Other Case Histories

Although several studies have been or are being conducted to evaluate the hydraulic performance of final covers that include GCLs (Blümel et al. 2002; Henken-Mellies et al. 2002; Wagner and Schnatmeyer 2002; Albright et al. 2004), only three well-documented studies have been published (Melchior 1997, 2002; Mansour 2001; Mackey and Olsta 2004) where GCLs have been exhumed from a final cover and tested to determine their hydraulic conductivity and related properties (water content, swell index, cation exchange complex, etc.). Melchior (1997, 2002) studied a final cover test section in Hamburg, Germany (average precipitation=758 mm/year), Mackey and Olsta (2004) studied final covers at two landfills on the coast of Florida (location and precipitation data not reported, but the Florida coastal climate is humid), and Mansour (2001) studied a final cover in Wasco, Calif. (average precipitation=186 mm/year).

Melchior (1997, 2002) constructed two 100 m^2 final cover test sections having a 300-mm-thick surface layer of sandy loam overlying a 150-mm-thick sand drainage layer and a conventional GCL (one needle punched and the other stitch bonded). The GCLs were underlain with a gravel-filled pan lysimeter lined with a geomembrane. Three observation plots (6 m^2) were also constructed with the same profile, but without lysimeters. Two of these plots contained conventional GCLs (one needle punched and the other stitch bonded) and the other contained a composite GCL installed with the geomembrane upward. The percolation record for the two 100 m^2 test sections was similar to that observed in the present study. Very low percolation rates were observed initially, and then the percolation rates increased to an annual rate ranging between 188 and 222 mm/year. Peak daily percolation rates were as high as 15 mm/day, which corresponds to a hydraulic conductivity of 1.7×10^{-5} cm/s under unit gradient conditions. The annual percolation rates observed by Melchior are very similar to those measured in the present study (203–262 mm/year).

Exhumation of the GCLs from the 100 m^2 test sections after 4 years showed that roots had penetrated the GCL and that the bentonite contained desiccation cracks. The native Na in the exchange complex was nearly completely replaced by Ca and Mg, and the swell index was 8–15 mL/2 g. The water content of the bentonite ranged between 55 and 100% (60% on average) and tests conducted on the exhumed GCLs at the end of the study yielded hydraulic conductivities ranging between 1.1×10^{-5} and 3.0×10^{-4} cm/s. Similar results were obtained for the GCLs in the observation plots, except for the composite GCL. Bentonite in the composite GCL had higher water content (137%) and exhibited only modest exchange (8%) of Ca and Mg for Na in the exchange complex. Melchior attributes the smaller changes in the composite GCL to protection afforded by the geomembrane, which prevented root intrusion, dehydration, and ion exchange by percolate from the overlying cover soil. This finding is consistent with the low percolation rates observed in the present study after the composite GCL was installed.

The two final covers (Landfills A and B) exhumed by Mackey and Olsta (2004) consisted of a surface layer overlying conventional needle-punched GCLs. Both had been in service for more than 5 years. Clean sand (0.61–0.81 m thick) was used for the surface layer at Landfill A and silty sand (0.46–0.86 m thick) was used for the surface layer at Landfill B. Shell fragments (a source of Ca) were found in some of the soils above the GCLs. The bentonite was moist at both sites (water contents were not reported) and roots were observed in some of the GCLs exhumed at both sites. Analysis of the exchange complex for the GCLs from both sites showed that nearly all of the Na had been replaced by Ca and Mg, and that Ca and Mg were the predominant cations in the cover soil at both sites. The swell index at both sites ranged between 7.5 and 14mL/2 g, which is consistent with Ca and Mg being the dominant cations in the exchange complex. Hydraulic conductivity of the GCL exhumed from Landfill A ranged between 8.5×10^{-9} and 6.4×10^{-6} cm/s, with lower hydraulic conductivities being reported for tests conducted by the GCL manufacturer (average$=1.4\times10^{-8}$ cm/s) than independent laboratories (average$=1.2\times10^{-6}$ cm/s). Lower hydraulic conductivities were reported for the GCL exhumed from Landfill B (from 3.5×10^{-9} to 2.3×10^{-8} cm/s).

Mansour (2001) exhumed GCLs from a test section consisting of a 0.66-m-thick surface layer of well-graded sandy soil with fines (plasticity not reported) overlying a conventional GCL (characteristics not described). The exhumation was conducted 5 years after the test section was constructed. Tests conducted on the exhumed GCL using deionized water as the permeant liquid and a confining stress of 35 kPa yielded a hydraulic conductivity of 1.9×10^{-9} cm/s. Water content of the GCL was not reported, but the swell index was determined to be 33 mL/2 g, on average. These properties are nearly identical to those measured on the GCL when it was installed, and the lack of change in swell index suggests that little or no cation exchange occurred in the bentonite. Analysis of soluble salts in the surface layer and the GCL indicated that the pore water in both materials was dominated by Na. The sodic condition of the surface layer probably prevented cation exchange in the GCL, as evinced by the absence of change in swell index. The high Na content of the surface layer also suggests that the soil probably was used as irrigated agricultural land in the past (Bohn et al. 1985).

The findings from these other case histories are consistent with a laboratory study conducted by Lin and Benson (2000). They subjected GCLs to cyclic wetting and drying, with the wetting being conducted by permeation with 0.012 M Ca solution (to induce ion exchange) or DI water (to prevent ion exchange). They found no change in hydraulic conductivity of the GCLs permeated with DI water, which is consistent with the findings from Mansour (2001), where replacement of Na by divalent cations did not occur. However, hydraulic conductivities between 3.9×10^{-6} and 7.6×10^{-6} cm/s were obtained for the tests conducted with the Ca solution, which are slightly lower but comparable to those measured in the present study and those reported by Melchior (2002). The findings by Melchior are also remarkably consistent with those in the present study; in both studies, similar hydraulic conductivities, water contents, swell indices, and exchange complexes were observed. The hydraulic conductivities reported by Mackey and Olsta (2004) fall between those reported by Mansour and those in the present study and by Melchior (2002). This may reflect the humid conditions and high precipitation in Florida relative to the other sites, which may have limited the amount of dehydration that occurred in the bentonite.

Egloffstein (2001, 2002) reports average hydraulic conductivities from 47 GCL samples exhumed from sites in Europe where "partial desiccation" and cation exchange occurred. Little information is provided about the exhumations, the specimens, the testing protocol, or the field water content and exchange complex of the GCLs. Permeation of these specimens under an effective confining pressure of 20 kPa over a period of 200 h resulted in a decrease in average hydraulic conductivity from approximately 5×10^{-6} to 1×10^{-7} cm/s. Similar reductions in hydraulic conductivity over time were not observed in the present study, and have not been reported in other studies. For example, the permeation phase of the tests conducted by Lin and Benson (2000) extended over a much longer period (>750 h) during each wetting cycle, with no apparent trend in hydraulic conductivity.

Egloffstein (2001, 2002) recommends that the surface layer should be at least 0.75 m thick so that adequate confining pressure is provided to close desiccation cracks during re-hydration and prevent high hydraulic conductivity. The basis for this conclusion is unclear, given that the lowest hydraulic conductivity of the GCLs tested by Egloffstein (2002) was 1×10^{-7} cm/s. Moreover, this conclusion is inconsistent with the findings of the present study, where the surface layer was 760 mm thick and the effective confining pressure during testing was 15 kPa. Similarly, Mackey and Olsta (2004) report a hydraulic conductivity of 6.4×10^{-6} cm/s for a GCL exhumed from a cover with a 0.76-m-thick surface layer that was tested using an effective confining pressure of 14 kPa.

Summary and Conclusion

A case history has been described where percolation from a final cover with a GCL as the hydraulic barrier was monitored using two lysimeters. The cover was initially constructed with a conventional GCL as the hydraulic barrier. Percolation from the base of the cover was low initially (<13 mm/year), but increased substantially within 4–15 months of installation. After 12–18 months of service, the average percolation rate ranged between 203 and 262 mm/year, and the percolation rate was as high as 450 mm/year. The conventional GCL ultimately was replaced with a composite GCL containing a geofilm laminated to one surface. Much lower percolation rates (2.6–4.1 mm/year, on average) have been transmitted since the composite GCL was installed, and similar percolation rates have been recorded regardless of whether the GCL was installed with the geofilm oriented upward or downward. The composite GCL has been in service for more than 5 years, and there is no indication that the percolation rate is increasing.

Samples of the conventional GCL were exhumed in 1999 and 2002 from regions within and outside the perimeter of each lysimeter for laboratory testing to determine the hydraulic conductivity of the GCL and the water content, swell index, and cation exchange complex of the bentonite. Samples of the underlying and overlying cover soils were also collected and tested. These tests confirmed that the large increases in percolation rate were due to large increases in hydraulic conductivity. The hydraulic conductivity of the GCL in the vicinity of both lysimeters ultimately ranged between 1.4×10^{-6} and 9.1×10^{-5} cm/s, whereas the hydraulic conductivity of the new GCL ranged between 2.7×10^{-9} and 7.8×10^{-9} cm/s. Replacement of the native Na cations in the exchange complex by Ca and Mg combined with dehydration of the bentonite appear to be key factors causing the large increase in hydraulic conductivity. The overlying and underlying cover soils appear to be the source of the Ca and Mg cations that exchanged for Na. Anomalies caused by the lysimeter and preferential flow due to root intrusion appear not to be factors causing the large increase in hydraulic conductivity.

The findings from this case study and studies published by others indicate that cation exchange combined with dehydration can adversely affect GCLs to the point where they maybe no longer effective as hydraulic barriers. Accordingly, GCLs should be used with caution unless a means exists to ensure that cation exchange and dehydration will not occur or another barrier to water flow is present. Egloffstein (2001, 2002) has suggested that an overlying layer 0.75–1.0 m thick is sufficient to protect GCLs, whereas this study and another in Florida, have shown that a cover layer 0.76 m thick can be insufficient to protect GCLs. More research is needed to determine if a thicker surface layer can protect GCLs, and to determine the physical and chemical properties of the surface layer that will minimize dehydration and cation exchange.

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Biological Assessment for the Potential Effects of Managing the Payette National Forest in the South Fork Salmon River Section 7 Watershed on Snake River Spring/Summer Chinook Salmon, Snake River Steelhead, and Columbia River Bull Trout
and
Biological Evaluation for Westslope Cutthroat Trout

Volume 31

East Fork South Fork Salmon River Bridge Repair

26 May 2009

Payette National Forest
McCall, Idaho

26 May 2009

Rodger L. Nelson, Fisheries Biologist
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Date

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I. INTRODUCTION

This Biological Assessment (BA) determines the effects of repairs to the East Fork South Fork Salmon River (EFSFSR) bridge at the mouth of the EFSFSR in the South Fork Salmon River (SFSR) Section 7 Watershed, on Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) and their designated critical habitat, Snake River steelhead (*O. mykiss*) and their designated critical habitat, and Columbia River bull trout (*Salvelinus confluentus*). This BA is tiered to previous BAs and supplements for the SFSR Section 7 Watershed, specifically portions of the EFSFSR analysis area as defined by Faurot and Burns (2007a) on the Payette National Forest (PNF). These BAs are listed at the end of this document under a section of the references cited called Previous BAs. Actions in this BA are similar actions as described in 50 CFR 402.12 (g). All acronyms, phrases, references, and associated documents from these BAs are included by reference.

This document also includes a Biological Evaluation (BE) of the effects of Federal actions on westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Biological Evaluations for sensitive species are prepared by direction of the Forest Service manual (FSM 2670).

Preliminary discussions among the Level 1 streamlined consultation team on 19 May 2009 led to agreement that there was no effect of this project to Northern Idaho Ground Squirrel (*Spermophilus brunneus brunneus*) or Canada Lynx (*Lynx canadensis*).

II. GENERAL DESCRIPTION OF THE SECTION 7 WATERSHED

A full description of the SFSR Section 7 watershed is provided in Faurot and Burns (2007a, pages 1-4); this BA incorporates those descriptions by reference and updates descriptions of specific components as needed.

A. LISTED SPECIES AND CRITICAL HABITAT AND SENSITIVE SPECIES

1. Overview

Detailed descriptions of the distributions of ESA-listed and sensitive species are provided in Faurot and Burns (2007a), and that description is incorporated here by reference; no substantive new information regarding the distribution or populations of these species is available.

2. Chinook Salmon

a. Species Distribution

Snake River spring/summer Chinook salmon were listed under ESA in 1992 (57 FR 14653); they are currently listed as "threatened." They are widespread in the SFSR Section 7 Watershed; detailed maps of known and suspected occurrence are provided in Faurot and Burns (2007a) and incorporated here by reference. Hereinafter, all references to Chinook salmon are to the listed species.

b. Designated Critical Habitat

Designated critical habitat was identified 1993 (58 FR 68543) and includes "areas consisting of the water, waterway bottom, and adjacent riparian zone of specified lakes and river reaches in hydrologic units presently or historically accessible” to them (50 CFR 226.205). We interpret these to comprise all of the mainstem upper SFSR and in tributaries at least as far upstream as designated critical habitat for Snake River Basin steelhead (below).

c. Essential Fish Habitat

Essential Fish Habitat (EFH) as established pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA, 50 CFR 600) in this area is synonymous with designated critical habitat (PFMC 1999).

2. Chinook Salmon

a. Species Distribution

Snake River Basin steelhead were listed as “threatened” in 1997. They are widespread in the SFSR Section 7 Watershed; detailed maps of known and suspected occurrence are provided in Faurot and Burns (2007a) and incorporated here by reference. Hereinafter, all references to steelhead are to the listed species.

b. Critical Habitat

Designated critical habitat was identified 2005 (70 FR 52629) and includes “includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line” (50 CFR 226.212). Endpoints are not fully identified here, but designated critical habitat includes the EFSFSR where the bridge repair project is located.

3. Bull Trout

a. Species Distribution

Columbia River bull trout were listed as “threatened” in 1998 (63 FR 31647) with all coterminous populations listed together in 1999 (64 FR 58930); detailed maps of known and suspected occurrence are provided in Faurot and Burns (2007a) and incorporated here by reference. Hereinafter, all references to bull trout are to the listed species.

b. Designated Critical Habitat

Designated critical habitat was identified 2005 (70 FR 56211) but none was designated on the PNF.

4. Westslope Cutthroat Trout

a. Species Distribution

Westslope cutthroat trout are designated by the Regional Forester as a “sensitive species.” Westslope cutthroat trout were petitioned for listing (63 FR 31691) but were determined by the USFWS to not be warranted in 2000 (65 FR 20120); detailed maps of known and suspected occurrence are provided in Faurot and Burns (2007a) and incorporated here by reference. Westslope cutthroat trout occur in the SFSR Section 7 watershed. Hereinafter, all references to cutthroat trout are for the petitioned species.

b. Designated Critical Habitat

Designated critical habitat is not applicable to westslope cutthroat trout.

B. SCOPE

This BA covers the repairs that are required on the EFSFSR bridge (Figures 1-3), which was damaged during the East Zone Complex wildfire in 2007. During post-fire inspections of the bridge, it was realized that much of the superstructure had been treated with lead-based paint and that the load capacity was insufficient. The PNF determined that replacement of the damaged, painted superstructure with a new steel structure that will be designed to meet current highway loading is the best alternative. Subsequently, it was also discovered that one in-stream pier supporting the bridge was being undermined (the piers are not deeply anchored in the streambed). Valley County determined that they needed to repair the undermined support, add rip-rap to the piers, and armor streambanks below the bridge abutments at either side of the river.

C. LOCATION

Information for the Salmon River and the SFSR Section 7 Watershed in Faurot and Burns (2007) is incorporated by reference. Specifically, the proposed repair action is in the EFSFSR analysis area is fully described in Faurot and Burns (2007a) just upstream of the confluence of the SFSR and the EFSFSR in the Lower East Fork South Fork Salmon River 6th-level hydrologic unit (HU; 170602080603) as shown in Figure 4.

III. SPECIFIC DESCRIPTION OF THE EFSFSR ANALYSIS AREA

A. EAST FORK SOUTH FORK SALMON RIVER ANALYSIS AREA

1. Natural Physical Characteristics

These are largely described in Faurot and Burns (2007a), with an update for the 2006 fires in Faurot and Burns (2007b), which are incorporated here by reference. In 2007, there was considerably more wildfire activity in the analysis area, which is shown by Burned Area Reflectance Classification intensity class graphically in Figure 5 and numerically in Table 1.

Table 1.—Percentages of the EFSFSR analysis area in BARC burn intensity/severity category**.**

BARC Class	Description	Area Burned (%)
0	Unburned, unchanged, or outside image	57
1	Low	17
2	Moderate	17
3	High	8

In addition, and partly as a result of the fire, a severe thunderstorm in July of 2008 caused extensive flooding and debris flows between Deadman Creek and Yellow Pine (Figure 6); these slides, at least insofar as they affected the EFSFSR road, were thoroughly documented in Nelson (2008a).

2. Anthropogenic Physical Characteristics

These are largely described in Faurot and Burns (2007a), which is incorporated here by reference. However, two upgrades of corrugated culverts to stream simulation crossings were accomplished in 2008; these are described in Nelson (2008a).

3. Cumulative Analysis Area Effects

Baseline condition includes cumulative effects of State or private activities that have or are occurring in the subwatershed where the federal action occurs. Activities on these lands include continued residential development and road construction, timber harvest, and water diversions/withdrawals. Increases in sediment, water temperature influences, and decreased stream flow are effects that have resulted from activities on private and state land. Human activities have reduced vegetation, increased sedimentation and altered stream channels and water flows. In addition, wildfire has altered baseline conditions extensively; suppression strategies that focused on structure protection rather than extinguishing the fires may have increased watershed effects with respect to streamflow, water yield, and sensitivity to flooding and debris flows. These are described in the "environmental baseline" matrix in Appendix C, which is slightly updated with respect to "disturbance history" and "physical barriers" from Faurot and Burns (2007a).

4. Restoration Opportunities

In general, these are well described in Faurot and Burns (2007a,b) and identified opportunities in those BAs are incorporated here by reference. In addition, the flooding in 2008 has also led to a need to install a permanent bridge over Parks Creek where the stream simulation culvert was buried by a large debris flow and subsequently removed; much of this is documented in Nelson (2008b,c,d,e).

5. Description and Distribution of Chinook, Steelhead, Bull Trout, and Cutthroat Trout

a. Chinook Salmon

Chinook salmon are widely distributed in the EFSFSR analysis area (Figure 7), using the mainstem primarily as a migratory corridor and with spawning areas in Johnson Creek (not shown) and the upper EFSFSR above Yellow Pine. Chinook salmon populations are in decline throughout their range in Idaho, due in large part to passage obstructions caused by the hydropower system on the Snake River and the Columbia River. Although habitat conditions have undoubtedly had some impact, Petrosky *et al.* (2001) suggest that there has been little change in survival during the freshwater spawning and rearing life history phase. Redds are counted annually in the SFSR and in Johnson Creek, a major EFSFSR tributary, by the Idaho Department of Fish and Game (IDFG), and are reported in Brown (2002), which I have updated with current data (Kim Apperson, Fisheries Biologist, IDFG, McCall, Idaho, personal communication)[1]. Trends in redd counts are similar in the SFSR to upper Big Creek in the Middle Fork Salmon River (Nelson and Hipple 2009), though actual numbers are higher (Figure 8). Johnson Creek (Figure 9) supports fewer fish than the SFSR and has not shown quite as precipitous a decline, with redd counts in 2002 being approximately as high as during the 1960s.

The SFSR is supplemented with artificially produced Chinook from the McCall hatchery, and IDFG conducts an annual sport fishery for hatchery fish when returns

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[1] Data from 2006-2007 were missing due to fires in 2006 and 2007 or incomplete (2008, SFSR only) due to rain and poor visibility.

exceed the number needed for supplementation purposes. In 2008, IDFG records indicate that 3,860 fish were harvested during the sport fishery during a season that ran from 25 June through 17 July. During the sport fishery, the first fish on was caught on 27 June, the third day of the season. In addition, the largest single-day catch occurred on 6 July and the second largest single-day catch occurred on 10 July, but was largely stable at about 168 fish per day (Figure 10).

Snorkel data (Appendix G, Attachment 1) obtained from the Idaho Department of Fish and Game (IDFG) for 2004 through 2006 shows that juvenile Chinook salmon are present within the project area during the time that in channel construction is proposed to occur. In 2004 the IDFG counted 758 juvenile salmon within a 19.75 meter wide by 140 meter long sample point that was just 1/3 mile upstream of the proposed project site. In the 2005 and 2006 data set, numbers of juvenile Chinook salmon were less but still present within proximity to the project area. Personnel communication with Kimberly Apperson with the IDFG on 21 April 21 2009 confirmed that the EFSFSR at and near the project site is used by juvenile salmon and steelhead as a rearing area. Adults are not known to spawn at or near the project site, but pass through the project area on their way to spawning habitat further up the drainage near Yellow Pine, Idaho[2].

b. Steelhead

It is safe to say that less is known about wild steelhead than about Chinook salmon. All Snake River steelhead are subspecies *O. m. gairdneri* and distinct from the coastal *O. m. irrideus* and are placed into the same geographic grouping by Brannon *et al.* (2004) and are placed by the National Marine Fisheries Service (NMFS) as belonging to the Snake River ESU[3] (NMFS 2005). In the SFSR, these are the so-called B-run fish, and are quite large. Steelhead populations are also in decline throughout Idaho and McClure *et al.* (2003) report a population growth rate of 0.97[4] for the A-run population in the ESU. Steelhead in the SFSR begin spawning about mid-April (personal observation) and there is no recreational fishery for steelhead in the SFSR and the population is not supplemented with hatchery-produced fish. In the SFSR, steelhead spawn in the same traditional spawning areas as Chinook salmon, but probably use other suitable locations as well. Steelhead occur widely in the EFSFSR analysis area (Figure 10), but spawning is not well documented; however, we did locate several redds and adults in 2004 downstream of Yellow Pine and noted that much of the spawning sites were in small pockets of suitable substrate, often in marginal positions (Figure 11), rather than in well developed spawning riffles (Nelson 2004a). Some steelhead also spawn upstream of Yellow Pine, and in 2004, I observed some spawning at the mouth of Vibika Creek (Nelson 2004b), also in a marginal position.

c. Bull Trout

Bull trout populations were poorly understood at the time of listing in 1998, and our understanding of them has increased greatly since. The bull trout populations in the SFSR watershed are part of the Columbia River Bull Trout DPS, which has been subdivided for recovery planning into “core areas”, this watershed being in the South Fork Salmon River core area (USFWS 2002).

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[2] This paragraph (and attachment) provided by Greg Martinez, U.S. Army Corps of Engineers, Boise, Idaho.

[3] ESU is an acronym for “evolutionarily significant unit.”

[4] Values less than 1.00 indicate a declining population.

They are generally assumed to be in decline across their range, but there are little hard data on population sizes and trends in the SFSR. In general, we regard the EFSFSR as an important bull trout stronghold. Several EFSFSR tributaries on the PNF support bull trout (Figure 12) and migrants have been observed in Tamarack Creek and Profile Creeks (Hogen and Scarnecchia 2006). In addition, an adfluvial life history using the Glory Hole at Stibnite for overwintering with downstream migration to tributaries for spawning has also been observed in the EFSFSR (Hogen and Scarnecchia 2006). Migrants stage at the mouths of presumptive spawning tributaries from mid-July to mid-August, move into tributaries and spawn from mid-August to mid-September, and quickly outmigrate as far as the main Salmon River (Hogen and Scarnecchia 2006). Snorkel data from the IDFG from 2004 to 2006 shows that Bull trout numbers are very low in this reach of the river at time of the proposed bridge work. Most adult bull trout that over winter in the EFSFSR near the project area have already migrated upstream and are holding or staging at the mouths of the smaller tributary streams.[5] Burns *et al.* (2005) summarize our assessment of bull trout viability (the PNF's designated Management Indicator Species [MIS]) across the Forest and indicates high viability in the EFSFSR analysis area because of high connectivity, suitable habitat, and the presence of fluvial and adfluvial migrants.

d. Westslope Cutthroat Trout

Westslope cutthroat trout are also widely distributed in the SFSR watershed[6]. We do not regularly collect population-level fish data, so no clear picture of abundance and trends exists. It is commonly believed that the range of westslope cutthroat trout is shrinking due to habitat degradation, loss of connectivity, harvest, and introductions of exotic species (Shepard *et al.* 2005; Thurow *et al.* 1997), and are thought to currently occupy somewhat more than 80% of their historic range. Thurow (1987) surveyed the mainstem and most important tributaries to the SFSR and reported that they were "uncommon" in both and comprised no more than 3% of the angler harvest in 1984 and 1985; this low abundance has led to catch-and-release angling regulations in the SFSR.

6. Habitat Condition, Trend, Limiting Factors

These are well described in Faurot and Burns (2007a,b) and documented in the "environmental baseline" matrix in Appendix C, which is slightly updated with respect to "disturbance history" and "physical barriers" from Faurot and Burns (2007a,b). The Level 1 streamlined consultation team agreed on 19 May 2009 that this assessment could be reduced to analysis of a few key indicators to expedite the consultation process. Faurot and Burns (2007b) identified several key indicators of which I have selected what appear to be the most pertinent to the bridge repair project.

a. Chemical Contaminants/Nutrients (FUR).

The entire EFSFSR is listed under 303(d); sediment and unknown metals as parameters of concern. The Vein Creek retardant spill degraded portions of the Quartz Creek drainage in the temporary timeframe. Mining at Stibnite had led to increased heavy metals concentrations in sediments and fish tissues, but the extent of contamination at this time is uncertain. This project has the potential to aggravate chemical contamination in the short term because of the instream use of heavy equipment and the need to pour concrete instream at the base of one bridge abutment.

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[5] These two sentences were provided by Greg Martinez, U.S. Army Corps of Engineers, Boise, Idaho.

[6] There is no map for the analysis area, but the Forest-wide map in Faurot and Burns (2007a) adequately displays our current understanding of westslope cutthroat trout distribution.

b. Interstitial Sediment Deposition (FR)

The “substrate embeddedness” indicator was revised by Nelson and Burns (2005) for the mainstem SFSR, but application can be made to the EFSFSR; however, the EFSFSR standard would be different because of inherent differences in natural sediment conditions. Nelson *et al.* (2006) used the modification suggested by Nelson and Burns (2005) and described the EFSFSR sampling sites as follows:

> We would classify only the Tamarack Creek site as FA, with FR classifications applied to E050 and the two Sugar Creek sites and FUR classifications for the two mainstem EFSFSR sites (free matrix).
>
> and
>
> Cobble embeddedness measurements were consistent with free matrix counts, with the Tamarack and Profile Creek sites being least embedded and the sites downstream of the Stibnite area being most embedded.

The current existence, use and maintenance of the mainstem EFSFSR Road, Quartz Creek Road and historical mining disturbance in the Stibnite area continue to be a source of existing and potential anthropogenic sediment to the EFSFSR adjacent to these 6th HUs. Because they occur in the same geology and have experienced similar weather and management activity, analysis area tributaries that lack data are expected to have embeddedness levels comparable to that seen in other tributaries.

In addition, the floods of 2008 deposited additional sediment to the EFSFSR and sediment accumulations behind log jams and debris fans that were created were evident (Nelson 2008a,f); however, it may also be that the influx of diverse particle sizes and woody debris (LWD) were more beneficial than deleterious because the system was deficient in large woody debris and spawning sites were limited downstream of Yellow Pine. I have identified several locations that may prove useful as photopoints for monitoring the changes in the river caused by this large flood event (Nelson 2008f).

This project includes the use of heavy equipment instream that could mobilize sediments in the streambed and result in sediment delivery from streambanks during work periods, though armoring of the piers and abutment areas should effectively mitigate this effect.

c. Large Woody Debris (FR)

Large woody debris are generally recognized as being relatively low in the mainstem EFSFSR, largely because of the road along the river (Appendix C) and the fact that LWD is often removed from the river to protect the road. The fires of 2007 and associated tree mortality had begun to increase recruitment of wood to the river (Nelson 2007), which will continue over the next several years. The 2008 flooding deposited large amounts of LWD very quickly and created several log jams downstream of Yellow Pine (Nelson 2008b,f). This indicator seems appropriate because accumulation of LWD at the McCall side of the bridge (Figure 13) and removal by Valley County has been raised as an issue during discussions of this project with the NMFS.

IV. DESCRIPTION OF PROPOSED ACTION

A. EFSFSR BRIDGE REPAIR

1. Need for Project

This bridge (Figures 1-3) spanning the East Fork South Fork Salmon River (EFSFSR) was damaged by fire in 2007 during the East Zone Complex Fire near its confluence with the South Fork Salmon River (SFSR). During post-fire inspections of the bridge, it was realized that much of the superstructure had been treated with lead-based paint and that the load capacity was insufficient. The Payette National Forest (PNF) determined that replacement of the damaged, painted superstructure with a new steel structure that will be designed to meet current highway loading is the best alternative. Subsequently, it was also discovered that one in-stream pier supporting the bridge was being undermined (the piers are not deeply anchored in the streambed). Valley County determined that they needed to repair the undermined support, add rip-rap to the piers, and armor streambanks below the bridge abutments at either side of the river.

The work is to be jointly undertaken by the two agencies: the PNF and Valley County. The contractor has been selected because some of the contract has been awarded; the interrelatedness of the two portions of the project makes doing it all in one effort most reasonable. The PNF portion involves all of the superstructure work, with pier stabilization and streambank rip-rapping handled by Valley County. Note that the PNF portion of the work includes construction of a temporary work pad in the EFSFSR for the crane that will be used during the replacement of the bridge beams and deck. The pad will also be used during the county-funded work of stabilizing the two east-side piers as necessary. Valley County will be staging rip-rap and the contractor will perform some preparatory work above the ordinary low water line prior to beginning any in-stream work. The following description concentrates on the PNF portion of the work, but the overlap makes some discussion of Valley County responsibilities appropriate. Valley County's description of the work follows as an attachment and includes engineering drawings of all bridge piers, repairs, and the work pad.

The existing bridge is approximately 246 feet in length with three instream piers and two abutments. For convenience, we have identified bridge components as follows:

- The abutment on the western McCall side is Abutment 1.
- The abutment on the eastern Yellowpine side is Abutment 2.
- Piers are numbered starting at the McCall side with Pier 1; the center is Pier 2 and the third is Pier 3.

The new bridge will be the same span and will be 16 feet wide to provide a single travel lane, with four parallel I-beams (after splicing) that are 36 inches deep. The four beams will be made of 12 sections total, 8 of them will be will be 85 feet long, and four of them will be 75 feet long. All the structural steel shapes will be weathering steel, which means that no painting will be needed. The contractor has designed the bridge so that there will be splices in the beams. One set of splices will be at the midpoint between pier 1 and 2, and the other set of splices will be between pier 2 and 3. The contractor will use a crane to set the individual beams on the piers, and then he will bolt them together at the splices. Design drawings are provided in Attachment 1.

2. Proposed Project Activities

a. Overview

The existing bridge is approximately 246 feet in length with three instream piers and two abutments. For convenience, we have identified bridge components as follows:

- The abutment on the western McCall side is **Abutment 1**.
- The abutment on the eastern Yellowpine side is **Abutment 2**.
- Piers are numbered starting at the McCall side with **Pier 1**; the center is **Pier 2** and the third is **Pier 3**.

The new bridge will be the same span and will be 16 feet wide to provide a single travel lane, with four parallel I-beams (after splicing) that are 36 inches deep. The four beams will be made of 12 sections total, 8 of them will be will be 85 feet long, and four of them will be 75 feet long (see Appendix G, Attachment 1). All the structural steel shapes will be weathering steel, which means that no painting will be needed. The contractor has designed the bridge so that there will be splices in the beams. One set of splices will be at the midpoint between pier 1 and 2, and the other set of splices will be between pier 2 and 3. The contractor will use a crane to set the individual beams on the piers, and then he will bolt them together at the splices. Design drawings are provided in Attachment 1.

b. Material Discharge Estimates[7]

- Discharge 50 cubic yards of graded riprap to armor around piers 1, 2 & 3.
- Discharge 275 cubic yards of riprap to re-armor bridge abutment 1.
- Discharge 125 cubic yards of riprap to re-armor bridge abutment 2.
- Discharge 140 cubic yards of rock riprap below the ordinary high water mark of the EFSFSR to build a temporary equipment pad on the south side of the river measuring 32’ x 58’ (Yellow Pine side).
- Discharge 100 cubic yards of riprap below the ordinary high water mark of the FSFSR to build a temporary equipment pad on the north side of the river measuring 20’ x 35’ (McCall Side).
- Discharge 3 cubic yards of grout below the ordinary high water mark of the EFSFSR to fill a scour hole under the concrete footer on pier 1.
- Discharge 10 cubic yards of sand bags to create a temporary coffer dam around Pier 1 to isolate the grout activity from the live water.

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[7] Sections b and c reproduced (and modified as necessary to conform to the structure of this document) from summary prepared by Greg Martinez, U.S. Army Corps of Engineers, Boise, Idaho from material originally provided by PNF and Valley County.

- Discharge 30 to 35 concrete Jersey Rail each measuring roughly 5’ high, x 2’ wide x 6’ long to form the outside edge of the temporary equipment pad on the south side of the river.

c. Construction Activities

An equipment pad will be constructed from the roadway down the bank along the upstream side of abutment # 1 (McCall approach). This access ramp construction will involve grading the existing bank to provide a widened, more gradually sloped ramp. A work platform consisting of rip rap will be constructed to support a crane for removal of parts of the superstructure. This working platform will extend below the ordinary high water mark of the river approximately 35 feet but will not encroach within the active water (See Sheet 1 of Appendix G, Attachment 2). Upon completion of the rip rap work platform on the McCall side a similar river access approach will be constructed along the downstream side of abutment 2 (See Sheets 2,3, and 4 of Appendix G, Attachment 2). Once the river bank has been re-graded, a working platform measuring 58’ x 32’ will be constructed in the river. This platform will provide access to pier 2, and allow the removal of the superstructure. In preparation for the construction of the work platform on the Yellow Pine side, concrete blocks will be placed in the river to both divert flows and to isolate the work zone. To promote the deflection of stream flow around the block walls, visqueen will be placed along the exterior face of the upstream wall, anchored with sand bags. Sand bags will also be placed along the bottoms and at the joints of these block walls to further reduce the flow of water into the platform zone. Next, filter fabric sandwiched between two layers of chain link material will be placed on the river bottom and along the sides of the block walls. The filter fabric is to reduce mobilization of streambed fines and filter the water as it leaves the work zone and re-enters the river. The purpose of the chain link material is two fold. The first purpose is to minimize any degradation of the filter fabric due to the rip rap and the second purpose is to promote recovery of both the filter fabric and the rip rap after all work is completed. Once the work zone has been covered sufficiently, the work platform will be constructed from the riverbank out past the downstream side of pier 3 to the side of pier 2. The platform will be constructed using approximately 140 cubic yards of clean rip rap, separated from the river bottom by the previously placed filter fabric and chain link material. Pumps will be used to improve the filtering of the water. Turbid water will be pumped out of the work zone to a settling pond adjacent to the road where it will be retained and filtered prior to returning it to the river or simply allowed to infiltrate the ground. After the work platform is constructed, and the remaining sections of the existing superstructure are removed, pier 2, pier 3 and abutment 2 will be retrofitted to accept the new superstructure. Once this work is completed, portions of the new superstructure will be placed from abutment 2 out past pier 2 towards abutment 1. Next, rip rap from the working platform will be placed around the footing of pier 2, The rip rap will be placed using a track-hoe, which has been walked out into the water. Rip rap will be staged in-stream from out-of-water positions to minimize in-water use of the track-hoe. After the rip rap is placed, the rip rap work platform will be reclaimed, placing some of it around the footing of pier 3 (which should be out of water at this time) and the remainder along the east bank in front of abutment 2. After all of the rip rap is reclaimed from the river, the filter fabric, chain link mats, sand bags and concrete blocks will be removed and transported off site. Upon completing work on the Yellow Pine approach side of the river, the contractor will mobilize to the McCall approach, via Yellow Pine, Johnson Creek Road, Warm Lake Road, South Fork Road.

Pier 1 repair (McCall side) will consist of retrofitting abutment 1 and pier 1, placing the remaining portions of the superstructure, placing grout (3 yards) and rip rap (20 yards) at pier 1 footing and armoring the embankment in front of abutment 1 (275 cubic yards). The retrofit work on pier 1 and the superstructure placement will be accomplished by placing a crane on the previously constructed work platform. After the superstructure work is completed, the repair work on pier 1 footing will take place. This work is necessary to address undermining of the footing. The work will consist of constructing a cofferdam around the footing and placing grout using a tremie pipe. During the process of placing the grout, a pump will be used to remove any foreign material to keep it out of the river (See Sheets 6 and 7 of Appendix G, Attachment 2). After completing the grouting process, the rip rap used for the work platform will be placed at the footing of Pier 1 (See Sheet 5 of Appendix G, Attachment 2) and in front of abutment 1. At pier 1, a track-hoe will walk a very short distance into the water, and place the rip rap. Because of the skew, the track-hoe will be able to retrieve the rip rap directly from the bank without traversing back and forth. At abutment 1, some additional fill will be necessary due to extensive erosion on the downstream side of the abutment where a significant amount of the bank is missing. A significant reach of the river just upstream of the abutment is well armored, with the top matching the high water line. This armoring will be matched and extended in front of, and past the abutment approximately 30 feet downstream. This will cover the section of embankment which is currently experiencing erosion on the downstream side of abutment 1. In order to further reduce the migration of fines from the bank into the stream, filter fabric will be placed prior to placement of rip rap.

Armoring of the embankment at abutment 2 will include minor grading to match the original fill slopes prior to placing the rock material. Currently, there is a significant amount of poorly graded material in place directly in front of the abutment. Work will consist mainly of improving the gradation of the existing material and redistribution.

A total of around 50 cubic yards of rip rap will be placed at the three pier footings. Approximately 20 cubic yards will be placed at pier 1 and pier 2 each with the remaining 10 cubic yards placed at pier 3. At the abutments, a total of approximately 400 cubic yards of rip rap will be placed. Abutment 1 will receive around 275 cubic yards and approximately 125 cubic yards will be placed at abutment 2.

At both abutments, the access ramps will be obliterated, the river banks re-vegetated and returned to approximately their natural state after all work is completed.

Placement of rip rap at all locations will consist of placing clean, graded material. Smaller diameter rock will be placed first, followed by progressively larger diameter rocks. The smallest diameter rock used will be approximately 2-3 inches. The largest diameter rock will be approximately 28 inches. At the pier footings, no excavating will take place prior to rip rap placement. By placing smaller diameter material against the river bottom with larger diameter material above, the material will settle if any future undermining action takes place. As this sequence continues, a state of equilibrium is reached where future undermining ceases. Note that there will be no excavation around the footings using this approach because the rip rap will be self-anchoring; this will minimize streambed disturbance during this phase of the work.

Other work includes removal of the existing superstructure, which includes the beams, the wood deck, the asphalt wearing surface, and the guardrails. All parts of the superstructure will be disposed of off Forest Service system lands. The contractor will remove most of the superstructure by setting equipment on the deck and pulling the deck, wearing surface, and guardrail as he backs away from the center of the bridge. The contractor will pull the beams as the last stage of the superstructure removal, starting on the Yellow Pine side (which are the beams that reach from abutment 2 to pier 3) by building two temporary work pads as described above.

The contractor has estimated the timing for each portion of the work; this is reflected in Attachment A. Work outside the water can occur at any time. No work below the existing water line will occur before 21 July[8] (Appendix G, Attachment 3), by which time most adult Chinook salmon, steelhead and bull trout heading for spawning areas in the upper EFSFSR and Johnson Creek should have passed through.

d. Environmental Protection and Mitigations

Contract Requirements.—This project uses standard specifications and supplemental specifications. The standard specifications are contained in the “Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-03 U.S. Customary Units”. The supplemental specifications have been written by the Forest Service to modify the standard specifications in order to make them more specific to the types of project that the Forest Service does. This project has several contract requirements for environmental protection including:

- Standard Specification 107.10 (Appendix G, Attachment 4) describes requirements for environmental protection. This project also has a Supplemental Specification 107.10 (Appendix G, Attachment 5) that requires the contractor to submit a hazardous spill plan.
- Standard Specification 157 (Appendix G, Attachment 6) and Supplemental Specification 157 (Appendix G, Attachment 7) requires a Soil Erosion Control Plan, to be submitted to the Forest Service Contracting Officer at least 14 days before operations begin.
- Standard Specification 203 (Removal of Structures) has a clause that says:

  “construct structurally adequate debris shields to contain debris within the construction limits. Do not permit debris to enter waterways, travel lanes open to public traffic, or areas designated not to be disturbed.”

  This sentence means the contractor must contain the chips of concrete from the top of the piers.
- Supplemental Specification 208 (Structural Excavation and Backfill for Selected Major Structures, Appendix G, Attachment 7) requires the contractor to submit a plan of work for excavation.

Required Mitigations.—Several specific mitigations for this project (in addition to project design features discussed previously:

- The work window for bridge construction will be during low flows, and will not begin before July 10 when most adult Spring Summer Chinook salmon, Snake River steelhead and Bull trout have passed the work area on their way to spawning habitat further upstream in the EFSFSR and Johnson Creek.

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[8] Represents a change from original proposal, updated by R.L. Nelson.

- Prior to construction of the equipment pad on the Yellow Pine side, the project impact area shall be swept of fish by having workmen walk through the area starting at the upstream end and proceeding downstream to chase fish from the area. Construction of the equipment pad shall commence as soon as possible to prevent fish from returning into the work area. This action shall only be done if water depths and velocities allow this to be done in a safe manner.

- Water from the de-watered work area will either be pumped to a temporary storage and treatment site, or onto upland areas where vegetation can filter sediment before any water reenters the river channel.

- All equipment will be inspected prior to mobilization to the site to ensure there are no hydraulic fluid or oil leaks and cleaned to remove build-up of chemical contaminants; similarly, all soil and organic matter will be removed to reduce the potential to spread terrestrial and aquatic invasive species.

- Pumps used to discharge turbid water will be placed in catchment basins large enough to contain their fuel and petroleum products.

- The large rocks used to help anchor the McCall side work platform (Figure 14) will not be removed or crushed to make rip rap.

    - These rocks are working with a bedrock vein upstream of the bridge that directs flow away from the streambank to protect the slope under the bridge abutment by deflecting stream energy and provide slack water habitat for fish.

    - If these rocks were replaced with smaller rip rap, the LWD that normally collects here would likely destroy the rip rap.

    - Additional large rocks (of similar size to these) could be usefully placed near the low water line adjacent to and/or slightly in front of pier 1 (Figure 15) to help protect the bank and anchor rip rap.

- Riprap used to construct the temporary equipment pads and to armor the piers and bridge abutments shall be clean angular rock and free of fines and organic debris.

- Rip rap for armoring piers will be staged in the river to minimize the travel of the excavator when placing rip rap around the piers. Rip rap can be placed at and instream staging area from the Yellow Pine side work pad before moving into the stream to place rip rap at pier 2.

- Armoring of the streambanks around the abutments will be done in such a way as to imitate the natural streambank below the high water mark, except that larger rocks can be situated in front of the large rocks identified above to anchor the rip rap.

- The caps for the bridge piers should be precast concrete, not constructed in place to avoid green concrete and wastewater from contaminating the EFSFSR.

- Immediately upon project completion, disturbed areas will be mulched or seeded to provide for temporary soil stability and promote the rapid re-vegetation of the area.

- Valley County will continue to clear the LWD jams that accumulate on the McCall side because the endanger the bridge abutments; this debris must be moved downstream of the bridge and placed below the high water line.

V. ANALYSIS OF POTENTIAL EFFECTS

A. GENERAL EFFECTS

1. Direct and Indirect Effects of Petroleum Products

These are well described in Faurot and Burns (2007a) and are incorporated here by reference.

2. Effects of Sediment on Salmonids

These are well described in Faurot and Burns (2007a) and are incorporated here by reference. This project has the potential to mobilize sediments from the streambank and streambed during workpad construction and removal and from the streambed during crane operation on the pad and excavator use instream for rip rap placement. Project design features that include isolating work areas from streamflow and use filter cloth to entrain sediments and pumping turbid water from the isolated work areas to settling basins on land will minimize these effects.

3. Effects of Portland Cement

The ingredients in Portland cement (chiefly tri-calcium silicate [$Ca_3Al_2O_4$], di-calcium silicate [Ca_2SiO_5], tri-calcium aluminate [$Ca_3Al_2O_6$], tetra-calcium aluminoferrate [$Ca_4Al^2Fe_2O_{10}$] and gypsum [$CaSO_4 \cdot 2H_2O$]) have been shown to have toxic effects on some species of this exposed directly to cement clinker (Adamu and Iloba 2008). However, the principal toxicity in the context of this project in which cement will have been pre-mixed with water to for a slurry is related to the high alkalinity (pH $\approx$ 12) of the slurry and wastewater. Water this alkaline is toxic to fish and contamination of stream water must be minimized.

B. EFFECTS OF BRIDGE REPAIR PROJECT

1. Direct and Indirect Effects

The effects analysis pertaining to watershed condition indicators (WCIs) is summarized in Table X with narration provided below. In addition, we have added an additional description of potential direct effects to fish.

a. Disturbance to Listed Fishes[9]

Short term impacts to listed fish could include crushing, displacement, stranding, and sediment effects to fish and their

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[9] This section provided by Greg Martinez, U.S. Army Corps of Engineers, Boise, Idaho.

habitat.

Crushing by large mechanized equipment used to place rock to construct the equipment pad on the Yellow Pine side, and armoring of piers 1, 2 and 3 can disorient, injure, or kill fish. Even when equipment is working from the river bank or from the constructed equipment pads, the constant or repeated motion of the excavator bucket placing rock around the piers and armoring abutment 1 could injure fish. Any fish that inhabits the project area, and that does not react quickly to avoid construction equipment moving in the river, can be hit or crushed by equipment and material. This is particularly likely for fish that are hiding or resting in the deeper areas of the river such as next to the bank, under overhanging banks, under rocks or within the scour hole under the footer on pier 1. These fish feel hidden and protected and are less likely to be aware of or move away from disturbances. The potential can be reduced by having workmen walk from upstream to downstream through the project area paying particular attention to the deeper pool areas prior to the placement of rock fill material for the equipment pad on the Yellow Pine side and when the piers are armored. This action could significantly clear the area of fish and reduce the potential for crushing although it will not prevent fish returning back into the project impact area. Areas within the river that are proposed to be filled with rock material either for the temporary equipment pad or armoring around piers 1, 2 and 3 should commence as soon as possible after the areas has been cleared of fish. Armoring of the riverside of abutment 2 and placing the equipment pad on the McCall side can be accomplished in the dry during low water conditions and therefore crushing fish is not expected to be a concern.

Given the limited area of impact within the river channel, the number of Spring/summer Chinook salmon, Snake River steelhead and bull trout exposed to risk of crushing and implementation of the measures to minimize impacts, crushing impact is expected to be negligible.

Fish near the project site may be repeatedly disturbed by the construction activity and flush from the disturbance. In the process of flushing they can become more exposed to predators, injure themselves in low water areas, become disoriented and stressed. If displaced, they may have to search out new areas for feeding and hiding. This impact is unavoidable. To minimize this potential impact, in channel work can not begin until July 1, 2009 and is scheduled to be completed by August 28, 2009. Impacts due to displacement are expected to be negligible and not quantifiable.

Fish that become trapped in areas of water that are disconnected from the main river channel can die. Mortality is caused because the small, isolated pools, warm quickly particularly if exposed to direct solar heating, they lose adequate dissolved oxygen, they expose fish to predators and they may evaporate or drain away.

The only opportunity for fish to be stranded is when they construct a form/cofferdam around pier 1 associated with filling the scour hole with concrete grout. To reduce this potential the form will be constructed on the west and upstream side first. The scour hole will be disturbed with hand tools to flush any fish present. Once this has been completed the south and downstream sides will be enclosed and will proceed to fill the scour hole. It is expected that a few fish may remain within the enclosed area and may be injured or killed as a result of this action, however, the overall impact would be negligible.

b. Chemical Contamination and Nutrients

Fuel-related mitigation keeps fuels as far as possible from live water, and includes measures to reduce the likelihood of uncontained spills; however, this action requires the use of heavy equipment within the river which increases the likelihood of contamination. Fueling must occur on dry ground in appropriate spill containment structures and fuel and oil must be cleaned off equipment before entering the river. Equipment must be well maintained and without fuel or lubricant leaks. The risk of fuel-related effects is reduced to very low levels because of these factors.

There is also a risk of direct effects from uncured concrete. Pier 1 is to be reinforced with a grout composed primarily of Portland cement that, while uncured, contains wastewater of very high pH (~12), a level toxic to fish. It is anticipated that the isolation of the pier during placement of the concrete and pumping water from work area will minimize the potential for contamination of river water and the trimie pipe technique for placing grout will allow only minimal, short-term contact of uncured cement with the streambed. Because of the short duration and small extent of this process, there will likely be minimal movement of alkaline wastewater into the stream, which would be diluted to non toxic levels almost immediately.

c. Interstitial Sediment Deposition

The project is unlikely to increase interstitial sediment to any measurable degree. Turbidity generated from project work and any larger particles that are mobilized from the streambank or bed are likely to be captured by the containment structures for the instream workpad.

Although different than sediment deposition, increased turbidity could result from instream work. This is expected to be minimized by the project design features that largely isolate work areas from streamflow, though use of the excavator instream could have a short-term effect.

Of the three listed fish species, Bull trout are the most sensitive to higher levels of turbidity. However, snorkel data from the IDFG from 2004 to 2006 shows that Bull trout numbers are very low in this reach of the river at time of the proposed bridge work. Most adult Bull trout that over winter in the EFSFSR near the project area have already migrated upstream and are holding or staging at the mouths of the smaller tributary streams. In addition, rock material used to armor the piers, bridge abutments and construct the temporary equipment pads would be clean rock and free of fines and other debris. Further, the project area consists of areas of exposed bedrock, particularly upstream of pier 1 or areas of sand, gravel and cobble which would have been swept clean of fines during the 2009 spring freshet. It is expected that in channel work associated with placement of rock would result in very minor and short term increases in suspended sediments and would have only a remote possibility of causing injury to listed fish species or their designated critical habitat.[10]

d. Large Woody debris

This project is unlikely to have direct effects to LWD recruitment or availability. In the long-term, however, the specific commitment of Valley County to clear LWD jams from pier 1 and return it to the river downstream of the bridge will be an improvement over past practices.

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[10] This paragraph provided by Greg Martinez, U.S. Army Corps of Engineers, Boise, Idaho.

2. Cumulative Effects, State and Private

Cumulative effects are effects of State or private activities that are reasonably certain to occur in the watershed where the Federal action occurs. The East Fork SFSR subwatershed has several parcels of private land (Stibnite, Red Metal, and Cinnabar Mine Areas, Eiguren Ranch, and Ryan Creek) as well as several State school sections (undeveloped). Effects on non-Federal lands include the beneficial effects of CERCLA and State mining reclamation actions in the Stibnite Area; actions related to the town of Yellow Pine that may be adverse, and Valley County road maintenance practices on the EFSFSR Road that have been documented as adverse (*e.g.*, herbicide application in RCAs, sidecasting of sediments from road blading, removal of logjams and subsequent destruction of redds) (on file at PNF SO).

3. Combined Effects, Including Interrelated and Interdependent Federal Actions

Combined effects encompass the effects of federal, state and private actions that have occurred or are likely to occur. Future actions on Federal lands include recreational site improvements, road maintenance, continued permitting of water diversions, prescribed and natural fire and watershed and fish habitat improvements. Due to management requirements and mitigation measures to be implemented with activities, these actions would be expected to yield negligible effects on the combined condition. Due to project design and mitigation measures, project actions would not be expected to adversely affect fish and fish habitat in the temporary (<3 years), short-term (3-15 years), and long-term (>15 years) timeframes. Activities are expected to improve sediment conditions in the analysis area and the SFSR Section 7 Watershed as a whole due to road decommissioning in the short-term (3-15 years) and long-term (>15 years) timeframes.

VI. MITIGATION MEASURES

All mitigation measures have been incorporated into the federal actions.

VII. MONITORING AND EVALUATION

No specific post-project monitoring is described. During construction, PNF and Valley County engineers will monitor implementation to ensure that project design features and mitigations are properly employed.

VIII. DETERMINATIONS

Table 2.—determinations for listed fishes and designated critical habitat.

Federal Action	Listed Species or Critical Habitat				
	Chinook, Steelhead	Chinook Designated Critical. Habitat	Steelhead Critical Habitat	Bull Trout	Cutthroat
EFSFSR Bridge Repair	LAA	NLAA	NLAA	NLAA	NLLL

NOTE: See Acronyms and Abbreviations (Appendix A) for explanation of species and determination acronyms

A. RATIONALE

1. Chinook Salmon

Most adult Chinook salmon will have migrated upstream to staging and spawning areas by the time instream work begins. There is some potential for stragglers to be disturbed by the construction work however, and there will be some reduction in the area through which adults can migrate. This disturbance will be small, but can be reasonably certain to occur, though it will not significantly affect the viability of the Chinook population. There may also be some short-term degradation of habitat conditions during the work period, particularly with respect to turbidity, but these are not expected to result in adverse modification of designated critical habitat.

2. Steelhead

Rearing steelhead in the area are likely to be disturbed by the construction activity, but not to the extent that population viability is affected. There is a small possibility of toxic effects from grout placement, but project design features should render this very unlikely. There may also be some short-term degradation of habitat conditions during the work period, particularly with respect to turbidity, but these are not expected to result in adverse modification of designated critical habitat.

3. Bull Trout

Bull trout are unlikely to be present in this portion of the EFSFSR during the work period because they will have passed through on their way to spawning areas upstream. Migrants may begin moving back downstream before work is concluded, but no substantial disturbance is anticipated. There may also be some short-term degradation of habitat conditions during the work period, particularly with respect to turbidity, will be of short duration and will have minimal effects to bull trout. Overall, viability of bull trout in the EFSFSR will be unaffected.

4. Westslope Cutthroat Trout

It is uncertain whether cutthroat trout will be in this area during the construction activity, but any that occur will simply be displaced temporarily. This action will not have any effect on the viability of westslope cutthroat trout in the EFSFSR analysis area and will move them closer to needing protection under ESA.

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X. APPENDICES

A. FIGURES

(Figures begin on next page)

Figure 1.—Composite picture of entire span from the west side (left) to the east(picture was stitched from four separate images, the discontinuity in the center is from improper image alignment).

Figure 2.—West abutment, pier 1, and river bank.

Figure 3.—East side abutment and pier 3.

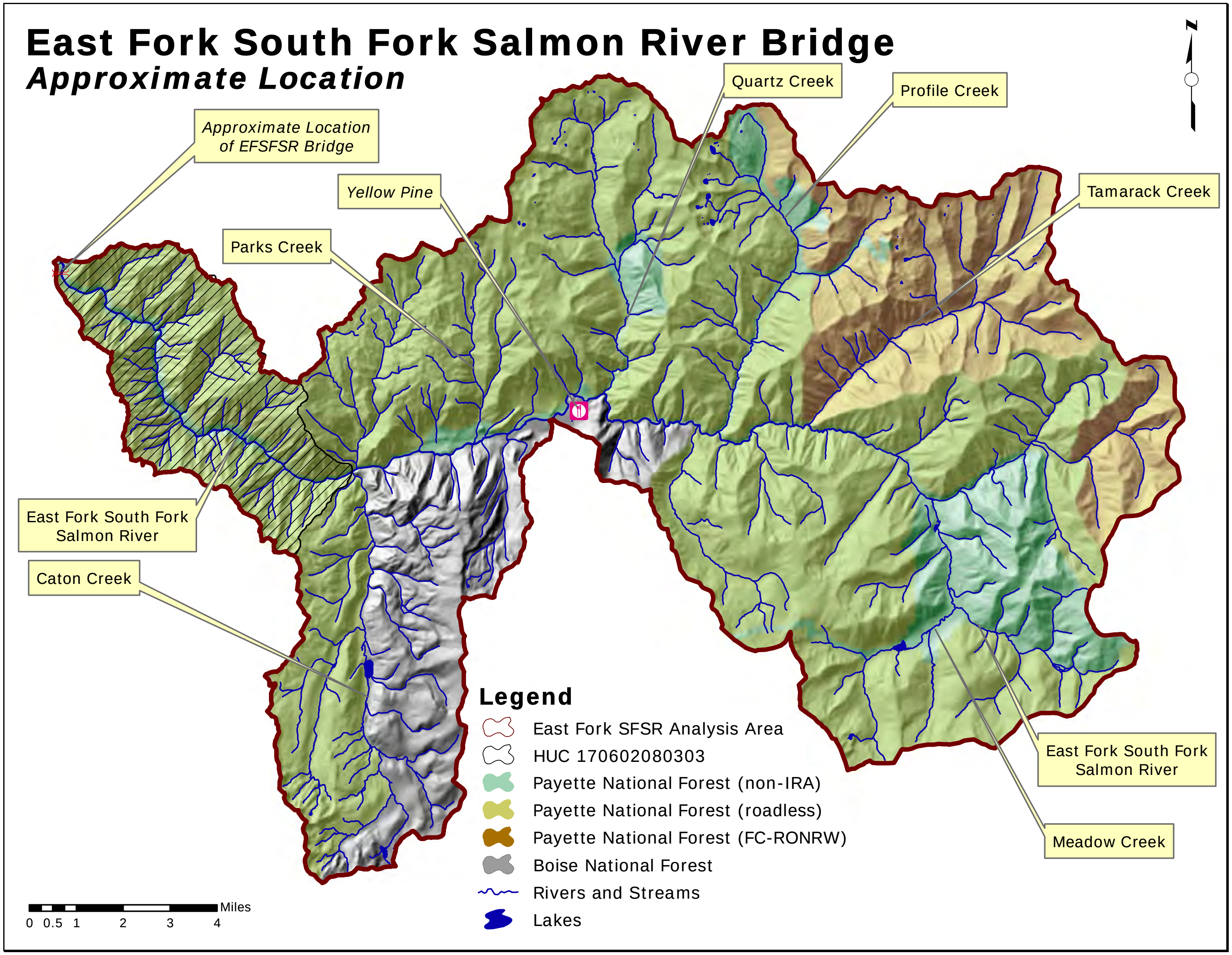

Figure 4.—Location of the EFSFSR Bridge in the EFSFSR analysis area of the SFSR Section 7 watershed.

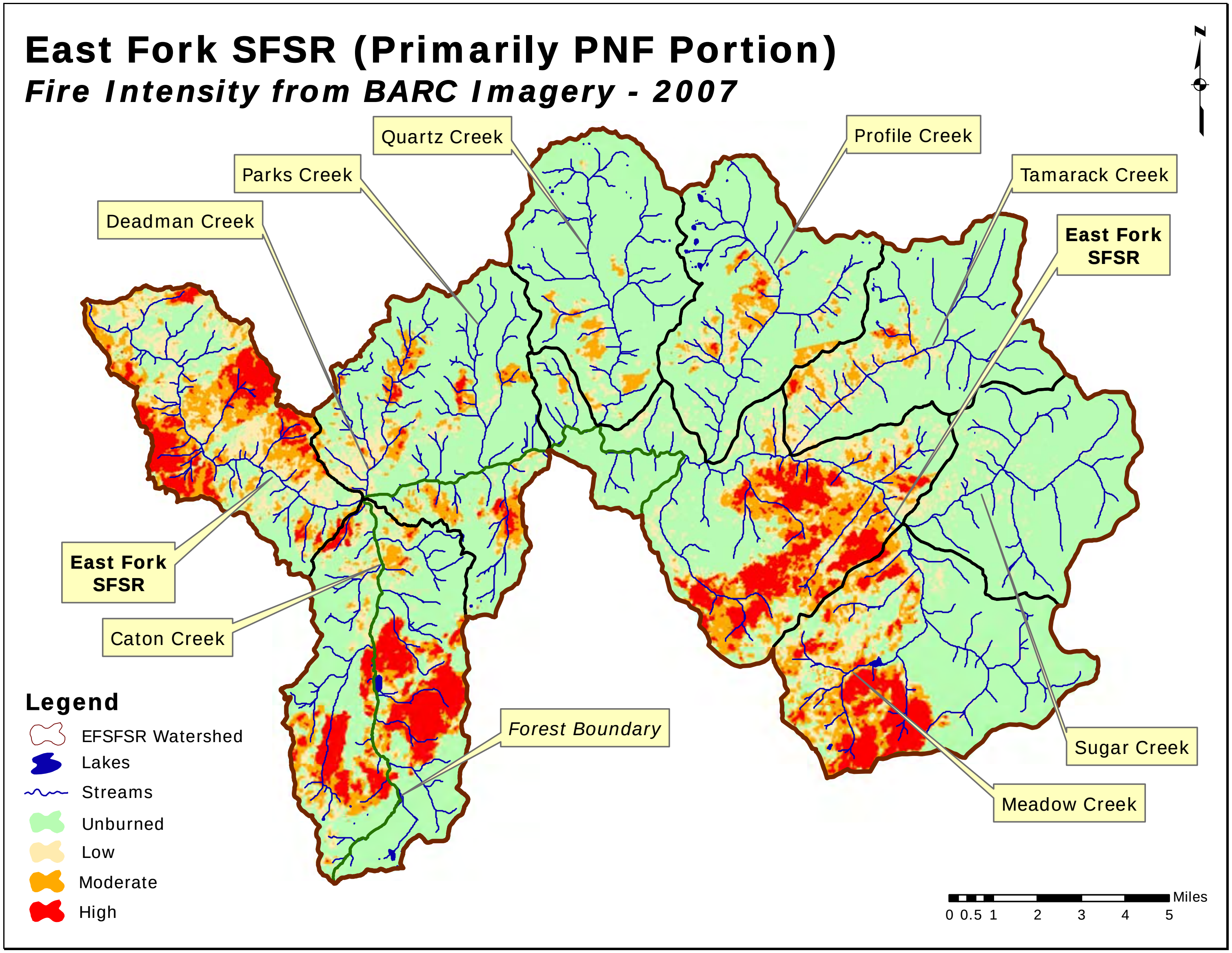

Figure 5.—Burn intensity in the EFSFSR watershed.

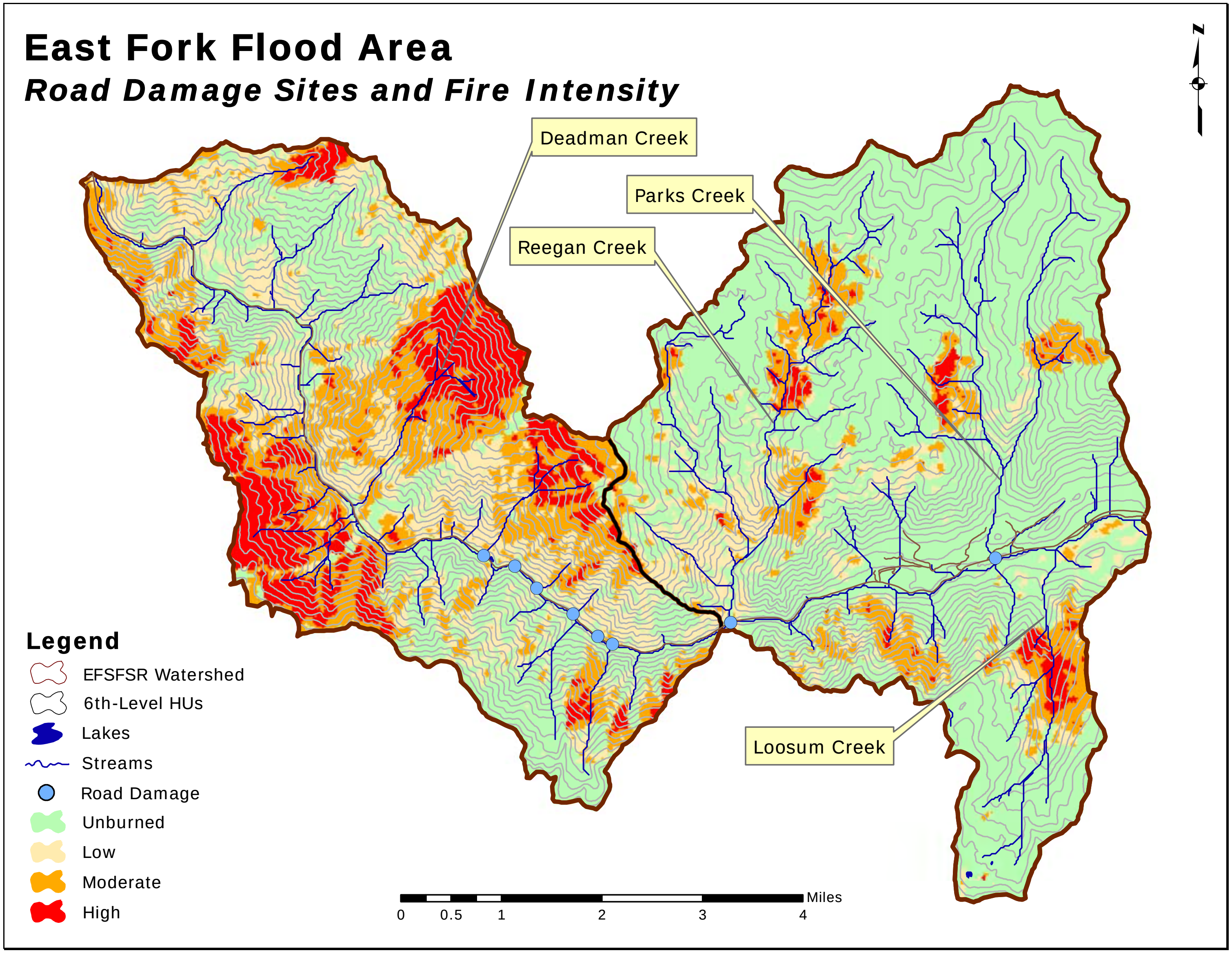

Figure 6.—Burn intensity and road damage locations in the EFSFSR area affected by the 2008 flooding.

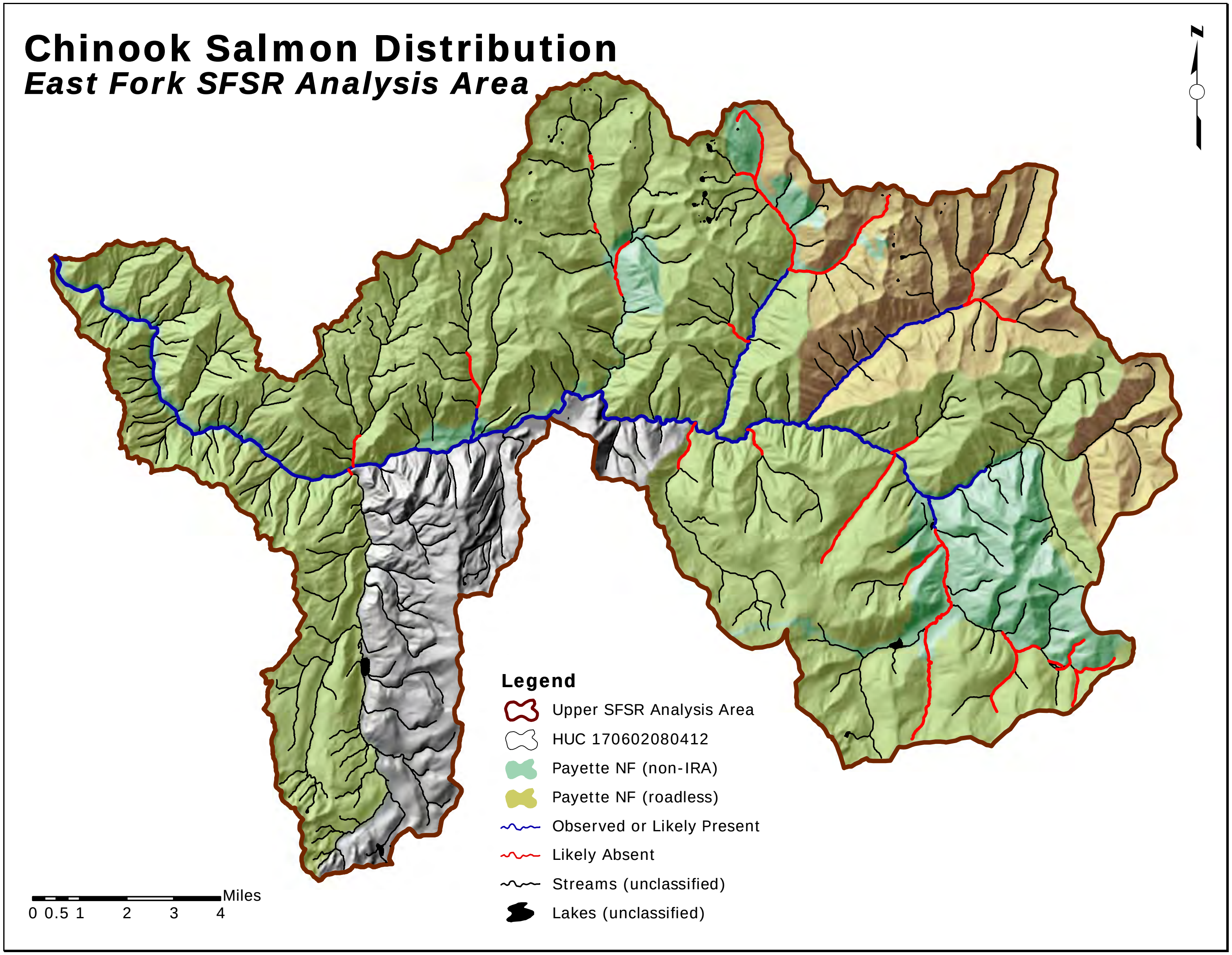

Figure 7.—State of the knowledge of Chinook salmon distribution in the EFSFSR analysis area.

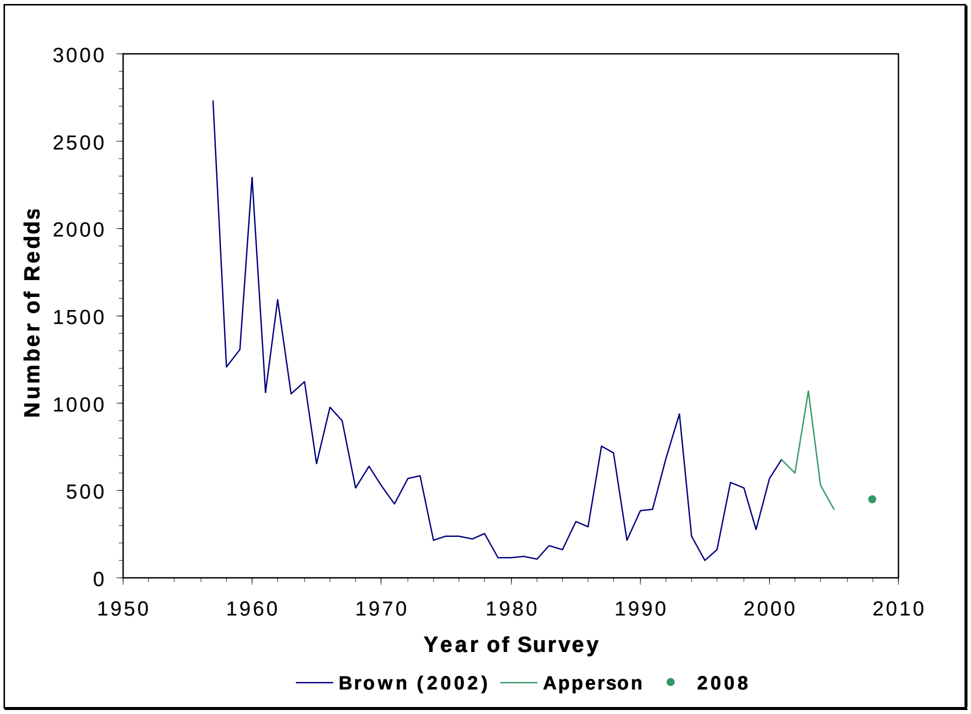

Figure 8.—Chinook salmon redds over time, SFSR index areas.

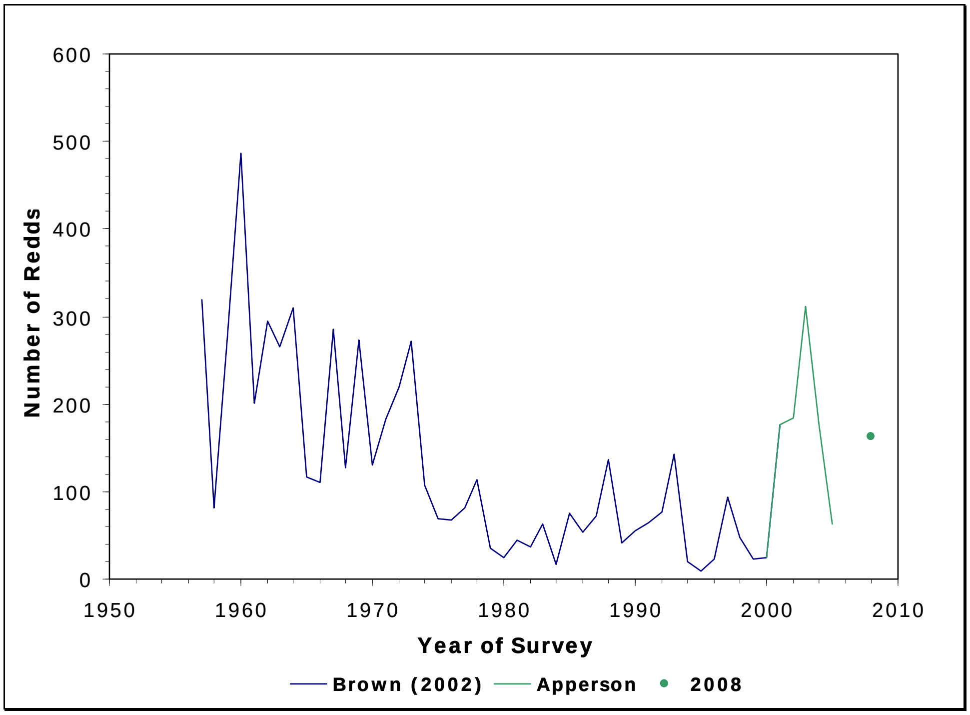

Figure 9—Chinook salmon redds over time, SFSR index areas.

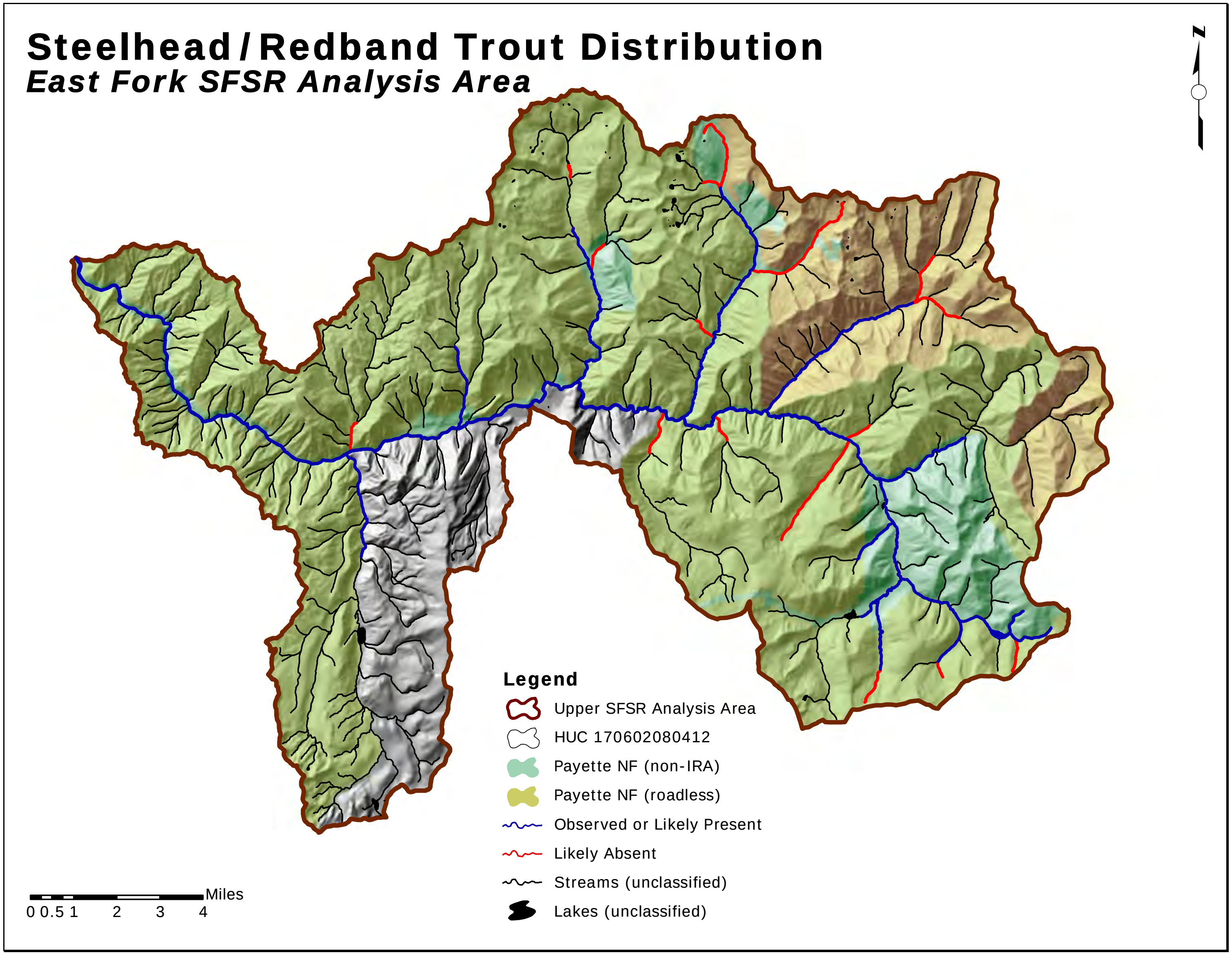

Figure 10.—State of the knowledge of Steelhead and redband trout distribution in the EFSFSR analysis area.

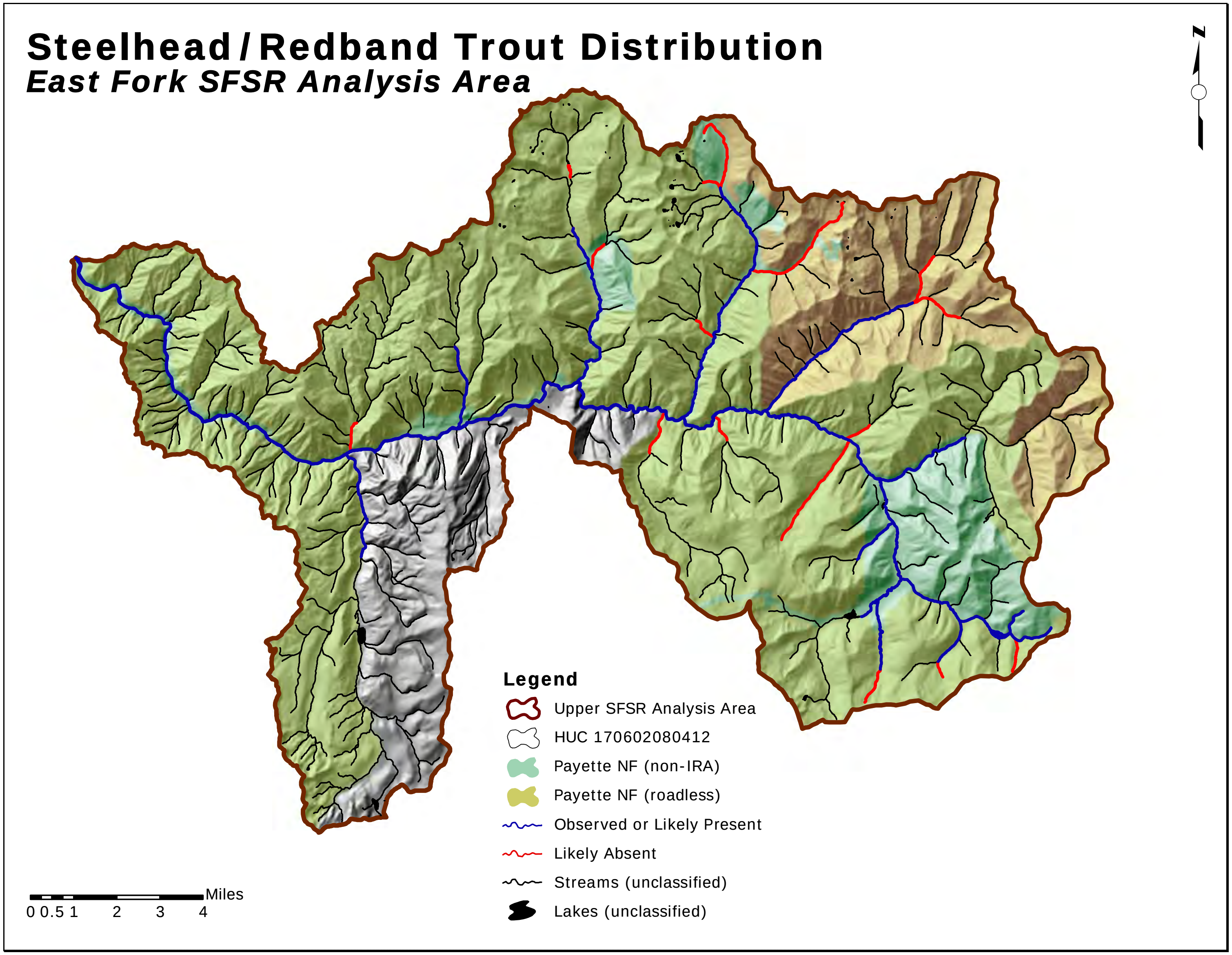

Figure 11.—State of the knowledge of Steelhead and redband trout distribution in the EFSFSR analysis area.

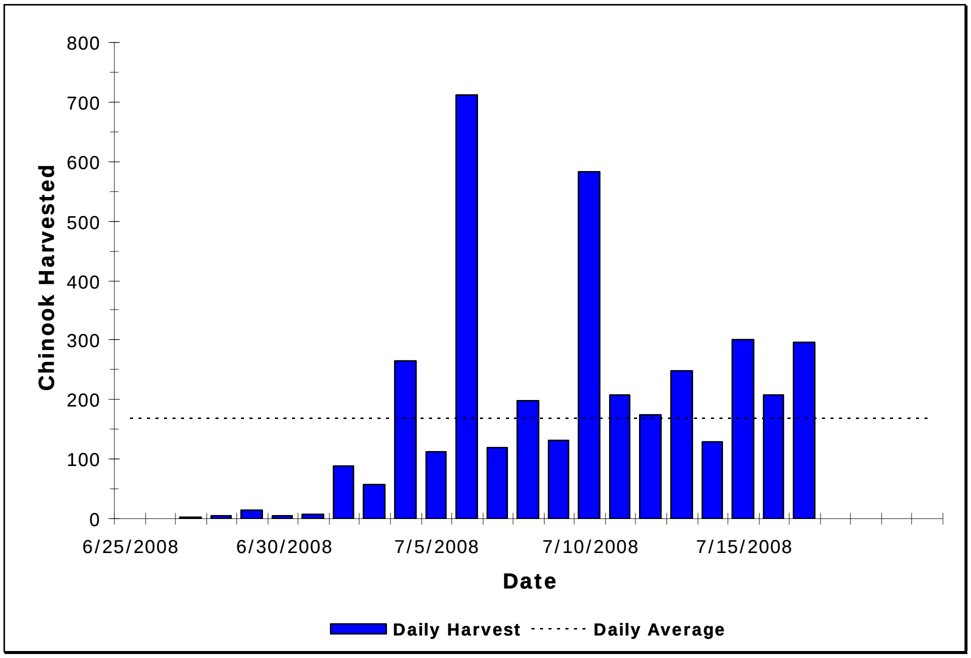

Figure 12.—Harvest of Chinook salmon during the SFSR sport fishery in 2008 (from data provided by the Idaho Department of Fish and Game).

Figure 13.—Steelhead on apparent redd about two miles downstream of Reegan Creek, 22 April 2004.

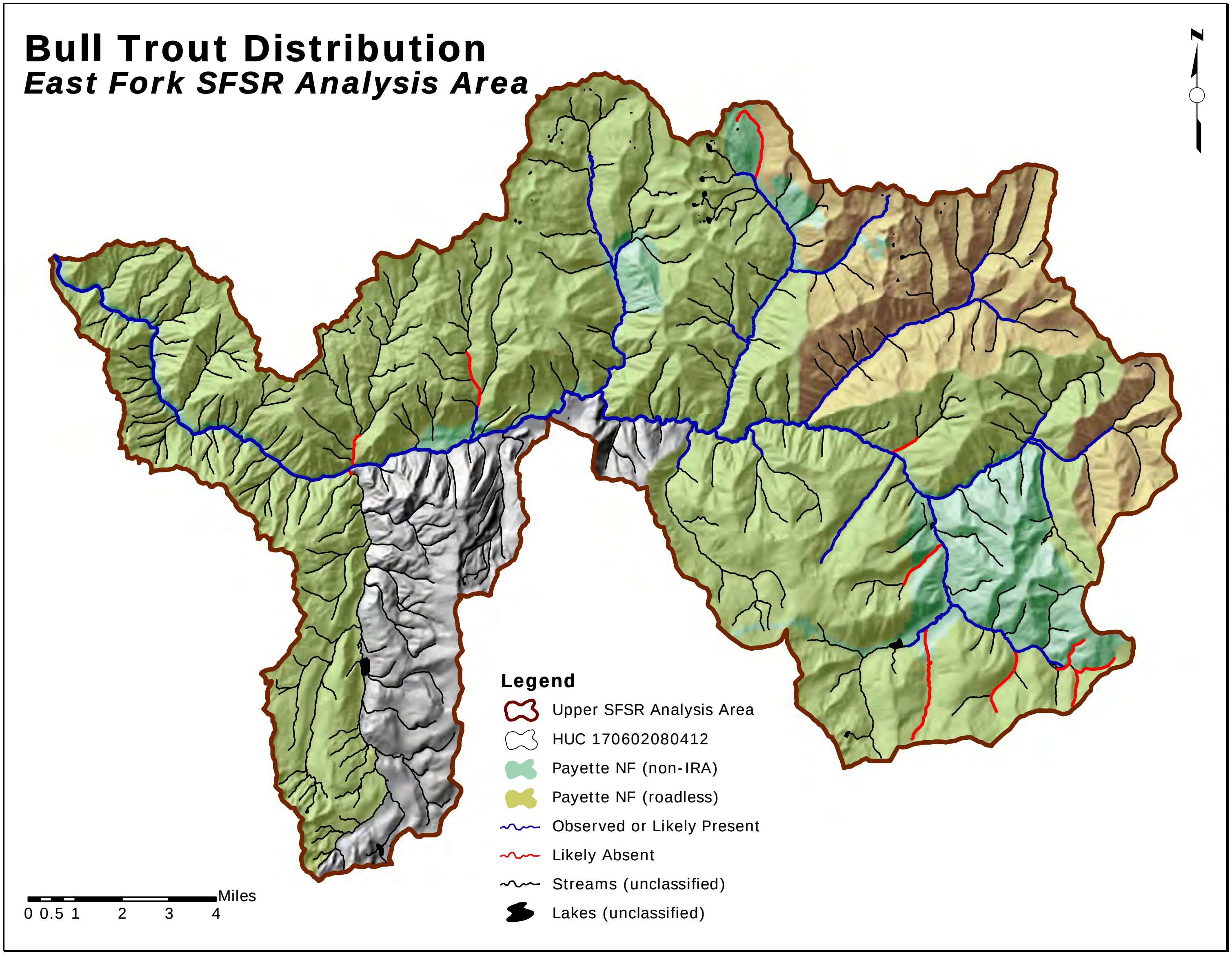

Figure 14.—State of the knowledge of bull trout distribution in the EFSFSR analysis area.

Figure 15.—Large woody debris accumulation at McCall side of EFSFSR bridge.

Figure 16.—Large rocks on the McCall side of the bridge to be left in place.

Figure 17.—McCall side streambank of the EFSFSR upstream of the bridge.

B. FEDERAL ACTIONS IN THE SOUTH FORK SALMON RIVER (UPPER SFSR, LOWER SFSR, SECESH, AND EFSF ANALYSIS AREAS) AND THEIR STATUS.

Volume & Title	Author & Year	Federal Action	Status	Effect
1. Mining Projects and Associated Activities	Lund and Burns 1993	Comfort Lode Mine Sediment control mitigation	Completed	Reduced sediment from historical mining
		Stibnite Mine Reclamation (see additional actions in Vols. 24 and 26)	Ongoing	Reduced erosion and sediment delivery, improved hydrologic function, revegetated disturbed sites, removal of hazardous materials
		Skipper Lode Mine reclamation Backfill adit, site cleanup	Completed	Improved hydrologic function
		Polaris Mine reclamation Eliminate occupancy and reclaim site	Incomplete	Minor effects from existing historical mine site related to ground disturbance and erosion
2. Engineering (1994-2000) Road Maintenance and Facility Projects	Lund and Burns 1993	Culvert/ditch inspection Dust abatement additives Wet season closure of unsurfaced roads Reclamation of non-system roads	Ongoing	Reduction of road-related sediment
3. Timber Harvest and Associated Activities	Lund and Burns 1993	South Fork small sales	Completed	Project mitigation prevented adverse effects to baseline erosion and sedimentation processes
4. SUPs and Watershed Improvement Projects	Lund and Burns 1993	Ruby Meadows	Completed	Reduction of ATV and motorcycle trail-related sediment
5. Miscel-laneous Projects	Lund and Burns 1994	Trails and Campground Maintenance Watershed and Habitat Improvement	Ongoing Ongoing	Reduction of trail-related sediment Watershed and habitat improvement - various
6. Bear Track, War Eagle, Gold Pan Plaza Mineral Exploration and Rehabilitation	Lund and Burns 1995	War Eagle Mine Road Reclamation	Completed	Reduction of road-related sediment
7. Tailholt Research Study	Faurot and Burns 1995		Cancelled	None
8. Secesh subdivision	Jacobson and Burns 1995	Road buildling	Complete	Increased road mileage within analysis area
9. Victor Loon Sheep Allotment	Wag-oner and Burns 1995	Sheep grazing	Ongoing	See Volume 24
10. SFSR Road Reconstruc-tion	Burns 1996	Numerous actions See Volume 24	Ongoing	See Volume 24
11. Lower SFSR Post-fire Projects and fuel haul	Faurot and Burns 1995	Helicopter harvest, 3607 acres. Various mitigation. Fuel haul.	Complete	No documented adverse effects from harvest. Road gravelling and other mitigation has helped to reduce road-related erosion along mainstem Secesh River.
12. Road Use Agreements in Lower SFSR	Jacobson and Burns 1996	IDL, IDFG, Mackay Corp. Road Use for Fuel Haul and Timber Haul	Complete	Road gravelling and other mitigation has helped to reduce road-related erosion
13. Marshall Mtn., Bear Pete, and Josephine Sheep Allotments	Armstrong and Burns 1996	Sheep grazing	Ongoing	See Volume 24
14. Stibnite-West End Extension	Faurot and Burns 1996	Road building and mine pit development	Complete	New roads added to analysis area, increased ground disturbance due to pit. Much of the disturbance has been reclaimed in subsequent actions.
15. Don Clark SUP	Wagoner and Burns 1996	Water Development permit	Permit dropped	None
16. Prescribed Fire and Yellow Pine Fuels reduction	Faurot and Burns 1997	Prescribed burning	Complete	No adverse effects documented to fish or fish habitat
17. Brundage-Reed Land Exchange	Burns 1997	Land exchange	Complete	None
18. Road re-construction, EWP projects in Lower SFSR	Walker and Burns 1997	Road reconstruction and emergency watershed protection (Elk Creek) Replacement of Midvale Telephone Lines, Road Use Agreement, Erosion control, fuel haul mitigation	Complete	Short-term adverse effects due to reconstruction

Volume & Title	Author & Year	Federal Action	Status	Effect
19. Ongoing Actions (Steelhead)	Faurot and Burns 1998	Road maintenance Travel Plan O&M Trails and Rec sites Misc Harvest, Small Sales Watershed and Hab. Improvement SUPs-Water development Mackey Bar SUPs SUPs-Outfitter/Guides Victor Loon sheep allotment Marshall/Bear/Josephine allotment Mitigation: SFSR floating restrictions	Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Complete	See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 Reduction in adverse effects from contact between floaters and spawning fish
20. Mackay Bar Grazing SUP	Wagoner and Burns 1998	Grazing SUP	Cancelled	None
21. Time-Critical Removal Actions at Cinnabar and Meadow Creek	Faurot and Burns 1998	Removal of contaminant exposure to the environment (CERCLA)	Complete	Exposure of Sugar and Meadow Creeks to arsenic, cyanide, mercury, and other heavy metals was reduced
22. Ongoing Actions (Bull Trout)	Faurot and Burns 1998	Water Diversion SUPs Outfitter and Guide SUPs Grazing Allotments Comfort Lode Mine Bear Track Mine Road Maintenance Travel Plan Rec, Admin, facilities O&M Misc Forest Products Watershed/fish habitat improvement Ruby Mdws Watershed Improvement Prescribed Burns Brundage/Reed Land Exchange SF Houselog Timber Sale SFSR Rd Reconstruction	Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing Incomplete Incomplete Incomplete Incomplete	See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24
23. Grouped Actions	Faurot and Burns 1999	Trails End Water SUP Eiguren Water SUP Stibnite Mine Closure Daddy Dels Placer Exploration SFSR Road Reconstruction	Ongoing Ongoing Incomplete Ongoing Incomplete	See Volume 24 See Volume 24 See Volume 24 See Volume 24 See Volume 24
24. Ongoing Actions	Wagoner and Burns 2001	Fish Habitat and Riparian Sampling	Ongoing	Project mitigation has prevented any documented adverse disturbance effects to fish or eggs
		Road maintenance Travel Plan O&M Trails and Rec sites Brundage-Reed Land Exchange Misc Harvest, Small Sales SUPs-Water diversions Mackey Bar SUPs SUPs-Outfitter/Guides Victor Loon sheep allotment Marshall/Bear/Josephine allotment Comfort Lode Mine SFSR Road Reconstruction South Fork Houselog	Ongoing	Localized areas have documented effects of reduced LWD in RCAs due to firewood harvest
		Trails End SUP Eiguren SUP SFSR Road Reconstruction Stibnite Reclamation/Closure Daddy Dels 1 Mine	Ongoing	Site-specific critieria for RCA buffers has prevented any documented adverse effects
		Road Management	Ongoing	Road management practices not within criteria in Wagoner and Burns has resulted in localized areas of fine sediment input and reduction of LWD. This has especially been evident on the EFSF where county practices have resulted in redd destruction and sediment input at replaced culvert sites.
		Trails, Recreation and Administrative Site Operation and Maintenance	Ongoing	Trail maintenance has reduced erosion in specific locations. Existing adverse effects due to trail crossings have not been systematically inventoried, and ford-related impacts are ongoing.

Volume & Title	Author & Year	Federal Action	Status	Effect
		Travel Plan	Ongoing	Existing adverse effects due to road and trail crossings have not been systematically inventoried, and ford-related impacts are ongoing. Off-road access has caused documented adverse effects to stream channels.
		Watershed and Fish Habitat Improvements and Mtc	Ongoing	Localized areas of rehabilitation and long-term reductions in sediment delivery and improved hydrologic function.
		Wildland Fire Suppression	Ongoing	Some adverse effects have been documented such as accidental retardant drops
		Water Diversion SUPs	Ongoing	Minor reductions (potentially immeasurable) in habitat from water withdrawals, exacerbated in low water years
		Outfitter and Guides SUPs	Ongoing	No adverse effects have been documented
		Grazing Allotments Victor Loon Josephine/Marshall Mtn/Bear Pete	Ongoing	At most monitoring sites, there are no discernable upward or downward trends in cobble embeddedness. The exceptions are Grouse Creek E062, which has a statistically significant downward trend, and Lick Creek E057, which has a significant upward trend. Lick Creek has not been grazed since 1992; therefore, the upward trend cannot be attributed to grazing (Zurstadt 2004).
		South Fork Houselog Small Timber Sales	Incomplete	None
		Burgdorf Bridge Relocation	Complete	Short-term adverse effects due to construction, improved location benefits hydrologic condition
		SFSR Road Reconstruction	Ongoing	Monitoring of past actions has demonstrated positive effects. Goat Creek culvert site remains unstable and as a fish migration barrier. Grants are being pursued to fund this activity for 2006-2007.
		Stibnite Mine Closure	Ongoing	Continuing actions associated with Stibnite Mine closure have reduced sediment sources, stabilized areas of ground disturbance, improved and restored drainage patterns, and reduced sources of contaminants to listed fish and habitat.
		Parks Eiguren Prescribed Burn	Complete	No adverse effects to fish have been documented
		Willowbasket Trail Relocation	Complete	Adverse trail effects have been reduced by trail relocation
25. Daddy Dels 2 Mine	Faurot and Burns 2001	Mine exploration and reclamation	Complete	Project mitigation prevented adverse effects to fish
26. Fitsum Prescribed Burn and Meadow Creek Relocation	Faurot and Burns 2004	Fitsum Prescribed Burn and Meadow Creek Relocation	Burn not yet initiated, relocation is complete	Meadow Creek relocation has removed heavy metals contamination from the stream and has improved channel and other fish habitat characteristics
Nick Ck Retardant Drop	Faurot and Burns 2005	Emergency BA: Accidental drop of retardant into Nick Creek	Complete	Probable adverse effects to downstream fish
27. Burgdorf Roads	Faurot and Burns 2005	Roads and mine reclamation, as described in the Burgdorf RAP	Incomplete	None
28. Ongoing Actions	Faurot and Burns 2007	Miscellaneous Forest Products	Ongoing	No adverse effects to fish have been documented Project mitigation should prevent adverse effects to fish
		Mistletoe Control and Pre-com. thinning	Ongoing	No adverse effects to fish have been documented Project mitigation should prevent adverse effects to fish
		Fire Management Activities	Ongoing	Project mitigation should prevent adverse effects to fish
		Fish Habitat and Riparian Sampling	Ongoing	No adverse effects to fish have been documented Project mitigation should prevent adverse effects to fish

Volume & Title	Author & Year	Federal Action	Status	Effect
		Watershed, Fish Habitat Improvement and Maintenance	Ongoing	No adverse effects to fish have been documented Project mitigation should prevent adverse effects to fish
		Noxious Weed Management	Proposed	The considered action is likely to adversely affect listed species or critical habitat and may affect individuals, but is not likely to result in a trend toward federal listing of cutthroat trout. Mitigation measures are expected to minimize effects, but sub-lethal effects to listed fish and their food sources are probable, therefore adverse effects are expected from this action.
		Road Management	Ongoing	On their own, the Road Management and Trails actions are expected to have negligible effects on listed fishes and critical habitat due to mitigation measures that address sediment delivery and removal of LWD from RCAs, minimize potential for petroleum or other chemical contamination, and provide for aquatic organism passage.
		Trails, Recreation, and Administrative Site Operation and Maintenance	Ongoing	On their own, the Road Management and Trails actions are expected to have negligible effects on listed fishes and critical habitat due to mitigation measures that address sediment delivery and removal of LWD from RCAs, minimize potential for petroleum or other chemical contamination, and provide for aquatic organism passage.
		Travel Plan	Ongoing	For the Travel Plan, proximity of listed fishes and critical habitat to roads and/or trails in this analysis area, and decreases in streambank stability due to use and increased use of existing trails, road, and fords are expected to have adverse effects. Adverse effects to listed fishes such as harassment or redd trampling are also likely to occur from fording streams on foot, horseback, or other non-motorized travel.
		Water Diversion Special Use Permits	Ongoing	The Eiguren, Peterson, Wyatt, Phillips-Larrea, LaPaglia, Spradling, Hardy, Titus, Smith, Holly, Sandy Cove, and Badley water diversion SUP actions are not likely to adversely affect listed species or habitat and may affect individuals, but are not likely to result in a trend toward federal listing of cutthroat trout. The amount of water diverted by these users would be negligible because the amount of habitat that would change is immeasurable, even at low flows, given the models. The Mackey Bar water diversion SUP action is likely to adversely affect listed species or habitat and may affect individuals, but are not likely to result in a trend toward federal listing of cutthroat trout. Up to half of the habitat available to cutthroat trout and steelhead is removed.
		Outfitter and Guides	Ongoing	Negligible effects from camp use are expected because past problems have been identified

Volume & Title	Author & Year	Federal Action	Status	Effect
				and remedied, and annual inspections will continue to see that camps are meeting LRMP standards and that changes are made should there be potential effects to fish or fish habitat.
		Stibnite Mine Closure	Ongoing	Potential impacts to riparian areas, removal of riparian vegetation, and ground disturbance leading to temporary sediment delivery are associated concerns with this ultimately beneficial activity. Because mitigation includes continued monitoring, RCA protection, and implementation of BMPs, and because sediment effects have been demonstrated to have been short-term, only temporary, negligible adverse effects are expected from this action.
		Grazing Allotments	Ongoing	Project mitigation should prevent adverse effects to fish
		SFSR Road Reconstruction	Ongoing	The overall effect of the remaining actions for the SFSR Road Reconstruction project is expected to improve baseline conditions and be beneficial to the listed fish.
		Miscellaneous Forest Products	Ongoing	No adverse effects to fish have been documented Project mitigation should prevent adverse effects to fish
29. Yellow Pine and Eiguren Hazardous Fuels Reduction Project	Faurot and Burns 2007	Prescribed fire activities in the EFSFSR near Yellow Pine.	Postponed	No adverse effects to fish or fish habitat are expected
30. Warren Wagon Road Widening	Thompson *et al.* 2008	Proposed Valley County road widening project to increase safety.	Proposed	Possible adverse effects to rearing anadromous fish due to blasting disturbance.

C. ENVIRONMENTAL BASELINE MATRIX.

East Fork South Fork Salmon River Analysis Area

The environmental baseline reported in Faurot and Burns (2007b) is incorporated here and reproduced below, except that the “disturbance history” indicator, which is primarily based on “equivalent clearcut area” (ECA) is updated here to account for the large changes induced by the Cascade Complex and East Zone Complex wildfires in 2007. Faurot and Burns (2007b) report that 53,018 acres in the SFSR burned in 2006 (South Fork Complex), and several individual fires in this complex burned in the EFSFSR analysis area; acreages for these have not been computed, but the fires were mostly of low intensity with some areas of moderate and high intensity fire, particularly in the Van Meter Fire above Yellow Pine and to a lesser extent in the Tamarack Fire on Tamarack Creek (Nelson 2006). These fires undoubtedly increased ECA to some extent, but this has not been mapped, but effects to listed fishes and their habitat from the 2006 fires were not expected to be adverse (Burns and Faurot 2007) and no adverse effects have been observed. The 2007 fires were much more extensive and probably had more area burned at moderate and high intensity. I have mapped burn intensity for BARC imagery for updating the “disturbance history” indicator using an adaptation of the approach being used in the coordinated Southwest Idaho Ecogroup Land and Resource Plan 5-year evaluation report (see Appendix D for a fuller description of the method and calculation details).

East Fork South Fork Salmon River Analysis Area			
Agency/Unit:	PNF Krassel and McCall Ranger Districts	HU Code & Name:	17060208-02 Upper East Fork South Fork Salmon River 5th 17060208-04 Lower East Fork South Fork Salmon River 5th HU
Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Subpopulation Character			
Subpopulation Size	Bull trout - Mean total local population size or local habitat capacity more than several thousand individuals. Adults in local population > 500. All life stages are represented within the local population.	FR: PJ	Population size unknown. Thurow (1987) reported that bull trout populations are viable; however the status of discrete populations is unknown. A recent tagging study of bull trout in the EFSFSR (Hogen, 2002) found the fish dispersed throughout the main river as well as in several tributaries, primarily Profile, Tamarack, and Sugar Creeks. Bull trout also moved further up into smaller tributaries of these three systems. Thurow (1986) documented fish densities for the mainstem and tributaries ranging from 0.26 to 0.51 fish per 100 m2. Spawning and rearing habitat for bull trout occur throughout the river and its

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(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
			tributaries; Quartz Creek, Profile Creek, and Tamarack Creek are particularly important streams for spawning by fluvial bull trout, and adfluvial bull trout use the Yellow Pine Pit in the Stibnite area (Hogen, 2002).”…
Water Quality			
Growth and Survival	Bull trout - Local population has the resilience to recover from temporary or short-term disturbances (e.g., catastrophic events, etc.) or local population declines within 1 to 2 generations (5-10 years). The local population is characterized as increasing or stable. At least 10 years of data support this estimate.	FR: PJ	Spawning occurred over a short, definite time period, from September 1 –15 with all spawning completed by September 20. Overwintering of fish tagged in the EFSFSR occurred in the EFSFSR and the main South Fork Salmon River, and extended into the main Salmon River as well (personal communication D.Hogen, former Council District fish biologist) (Burns et al. 2005). Tributaries function as spawning and rearing areas for fluvial and resident stocks, and the mainstem SFSR serves as a migration corridor and overwintering area for both emigrating juveniles and adult fish.
Life History Diversity and Isolation	Bull trout - The migratory form is present and the local populations are in close proximity to each other. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring local populations are large with high likelihood of producing surplus individuals or straying adults that will mix with other local populations.	FR: PJ	Spawning and rearing habitat for bull trout occur throughout the river and its tributaries; Quartz Creek, Profile Creek, and Tamarack Creek are particularly important streams for spawning by fluvial bull trout, and adfluvial bull trout use the Yellow Pine Pit in the Stibnite area (Hogen, 2002).”… All three life histories are present in the SFSR. Fluvial individuals have been documented in the EFSFSR, some of which make extensive migrations, (Hogen 2002) and Secesh River (Watry and Scarnecchia

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Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		

Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
			2004); in addition, Hogen (2002) and Watry and Scarnecchia (2004) documented adfluvial bull trout in the EFSFSR and Secesh River, respectively.
Persistence and Genetic Integrity	Bull trout - Connectivity is high among multiple (5 or more) local populations with at least several thousand fish each. Each of the relevant local populations has a low risk of extinction. The probability of hybridization or displacement by competitive species is low to nonexistent	FR: PJ (see above)	Burns et al 2005: "All bull trout life history strategies are present in the SFSR watershed, which contributes to long term population viability. There are very few human caused or natural barriers that fragment occupied or suitable bull trout habitat. Therefore, the populations of bull trout in the drainage are well connected, which enhances long term viability. There are data from the SFSR drainage showing areas of bull trout and brook trout overlap, and in these areas hybridization is likely, and, indeed, we have observed probable hybrids in some; viability is undoubtedly reduced in these areas."
Temperature	7 day average. Maximum, ºC Bull trout: Incubation (Sept-Mar): 2-5°C Rearing (year-round): 4-12°C Spawning (Sept): 4-9°C Migration (June-Sept): NTE 15°C	FR D	Wagoner and Burns (2001): FA. Median temperatures exceed the 15 degree (C) criterion for classification as "Functioning Appropriately" for bull trout migration for the SFSR, though the EFSFSR is close (Nelson and Burns 2006). Though temperature values are within the FR/FUR ranges (unpublished data on file at PNF SO), data are considered to reflect a natural temperature regime in most of the SFSR drainage because there is little evidence of management effects in these watersheds that would contribute to elevated temperatures. Given the stream elevation, topography, aspect, and riparian vegetation characteristics, this data likely reflects the natural range of variability, except along the mainstem roads, where shading is compromised.

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Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Temperature	7 day average maximum, °C Chinook/steelhead: Spawning, rearing, & migration: 10-13.9 °C. As directed by the NOAA BO on the LRMP (NMFS 2003), these default WCI values are being revised to appropriate values for this subbasin based on the best available data on functioning habitat conditions for ESA-listed fish within the subbasin.	FR D	See above
Intragravel Quality (Sediment)	LRMP definition: <12%fines (<0.85mm) in gravel. Surface fines(≤ 6mm) ≤ 20%	see Interstitial Sediment WCI	NA
Chemical Contaminants/Nutrients	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients, no 303 (d) water quality limited water bodies.	FUR D	Entire EFSFSR listed under 303(d) (State of Idaho DEQ 1999) sent and unknown metals as parameters of concern.
Habitat Access			
Physical Barriers	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows.	FR D	Reegan Creek culvert and possibly other culverts are likely barriers at low flows (Wagoner and Burns (2001), Hogen 2002, Thurow 1987) Deadman and Caton Creeks have natural barriers to fish passage (Deadman: boulder with 8-foot drop 30m above EFSFSR Road). EFSFSR Road could present a man-made barrier in Reegan, Williams and Dutch Oven Creeks (Data on file at the PNF Supervisor's Office, McCall, Idaho). The Glory Hole and Box Culvert in the mainstem EFSFSR is likely a barrier at low flows (Wagoner and Burns (2001), Hogen 2002, Thurow 1987).
Habitat Elements			

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Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Interstitial Sediment Deposition (Substrate Embeddedness)	LRMP definition Dominant substrate is gravel or cobble, or embeddedness is<20%	FR D,PJ	Nelson et al. 2006 describe the EFSFSR sampling sites as follows: “we would classify only the Tamarack Creek site as FA, with FR classifications applied to E050 and the two Sugar Creek sites and FUR classifications for the two mainstem EFSFSR sites (free matrix).” “Cobble embeddedness measurements were consistent with free matrix counts, with the Tamarack and Profile Creek sites being least embedded and the sites downstream of the Stibnite area being most embedded.” The current existence, use and maintenance of the mainstem EFSFSR Road, Quartz Creek Road and historical mining disturbance in the Stibnite area continue to be a source of existing and potential anthropogenic sediment to the EFSFSR adjacent to these 6th HUs
Large Woody Debris	>20 pieces per mile, >12 in. in diameter, >35 feet in length, and adequate sources of large woody debris for both long and short-term recruitment.	FUR D, PJ	(Upper) EFSFSR Watershed Analysis (Kuzis 1997): EFSFSR 1-4 pieces/mi (may not be PACFISH wood) Limited recruitment due to Stibnite mining disturbance and mainstem EFSFSR, Profile, Sugar and Quartz Creek Roads. Unpublished data on file at PNF SO: Meadow Creek survey 2004, less than 1 piece per mile.

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(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		

Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Pool Frequency	Bull trout: Wetted Width (ft.) — Number of Pools/Mile 0-5 39 5-10 60 10-15 48 15-20 39 20-30 23 30-35 18 35-40 10 40-65 9 65-100 4 Chinook/steelhead: Channel Width (ft.) — Number of Pools/Mile 5 184 5-10 96 10-15 70 15-20 56 25-50 26 50-75 23 75-100 18	FR D, PJ	Wagoner and Burns (2001): FUR EFSFSR Watershed Analysis (Upper EFSFSR 5th HU) (Kuzis 1997): Upper EFSFSR 5-15 ft wide 4 - 7 pools/mi FUR Parks Creek 13.4 ft wide 55.8 pools/mi FR Quartz Creek 23 ft wide 45.1 pools/mi FR No Mans Creek 13.4 ft wide 137.9 pools/mi FA Reegan Creek 13.8 ft wide 76.6 pools/mi FA Unpublished data on file at PNF SO, Meadow Creek survey 2004: 43-47 pools/mile (7-29 ft width) FR
Pool Quality	Each reach has many large pools >3.28 feet (1 meter) deep. Pools have good cover and cool water, and only minor reduction of pool volume by sediment.	FR D, PJ	Reaches have few large pools or inadequate cover/temperature (see temperature and RCA WCIs) (Kuzis 1997)
Off-Channel Habitat	Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; side channels are low energy areas.	FR PJ	Wagoner and Burns (2001): FR Upper EFSFSR has experienced continual rerouting and diversions. Roaded RCAs have confined off-channel habitats (EFSFSR, Meadow Creek, Profile Creek, Sugar Creek, Quartz Creek)

East Fork South Fork Salmon River Analysis Area			
Agency/Unit:	PNF Krassel and McCall Ranger Districts	HU Code & Name:	17060208-02 Upper East Fork South Fork Salmon River 5th 17060208-04 Lower East Fork South Fork Salmon River 5th HU
Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Refugia	Bull trout - Habitats capable of supporting strong and significant local populations are protected and are well distributed and connected for all life stages and forms of the species. Chinook/steelhead - Habitat refugia exist and are adequately buffered (e.g., by intact RCAs); existing refugia are sufficient in size, number, and connectivity to maintain viable populations.	FR PJ	Wagoner and Burns (2001): FR The Tamarack Creek drainage, which is located almost entirely in the Wilderness, provides high-quality refugia within this analysis area. However, perennial stream RCAs in the Upper EFSFSR 38% disturbed (Kuzis 1997), roads have substantially affected RCAs along EFSFSR, Profile, Sugar, and Quartz Creek, and Burns et al. (2005) and Kuzis (1997) document that the Bradley Pit isolates the upper EFSFSR from upstream fish migrations and that portions of this watershed have had extensive habitat modification and degradation. Reegan Ck – EFSFSR rd culvert is a barrier Diversion on Parks Creek Diversion on un-named trib W. of Eiguren ranch (pvt. land)
Channel Condition and Dynamics			
Avg Width/Maximum Depth Ratios in scour pools	</= 10	FR PJ	Weighted average width/max depth ratios in scour pools from Fbase outputs on file at PNF SO. Fiddle Creek 2004: 5.9. The following data may include dam pools. These numbers are not FBase output. These unweighted numbers were calculated from raw data by averaging pool widths for a reach, then dividing by average maximum pool depths for that reach. They cannot be compared to default WCIs, but are provided here for reference (unpublished data on file at PNF SO): Parks Creek – 6.3 (2002) Quartz Creek – 4.7 (2002) No Mans Creek 5.5 (2002) Reegan Creek 7.2 (2002) Based on personal observation, width/depth ratios for this analysis area are Functioning at Risk. Wagoner and Burns (2001): FUR

East Fork South Fork Salmon River Analysis Area			
Agency/Unit:	PNF Krassel and McCall Ranger Districts	HU Code & Name:	17060208-02 Upper East Fork South Fork Salmon River 5th 17060208-04 Lower East Fork South Fork Salmon River 5th HU
Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Streambank Condition	>90% of any stream reach has stable banks relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.	FR PJ	EFSFSR road affects EFSFSR streambanks adjacent to project area (personal observation). Wagoner and Burns (2001): FUR EFSFSR Watershed Analysis (Kuzis 1997): Mean of Upper EFSFSR 5th HU: 88%
Floodplain Connectivity	Within RCAs, floodplains and wetlands are hydrologically linked to the main channel; overbank flows occur and maintain wetland/floodplain functions; and riparian vegetation succession.	FR PJ	Wagoner and Burns (2001): FR (EFSFSR 4th HU) Quartz, Sugar, Profile, and mainstem EFSFSR roads lie close to the stream and have likely affected links to floodplains or wetlands. EFSFSR road has reduced links to floodplain and wetlands. Severely reduced linkage to floodplains and wetlands due to impacted RCAs in Stibnite mining area (personal observation). EFSFSR Watershed Analysis (Kuzis 1997): Meadow Creek and the EFSFSR experienced almost continual rerouting and diversion beginning in the early 1900s. Perennial stream RCAs are 38% disturbed Lower EFSFSR tribs (Williams, Dutch Oven, Deadman Creeks) are relatively intact drainages and likely to have functioning floodplains (personal observation)
Flow\Hydrology			
Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of a similar size, geomorphology and climatology.	FR PJ	Lower EFSFSR tribs are relatively intact drainages and likely to have little change in flows (personal observation). Diversions affect base flows in portions of Boulder Creek and un-named EFSFSR trib. on private lands near Yellow Pine.. Roads, the Glory Hole and other historical diversions in the Stibnite Mining Area have affected flow timing in the Upper EFSFSR, Profile Creek, and along the mainstem EFSFSR. EFSFSR Watershed Analysis (Kuzis 1997): "In general, water flow volume and peak flow conditions have been little affected ..."

East Fork South Fork Salmon River Analysis Area			
Agency/Unit:	PNF Krassel and McCall Ranger Districts	HU Code & Name:	17060208-02 Upper East Fork South Fork Salmon River 5th 17060208-04 Lower East Fork South Fork Salmon River 5th HU
Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		
Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Drainage Network Increase	Zero or minimum change in active channel length correlated with human caused disturbance.	FUR PJ	Lower EFSFSR tribs are relatively intact drainages and likely to have little drainage network increase. Extensive channel rerouting and diversion beginning in the early 1900s, and a high percentage of roads within RCAs, have changed channel lengths in the Upper EF due to mining and RCA roads (personal observations).
Watershed Condtion			
Road Density and Location	Total road density <0.7 miles/square mile of subwatershed, no road within RCAs.	FR PJ	Total road density = 0.7 mi/sq. mi. RCA road density=2.2 mi/sq mi, many roads within RCAs, (CD1: \Support Documents\Maps\total_roads.pdf)
Disturbance History	<15% ECA (entire watershed) with no concentration of disturbance in areas with landslide or landslide prone areas, and/or refugia, and/or RCAs.	FUR D, PJ	ECA ≈ 25%, (see Appendix D) Disturbance is concentrated in RCAs (roads, mining) in upper watershed. Extensive channel rerouting and diversion beginning in the early 1900s, and a high percentage of roads within RCAs, have changed channel lengths in the Upper EF due to mining and RCA roads (personal observation).
Riparian Conservation Areas	The riparian conservation areas within the subwatershed(s) have historic and occupied refugia for listed, sensitive or native/desired nonnative fish species which are present and provide: adequate shade, large woody debris recruitment, sediment buffering, connectivity, and habitat protection and connectivity to adequately minimize adverse effects from land management activities (>80% intact). All vegetative components are within desired conditions identified in Appendix A of the Forest Plan. RCA functions and processes are intact, providing resiliency from adverse affects associated with land management activities. Co	FUR PJ	Roads along EFSFSR, Sugar, Profile and Quartz Creek s, and mining in the upper watershed, have affected RCA function (personal observation). RCAs observed to be 62% intact for upper EFSFSR (Kuzis 1997) passage barriers at Reegan Creek-EFSFSR road culvert and Glory Hole; sediment delivery to tributaries crossing EFSFSR road, and water diversions on Parks Creek, Boulder Creek, and un-named tributary E. of Reegan Creek. Lower EFSFSR tribs are relatively intact drainages and likely to have >80% intact RCAs (personal observation).

East Fork South Fork Salmon River Analysis Area			
Agency/Unit:	PNF Krassel and McCall Ranger Districts	HU Code & Name:	17060208-02 Upper East Fork South Fork Salmon River 5th 17060208-04 Lower East Fork South Fork Salmon River 5th HU
Fish Species Present:	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of Matrix:	Two 5th Hydrologic Units
(Anadromous. Sp.) Population:	South Fork Salmon River	Subpopulation:	East Fork South Fork Salmon River Analysis Area
(Bull trout) Core Area:	South Fork Salmon River	Local Population:	South Fork Salmon River
Management Action(s):	Yellow Pine and Eiguren Hazardous Fuels Reduction Project		

Pathway Indicators	Population and Environmental Baseline		
	Desired Condition	Baseline	Discussion of Baseline –Current Condition
Disturbance Regime	Disturbance resulting from land management activities are negligible or temporary. Streamflow regimes are appropriate to the local geomorphology, potential vegetation and climatology resulting in appropriate high quality habitat and watershed complexity that provide refugia and rearing space for all life stages or multiple life-history forms. Ecological processes are within historical ranges.–Resiliency of habitat to recover from land management disturbances is high.	FR PJ	See above Adjacent road has affected EFSFSR, Quartz, Profile, and Sugar Creeks' resiliency (personal observation). Disturbance from land management actions such as mining and roads (riparian) is not negligible or temporary. Resiliency of habitat to recover from land management disturbances is moderate throughout most of the analysis area, but low in the Stibnite area (personal observation).
Integration of Species and Habitat Conditions	Bull trout - Habitat quality and connectivity among subpopulations is high. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival and growth are consistent with the desired conditions for the habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5-10 years). The subpopulation is fluctuating around an equilibrium or is growing.	FR PJ	Sediments and suitable habitat availability have been altered and may not return to pre-disturbance conditions within 5 years (see above WCIs and personal observation). Survival and growth rates for bull trout are reduced (see population character WCIs and Burns et al. 2005). Local populations are stable or fluctuating in a downward trend for all listed species (57FR14653, 60FR43937, 63FR31647). Connectivity among local populations occurs but habitats are fragmented (Burns et al. 2005).

D. ESTIMATION OF ECA.

The PNF has not formally recalculated ECA since development of the revised LRMP (USFS 2003). Determination of ECA is based on a variety of watershed disturbances including road development, harvest, plantation age, etc., and Nelson et al. (2005) demonstrated that ECA estimations at watershed scales were of questionable value in determining quality of fish habitat. Nonetheless, large wildfires have the ability to alter the hydrologic regime in affected watersheds and the change in ECA provides an important component of the environmental baseline description.

Prior to the 2006 and 2007 fires, ECA for the EFSFSR analysis area was estimated at 4% (Faurot and Burns 2007, from LRMP analysis). The post-fire ECA has not been calculated, but can be estimated from the Burned Area Reflectance Classification imagery collected after the 2007 Cascade Complex and east Zone Complex wildfires. I performed this Geographic Information System (GIS)-based analysis myself by using BARC images from both fires, clipping them to the analysis area boundary, and computing acreages in four burn intensity/severity categories: None, Low, Medium, High; these are counted as 30m cells in the BAERC image raster clipped to the analysis area boundary. In order to derive a final ECA estimate, I made several assumptions:

1. The effects on ECA of the 2006 SFSR Complex fires was overwhelmed by the larger and more intense 2007 fires (the relatively low severity of the 2006 fires is documented in Nelson (2006a,b).

2. Roads could be discounted from the analysis. Much of the EFSFSR analysis area is within inventoried roadless areas or designated wilderness (Figure 1) and timber harvest was not a primary activity (note, this is for the PNF portion only).

3. Effects of prescribed fire on ECA were insignificant relative to the change from the 2007 fires.

4. The simple table equating burn intensity/severity to ECA proposed for use in the LRMP 5-Year evaluation (Table A1)[11] provides an adequate estimate of ECA for the watershed.

Table 3.—Approximate ECA by BARC burn intensity/severity category.

BARC Class	Description	Approximate ECA (%)
0	Unburned, unchanged, or outside image	0
1	Low	20
2	Moderate	75
3	High	100

5. A weighted average of the acreages (using the values from the map in Figure 1) by BARC/ECA class would provide a useful approximation of actual post-fire ECA.

The weighted average of the for ECA classes is:

$$\text{Mean} = ((0 \times 16646) + (20 \times 5025) + (75 \times 4896) + (100 \times 2431) / 28998) \tag{1}$$

For an estimated analysis area-wide ECA of approximately 25%.

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[11] This was provided by officials charged with managing the 5-Year LRMP evaluation process (Ehinger 2008); only the burn intensity/severity table was used here.

E. EFFECTS MATRIX

1. East Fork South Fork Salmon River Analysis Area

EFSFSR Analysis Area Effects Matrix					
Agency/Unit	USDA Forest Service Krassel Ranger District	Hydrologic Unit Code and Name			Lower and Upper EFSFSR 5th Hydrologic Units
Fish Species Present	Chinook salmon, steelhead, bull trout, cutthroat	Spatial Scale of this Matrix			EFSFSR Analysis Area Two 5th level Hydrologic Units
Core Area (Bull Trout)	South Fork Salmon River	Local Population			EFSFSR
Management Actions	Yellow Pine and Eiguren Hazardous Fuels Reduction Project				
	Effects of the Management Action(s)				
		Expected Trend - negative, + positive, * negligible, none			
Pathways & Indicators	Effects I=improve/D=degrade/M=maintain/N=no influence	Temporary (0-3 yrs)	Short-term (3-15 yrs)	Long-term (15 yrs +)	Discussion of Effects
Local Population Character					
Chemical Contamination and Nutrients	M	-*	none	none	Project design features and mitigation measures will minimize the potential for any more than temporary, unlikely effects from cement toxicity and petroleum product spills or leaks.
Interstitial Sediment Deposition	M	-*	none	none	Project design and mitigation measures would be expected to maintain current habitat conditions and thus current local populations. Temporary sediment or turbidity increases would have no measurable persistent effects.
Large Woody Debris	M	none	+*	+*	LWD will be largely unaffected directly by the project, but increased recruitment following the 2007 fires is expected and improved management of debris accumulations at the bridge will increase LWD instream over time.

F. STANDARD ACRONYMS, ABBREVIATIONS AND CONVERSIONS

NOTE: The following list of standard acronyms, abbreviations, and conversions is not exhaustive.

1. Acronyms

a. General

AMP	Allotment Management Plan
AOI	Annual Operating Instructions
AOP	Annual Operating Plan
AUM	Animal Unit Month
BA	Biological Assessment
BE	Biological Evaluation
BLM	Bureau of Land Management
BMP	Best Management Practices
BNF	Boise National Forest
BO	Biological Opinion
BR	Brownlee Reservoir or Brownlee, a PNF ESA §7 Watershed
C&H	Cattle and horse, a grazing allotment use designation
CFR	Code of Federal Regulations
CWA	Clean Water Act
DC	Deep Creek, a PNF ESA §7 Watershed
DEIS	Draft Environmental Impact Statement
EFSFSR	East Fork South Fork Salmon River
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCRONRW	Frank Church River Of No Return Wilderness
FDR	Forest Development Road
FEIS	Final Environmental Impact Statement
FH	Forest Highway
FT	Forest Trail
FONSI	Finding Of No Significant Impact
FR	Federal Register
HM	Head Months
HU	Hydrologic Unit, used in the form "Brownlee Reservoir 4th level hydrologic unit"
HUC	Hydrologic Unit Code, used in the form "the 4th level hydrologic unit code is 17050201"
IDE	Idaho Division of Environment
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game.
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
INCD	Idaho Natural Conditions Database
INFRA	Payette National Forest Infrastructure Database
IWWA	Inland West Watershed Assessment
LOC	Letter of Concurrence.
LRMP	Land and Resource Management Plan; also called Forest Plan
LSR	Little Salmon River, also used for the PNF ESA §7 Watershed of the same name

LWD	Large Woody Debris
MBF	Thousand Board Feet
MFSR	Middle Fork Salmon River
MFT	Middle Fork Tribs or Middle Fork Salmon River Tributaries, a PNF ESA §7 Watershed
MMBF	Million Board Feet
MSSE	Main Salmon SE or Main Salmon River Tributaries (Southeast: South Fork Salmon River to Middle Fork Salmon River), a PNF ESA §7 Watershed
MSSW	Main Salmon SW or Main Salmon River Tributaries (Southwest: Little Salmon River to South Fork Salmon River), a PNF ESA §7 Watershed
MYOP	Multi-Year Operating Plan
NFPR	North Fork Payette River, also used for the PNF ESA §7 Watershed of the same name
NFS	National Forest System (e.g., NFS lands).
NMFS	National Marine Fisheries Service
NPNF	Nez Perce National Forest
NPT	Nez Perce Tribe
O&M	Operation and Maintenance
PNF	Payette National Forest
RA	Resource Area
RCA	Riparian Habitat Conservation Area
RMO	Riparian Management Objectives
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
S&G	Sheep and goat, a grazing allotment use designation
SBT	Shoshone-Bannock Tribe
SFSR	South Fork Salmon River, also used for the PNF ESA §7 Watershed of the same name
SUP	Special Use Permit
TES	Threatened, endangered, sensitive
TS	Timber Sale
TSI	Timber Stand Improvement
USC	United States Code
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WCI	Watershed Condition Indicator
WFU	Wildland Fire Use
WR	Weiser River, also used for the PNF ESA §7 Watershed of the same name

b. Fish Species

BT	Columbia River bull trout (*Salvelinus confluentus*)
EB	Eastern brook trout (*Salvelinus fontinalis*)
LT	Lake trout (*Salvelinus namaycush*)
MS	Mottled sculpin (*Cottus bairdi*)
PL	Pacific lamprey (*Lampetra tridentata*)
RB	Redband trout (*Oncorhynchus mykiss gairdneri*)
RBT	Rainbow trout (*Oncorhynchus mykiss irideus*)
SP	Splake (*Salvelinus fontinalis x S. namaycush*)
SpCS	Spring Chinook salmon (*Oncorhynchus tshawytscha*)
SpSCS	Spring/summer Chinook salmon (*Oncorhynchus tshawytscha*)
SpSSFCS	Spring/summer and fall Chinook salmon (*Oncorhynchus tshawytscha*)

SST	Snake River summer steelhead (*Oncorhynchus mykiss gairdneri*)
WCT	Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
YCT	Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*)

c. Determinations—Listed Species and Critical Habitat

LAA	May Affect, Likely to Adversely Affect
NE	No Effect
NLAA	May Affect, Not Likely to Adversely Affect

d. Determinations—Species and Critical Habitat Proposed for Listing

LJ	Likely to Jeopardize
LRDAM	Likely to Lead to Destruction or Adverse Modification
NLJ	Not Likely to Jeopardize
NLRDAM	Not Likely to Lead to Destruction or Adverse Modification

e. Determinations—Sensitive Species

LLL	Likely to Lead to Listing
NLLL	Not Likely to Lead to Listing

2. Abbreviations

ac	acre
cfs	cubic feet per second
cms	cubic meters per second
ft	feet
ha	hectare
km	kilometer
km^2	square kilometer
m	meters
mi	mile
mi^2	square mile
hr	hour

3. Conversions

The following were used to convert between English and metric units of measure:

ac = ha ∗ 2.4710
ha = ac ∗ 0.4047
in = cm ∗ 0.39
cm = in ∗ 2.54
mi = km ∗ 0.622
km = mi ∗ 1.609
mi^2 = km^2 ∗ 0.386
km^2 = mi^2 ∗ 2.589
mi/mi^2 = km/km^2 ∗ 1.609
km/km^2 = mi/mi^2 ∗ 0.622
cms = cfs * 0.02832

G. ATTACHMENTS

(On following pages)

1. IDFG data, 6 pages.
2. Bridge design and construction shop drawings (from contractor), 11 pages.
3. Workpads, pier repairs, and rip rap designs, drawn by Valley County Engineer, 11 pages.
4. Work schedule, 2 pages.
5. Standard Specification 107.10, 2 pages.
6. Supplemental Specification 107.10, 2 pages.
7. Standard Specification 157, 5 pages.
8. Supplemental Specification 157, 2 pages.
9. Supplemental Specification 208, 1 page.
10. Rip Rap Calculations, Standards, and Notes, 10 pages.

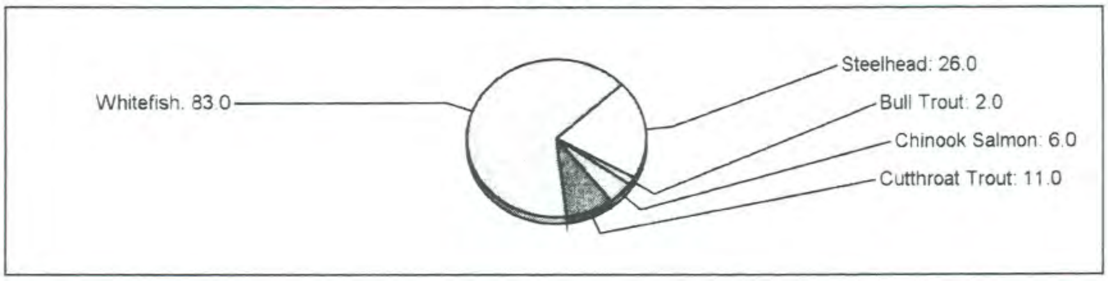
Standard Stream Survey: Single Survey Lookup

Stream & Parent	Strata	Section	Survey Date
[illegible]	[illegible]	[illegible]	[illegible]

Site Description:	The site is at road mile (mile post) 35.8 which is 14.1 miles downstream from FS 413 (Johnson Cr rd) or 0.3 miles upstream from East Fork bridge. The site is between 127 - 164 meters. A tree on the road side (at the small pull out) is flagged. The top a		
HydroID:	3802	**LLID:**	1157131450148
Drainage:	Salmon River	**Measure (m):**	945
Fish SurveyID:	39829	**EPA Reach:**	1706020804000

Project Leader:	Apperson,Kimberly	**Conductivity:**	
Collecting Agency:	Idaho Department of Fish and Game	**Gradient (%):**	
Program:	General Parr Monitoring	**Visibility:**	4.59999990463257
H2O Temp (C):	16	**Habitat Type:**	Combination
SurveySite Length (m):	91	**Sample Method:**	Snorkel (Entire Width)
Mean Width (m):	22.70	**Electro Passes:**	
Section Area (sq. m):	2,066	**No. Snorkelers:**	4
Survey Comments:	Estimate habitat type: 40 pool, 20 riffle, 20 run, 20 pocket		Weather: clear and sunny

Species Composition



Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
Bull Trout		**Average: 0**		**Total:**	2.0
	18<19"		Unknown	Unknown	1.0
	20<21"		Unknown	Unknown	1.0
Chinook Salmon (Summer Run)		**Average: 0**		**Total:**	6.0
	Unknown		Unknown	Age 0	5.0
	Unknown		Unknown	Age 1	1.0
Cutthroat Trout		**Average: 0**		**Total:**	11.0
	6<7"152<178mm		Unknown	Unknown	1.0
	7<8"178<203mm		Unknown	Unknown	3.0
	8<9"203<229mm		Unknown	Unknown	5.0
	9<10"229<254mm		Unknown	Unknown	1.0
	10<11"254<279mm		Unknown	Unknown	1.0
Dace (Var. Sp.)		**Average: 0**		**Total:**	
	Unknown		Unknown	Unknown	

Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
Mountain Whitefish		Average: 0		Total:	83.0
	7<8"178<203mm		Unknown	Unknown	1.0
	8<9"203<229mm		Unknown	Unknown	5.0
	10<11"254<279mm		Unknown	Unknown	9.0
	11<12"279<305mm		Unknown	Unknown	17.0
	12<13"305<330mm		Unknown	Unknown	19.0
	13<14"330<356mm		Unknown	Unknown	3.0
	14<15"356<381mm		Unknown	Unknown	22.0
	15<16"381<406mm		Unknown	Unknown	6.0
	16<17"406<432mm		Unknown	Unknown	1.0
Steelhead (Snake River Basin)		Average: 0		Total:	26.0
	3<4"76<102mm		Unknown	Unknown	1.0
	4<5"102<127mm		Unknown	Unknown	3.0
	5<6"127<152mm		Unknown	Unknown	5.0
	6<7"152<178mm		Unknown	Unknown	8.0
	7<8"178<203mm		Unknown	Unknown	1.0
	8<9"203<229mm		Unknown	Unknown	7.0
	10<11"254<279mm		Unknown	Unknown	1.0

Created:	10/4/2006 2:47 PM	**Created by:**	IDFG\shochhalter
Survey Modified:	12/12/2008 10:11 AM	**Survey Modified by:**	IDFG\jdavis
Fish Data Modified:	3/18/2009 3:11 PM	**Fish Data Modified by:**	IDFG\jdavis

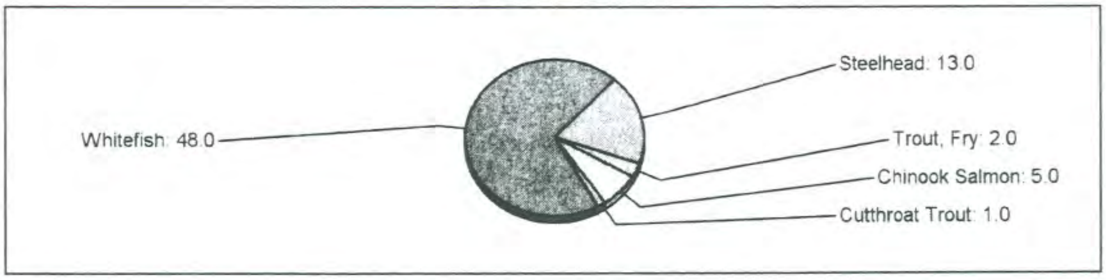
Standard Stream Survey: Single Survey Lookup

Stream & Parent	Strata	Section	Survey Date
[illegible]	[illegible]	[illegible]	[illegible]

Site Description:	The site is at road mile (mile post) 35.8 which is 14.1 miles downstream from FS 413 (Johnson Cr rd) or 0.3 miles upstream from East Fork bridge. The site is between 127 - 164 meters. A tree on the road side (at the small pull out) is flagged. The top a		
HydroID:	3802	**LLID:**	1157131450148
Drainage:	Salmon River	**Measure (m):**	945
Fish SurveyID:	31240	**EPA Reach:**	1706020804000

Project Leader:	Apperson,Kimberly	**Conductivity:**	
Collecting Agency:	Idaho Department of Fish and Game	**Gradient (%):**	
Program:	General Parr Monitoring	**Visibility:**	4.69999980926514
H2O Temp (C):	11	**Habitat Type:**	Combination
SurveySite Length (m):	119	**Sample Method:**	Snorkel (Entire Width)
Mean Width (m):	22.78	**Electro Passes:**	
Section Area (sq. m):	2,711	**No. Snorkelers:**	5
Survey Comments:	Estimated Percent Habitat Types: Pool 25; Riffle 20; Run 50; Pocket 5 Weather: Overcast. Partial corridor float.		

Species Composition



Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
Chinook Salmon		**Average: 0**		**Total:**	5.0
	Unknown		Unknown	Age 0	5.0
Cutthroat Trout		**Average: 0**		**Total:**	1.0
	13<14"330<356mm		Unknown	Unknown	1.0
Mountain Whitefish		**Average: 0**		**Total:**	48.0
	1<2"25<50mm		Unknown	Unknown	12.0
	8<9"203<229mm		Unknown	Unknown	1.0
	9<10"229<254mm		Unknown	Unknown	1.0
	10<11"254<279mm		Unknown	Unknown	4.0
	11<12"279<305mm		Unknown	Unknown	2.0
	12<13"305<330mm		Unknown	Unknown	8.0
	13<14"330<356mm		Unknown	Unknown	5.0
	14<15"356<381mm		Unknown	Unknown	10.0
	15<16"381<406mm		Unknown	Unknown	3.0
	16<17"406<432mm		Unknown	Unknown	1.0

Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
	17<18"432<457mm		Unknown	Unknown	1.0
Steelhead (Snake River Basin)		Average: 0		Total:	13.0
	3<4"76<102mm		Unknown	Unknown	1.0
	4<5"102<127mm		Unknown	Unknown	1.0
	5<6"127<152mm		Unknown	Unknown	5.0
	6<7"152<178mm		Unknown	Unknown	1.0
	7<8"178<203mm		Unknown	Unknown	2.0
	8<9"203<229mm		Unknown	Unknown	3.0
Trout, Fry (Oncorhynchus var. species)		Average: 0		Total:	2.0
	Unknown		Unknown	Unknown	2.0

Created:	9/13/2005 7:33 AM	**Created by:**	IDFG\mackerman
Survey Modified:	12/12/2008 10:11 AM	**Survey Modified by:**	IDFG\jdavis
Fish Data Modified:	3/18/2009 3:11 PM	**Fish Data Modified by:**	IDFG\jdavis

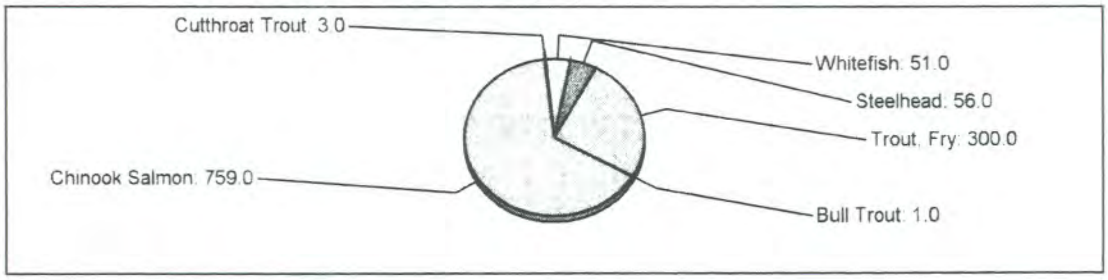
Standard Stream Survey: Single Survey Lookup

Stream & Parent	Strata	Section	Survey Date
[illegible]	[illegible]	[illegible]	[illegible]

Site Description:	The site is at road mile (mile post) 35.8 which is 14.1 miles downstream from FS 413 (Johnson Cr rd) or 0.3 miles upstream from East Fork bridge. The site is between 127 - 164 meters. A tree on the road side (at the small pull out) is flagged. The top a		
HydroID:	3802	**LLID:**	1157131450148
Drainage:	Salmon River	**Measure (m):**	945
Fish SurveyID:	27969	**EPA Reach:**	1706020804000

Project Leader:	Apperson,Kimberly	**Conductivity:**	
Collecting Agency:	Idaho Department of Fish and Game	**Gradient (%):**	
Program:	General Parr Monitoring	**Visibility:**	4.19999980926514
H2O Temp (C):	15	**Habitat Type:**	Combination
SurveySite Length (m):	140	**Sample Method:**	Snorkel (Entire Width)
Mean Width (m):	19.75	**Electro Passes:**	-99
Section Area (sq. m):	2,765	**No. Snorkelers:**	4
Survey Comments:	HABITAT %: POOL 75, RIFFLE 5, RUN 20 WEATHER: SUNNY		

Species Composition



Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
Bull Trout		**Average: 0**		**Total:**	1.0
	14<15"356<381mm		Unknown	Unknown	1.0
Chinook Salmon		**Average: 0**		**Total:**	759.0
	Unknown		Unknown	Age 0	758.0
	Unknown		Unknown	Age 1	1.0
Cutthroat Trout		**Average: 0**		**Total:**	3.0
	4<5"102<127mm		Unknown	Unknown	1.0
	10<11"254<279mm		Unknown	Unknown	1.0
	11<12"279<305mm		Unknown	Unknown	1.0
Longnose Dace		**Average: 0**		**Total:**	
	Unknown		Unknown	Unknown	
Mountain Whitefish		**Average: 0**		**Total:**	51.0
	1<2"25<50mm		Unknown	Unknown	2.0
	5<6"127<152mm		Unknown	Unknown	1.0
	7<8"178<203mm		Unknown	Unknown	1.0

Species	Length Group (Snorkel)	Length (Electro)	Pass #	Age	Number Counted
	8<9"203<229mm		Unknown	Unknown	3.0
	9<10"229<254mm		Unknown	Unknown	3.0
	10<11"254<279mm		Unknown	Unknown	13.0
	11<12"279<305mm		Unknown	Unknown	4.0
	12<13"305<330mm		Unknown	Unknown	8.0
	13<14"330<356mm		Unknown	Unknown	3.0
	14<15"356<381mm		Unknown	Unknown	6.0
	15<16"381<406mm		Unknown	Unknown	7.0
Sculpin (Var. Species)		**Average: 0**		**Total:**	
	Unknown		Unknown	Unknown	
Steelhead (Snake River Basin)		**Average: 0**		**Total:**	56.0
	3<4"76<102mm		Unknown	Unknown	14.0
	4<5"102<127mm		Unknown	Unknown	19.0
	5<6"127<152mm		Unknown	Unknown	8.0
	6<7"152<178mm		Unknown	Unknown	10.0
	7<8"178<203mm		Unknown	Unknown	1.0
	8<9"203<229mm		Unknown	Unknown	4.0
Trout, Fry (Oncorhynchus var. species)		**Average: 0**		**Total:**	300.0
	Unknown		Unknown	Age 0	300.0

Created:	10/30/2005 12:00 AM	**Created by:**	
Survey Modified:	12/12/2008 10:11 AM	**Survey Modified by:**	IDFG\jdavis
Fish Data Modified:	3/18/2009 3:11 PM	**Fish Data Modified by:**	IDFG\jdavis

GENERAL NOTES

1) All structural steel shapes and plates shall conform to the requirements of AASHTO M270 Grade 50W. (ASTM A709 Grade 50W) Unless noted otherwise.

2) Steel decking shall be 4.25" deep by 12" lay length by 7 gauge "Type A" rolled formed galvanized corrugated steel conforming to ASTM A609 Grade 50. Steel decking shall be installed perpendicular to the direction of the supporting girders.

3) All structural steel connections shall be made with high strength bolts and washer conforming to AASHTO M164 (ASTM A325 Type 3).

4) Certified Mill Test Reports shall be furnished for the steel stringers, structural steel plates and shapes, steel bridge decking, high strength bolts, elastomeric pads and anchor bolts.

5) All Welding shall be in accordance with AWS D1.5. All electrodes shall be E70XX,

6) Expansion Bearing Pads shall be as specified on Drawing.

7) Exterior Surfaces shall be cleaned per SSPC SP7 prior to shipment to assure uniform weathering.

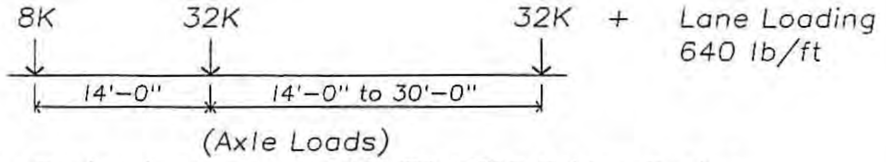
8) Bituminous or gravel wearing surface shall be compacted to a thickness of 3 inches above the corrugation at the crown of the roadway and tapered to 2 inch thickness at the edges.

△2

9) W-Beam guardrail shall be (2) Layers, 12 Ga. Weathering Steel (Typical) w/ Reflector Tabs (2-Sided Crystal) @ Alternate Posts Per AASHTO M180

DESIGN NOTES

1. Design live load: HL93

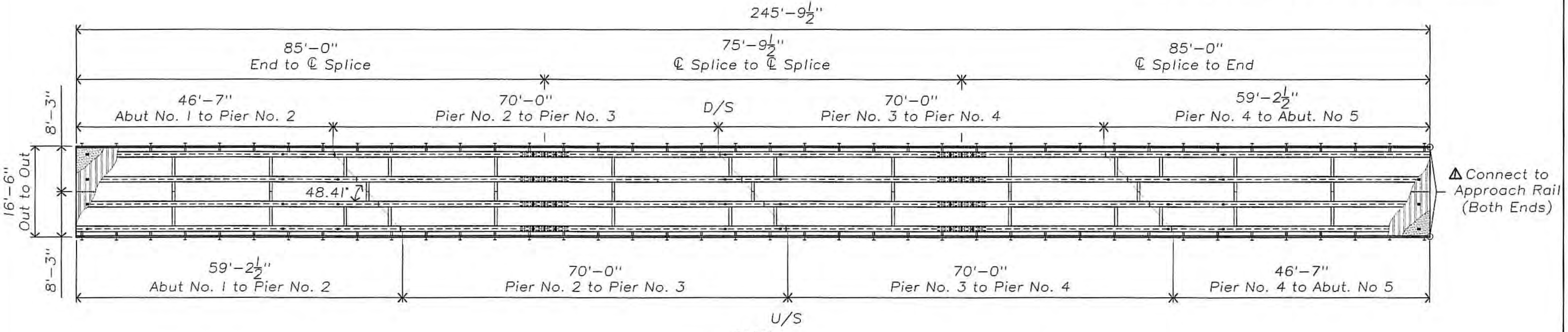


(Axle Loads)

2. Design is based on AASHTO LFRD Bridge Design Specifications 4th Edition, 2007 & Interim's

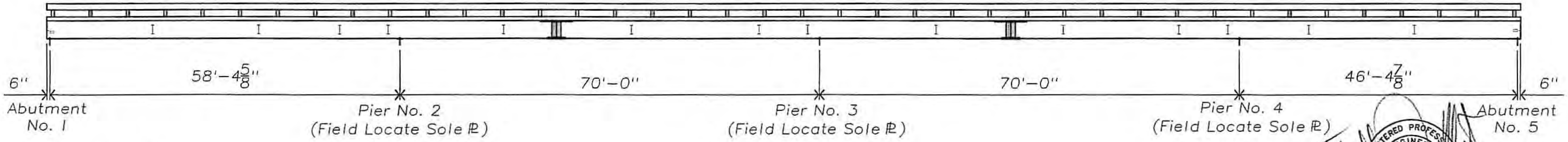
3. Live Load Deflection Span 2 & 3 is 1.05" = L/800

4. Bridge Weight: Approx. 111.72 Tons
   Approx. 18.62 Tons per Module (6 Modules)
   (Bridge Weight Does Not Include Wearing Surface)



PLAN

Not to Scale



U/S Elevation

Not to Scale

△1 LEGEND

Expansion Bearing	E
Fixed Bearing	F
Down Stream	D/S
Up Stream	U/S

△2

S/N 245MB16HL93-20001-01

3055
FRANKLIN R. MUTH
3/23/09

ROSCOE BRIDGE

C.L Heilman
245'-9 1/2" Length x 16'-0" Width
East Fork of the South Fork
of the Salmon River

MUTH
CONSULTING ENGINEERS
MISSOULA, MONTANA

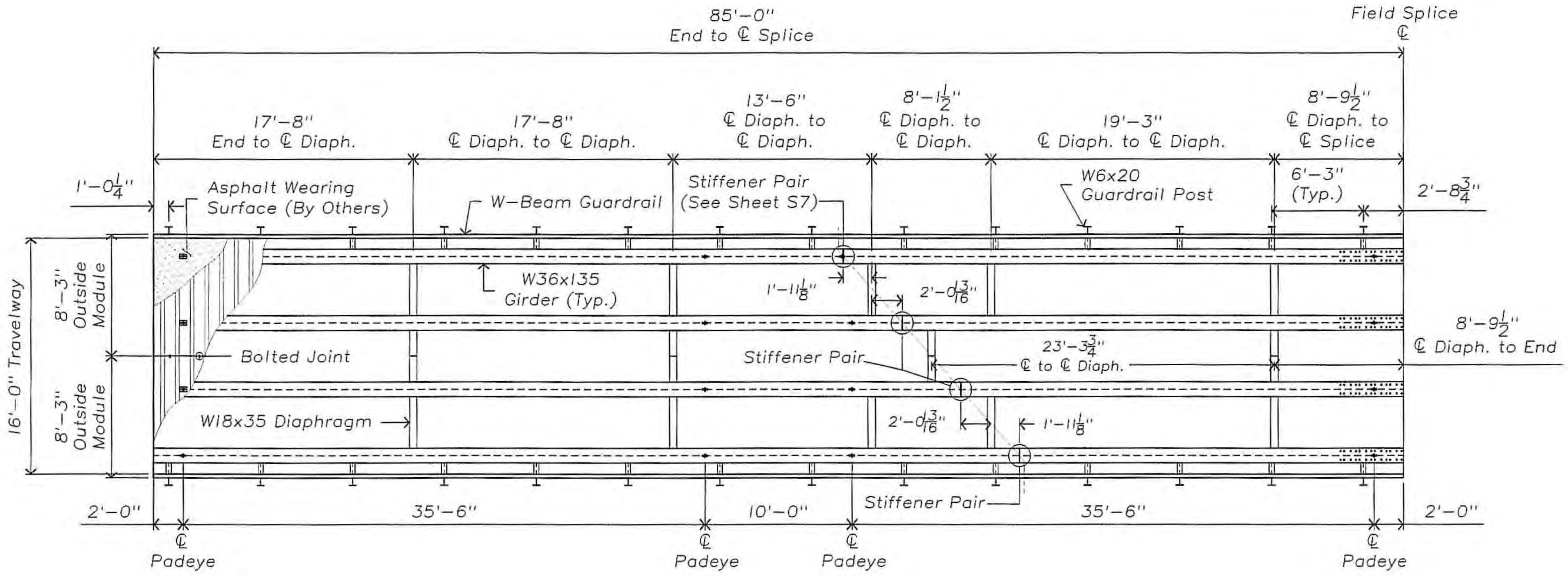
△1 Date 01.25.09 Revised Add Legend
△2 Date 03.13.09 Revised Approach Rail/Guard Rail/Job No.

Engineers' Project No. : 08-M-303 Sheet S1 of S11

Designed : TWS
Drawn : IML
Checked : FRM
Approved :

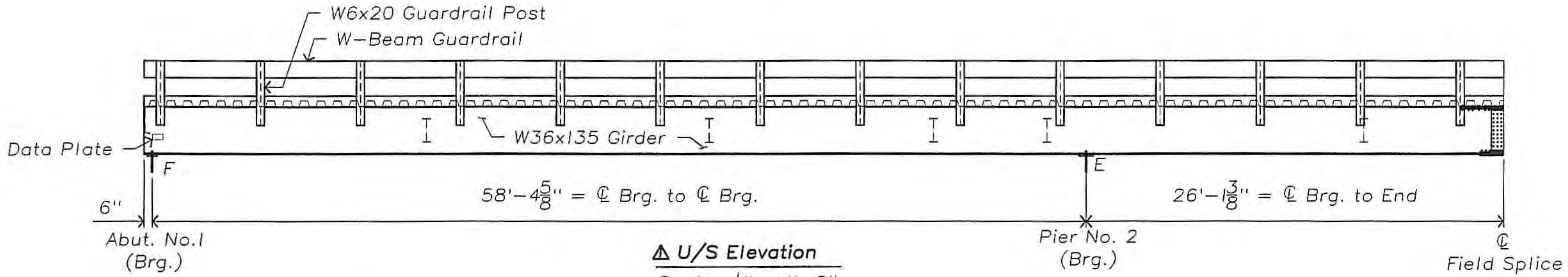
Sheet Title :
GENERAL LAYOUT

Plot Date: 3/23/2009



△ PLAN

Scale : ⅛" = 1'-0"



△ U/S Elevation

Scale : ⅛" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER
3055
STATE OF IDAHO
FRANKLIN R. MUTH

3/23/09

MUTH
CONSULTING ENGINEERS
MISSOULA, MONTANA

ROSCOE BRIDGE

S/N 245MB16HL93-20001-01

C.L Heilman
245'-9 1/2" Length x 16'-0" Width
East Fork of the South Fork
of the Salmon River

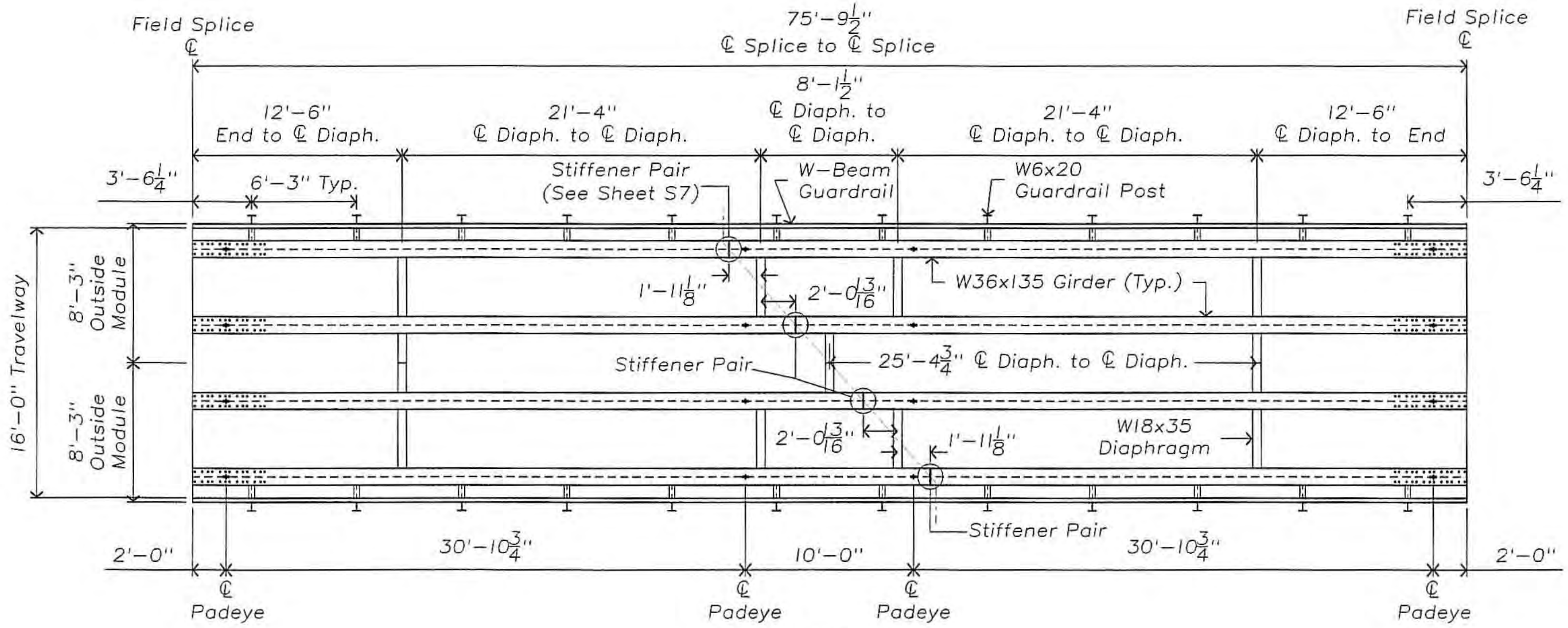
△ Date 03.13.09 Revised Diaph / Brg Location
△ Date ______ Revised ______

Engineers' Project No. : 08-M-303
Sheet S2 of S11

Designed : TWS
Drawn : IML
Checked : FRM
Approved :

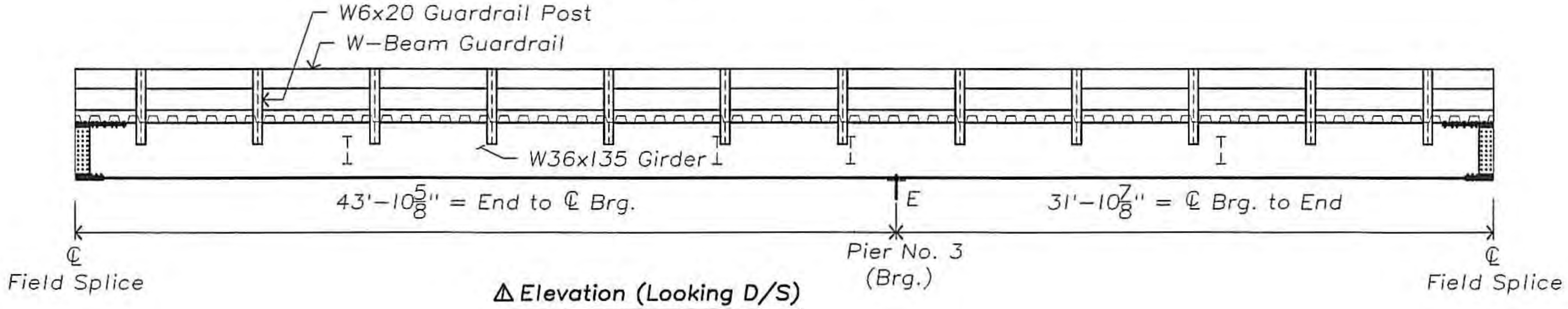
Sheet Title :
GENERAL LAYOUT
SECTION I

Plot Date: 3/23/2009



△ PLAN

Scale : ⅛" = 1'−0"



△ Elevation (Looking D/S)

Scale : ⅛" = 1'−0"

13055
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3/23/09

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MISSOULA, MONTANA

ROSCOE BRIDGE

S/N 245MB16HL93-20001-01

C.L Heilman
245'−9 1/2" Length x 16'−0" Width
East Fork of the South Fork
of the Salmon River

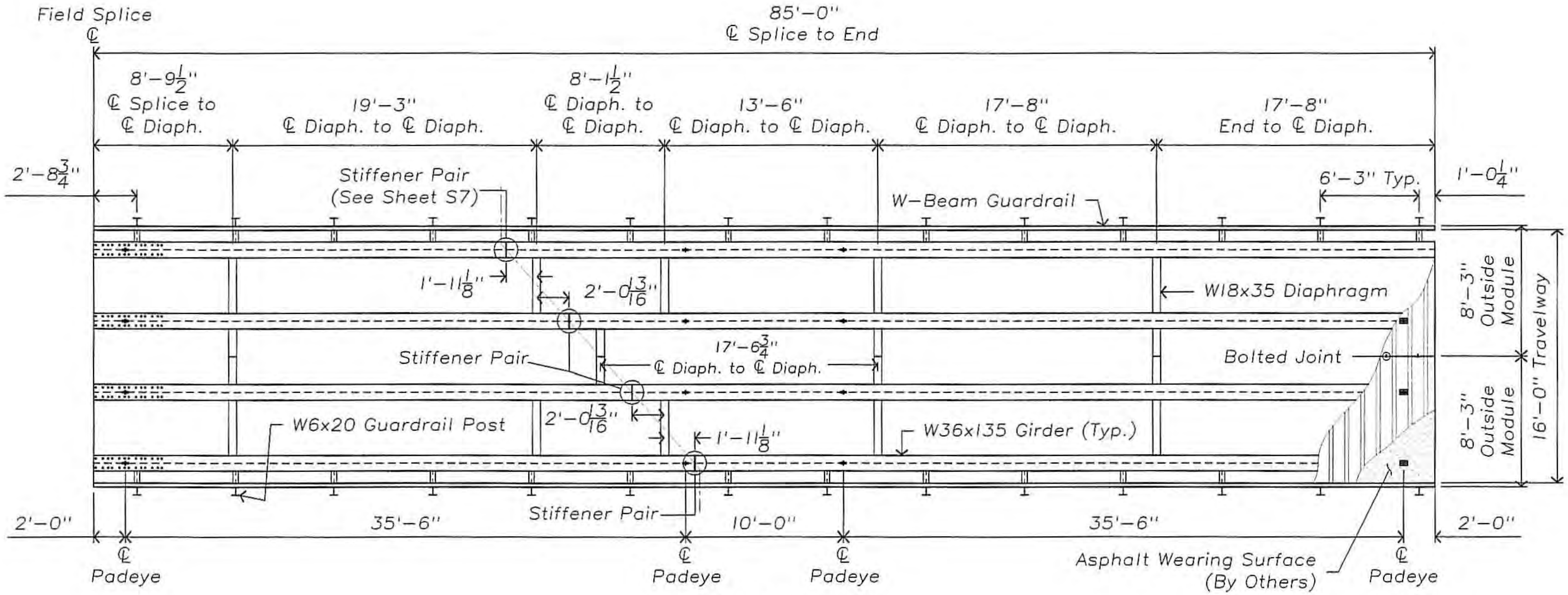
△ Date 03.13.09 Revised Diaph / Brg Location
△ Date ________ Revised ________

Engineers' Project No. : 08−M−303 | Sheet S3 of S11

Designed : TWS
Drawn : IML
Checked : FRM
Approved :

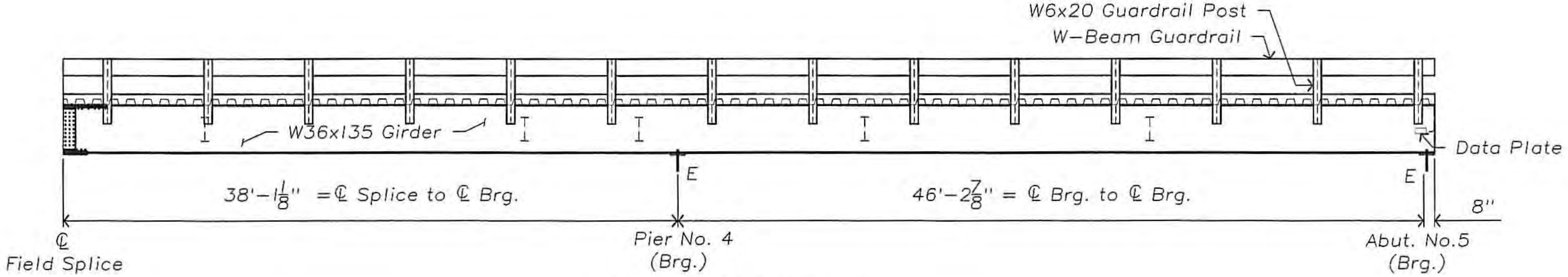
Sheet Title :
GENERAL LAYOUT
SECTION 2

Plot Date: 3/23/2009



△2 △1 PLAN

Scale : ⅛" = 1'–0"



△2 Elevation (Looking D/S)

Scale : ⅛" = 1'–0"

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3/23/09

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MISSOULA, MONTANA

ROSCOE BRIDGE

S/N 245MB16HL93-20001-01

C.L Heilman
245'–9 1/2" Length x 16'–0" Width
East Fork of the South Fork
of the Salmon River

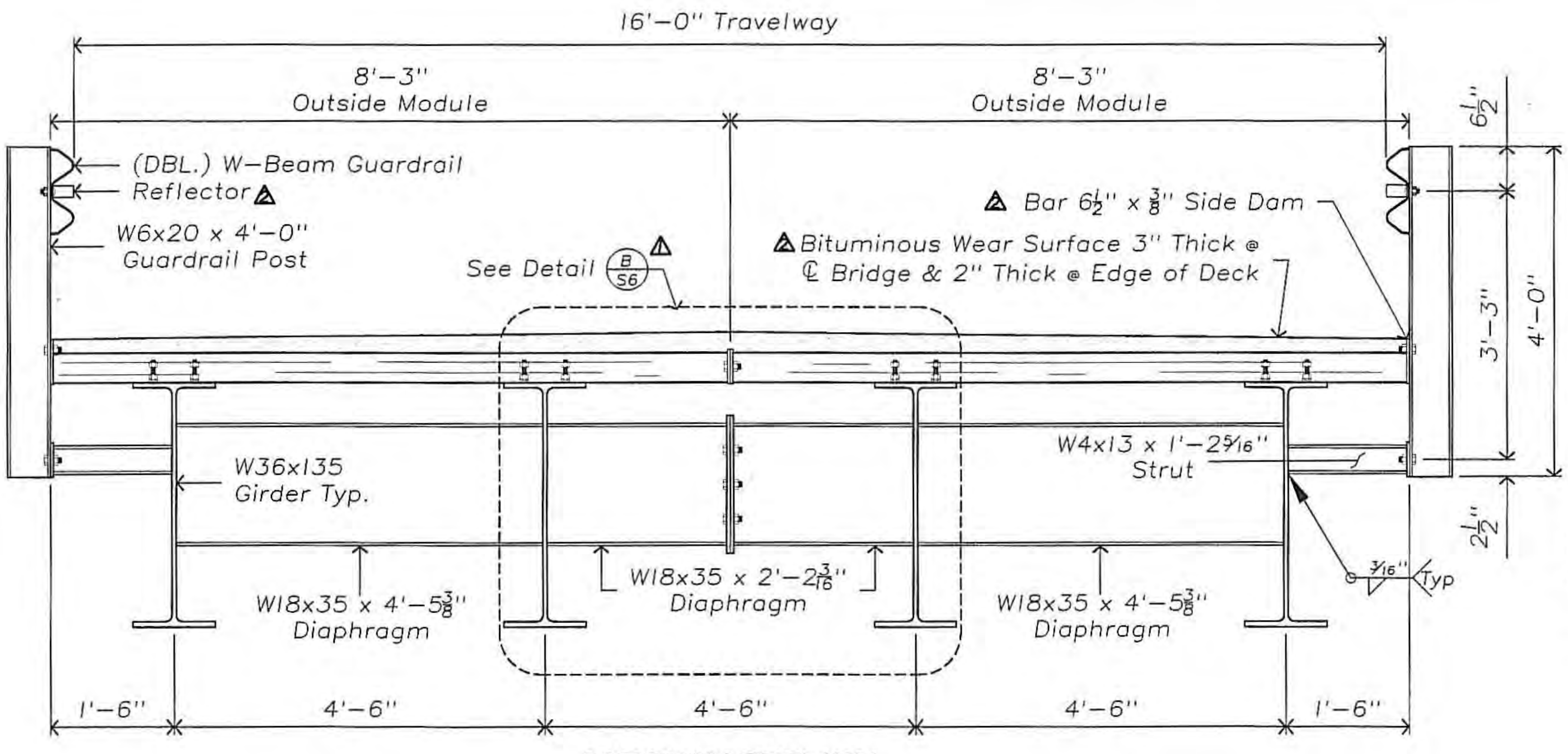
△1 Date 01.25.09 Revised Update Dimensions
△2 Date 03.13.09 Revised Diaph / Brg Location / Guardrail

Engineers' Project No. : 08–M–303 Sheet S4 of S11

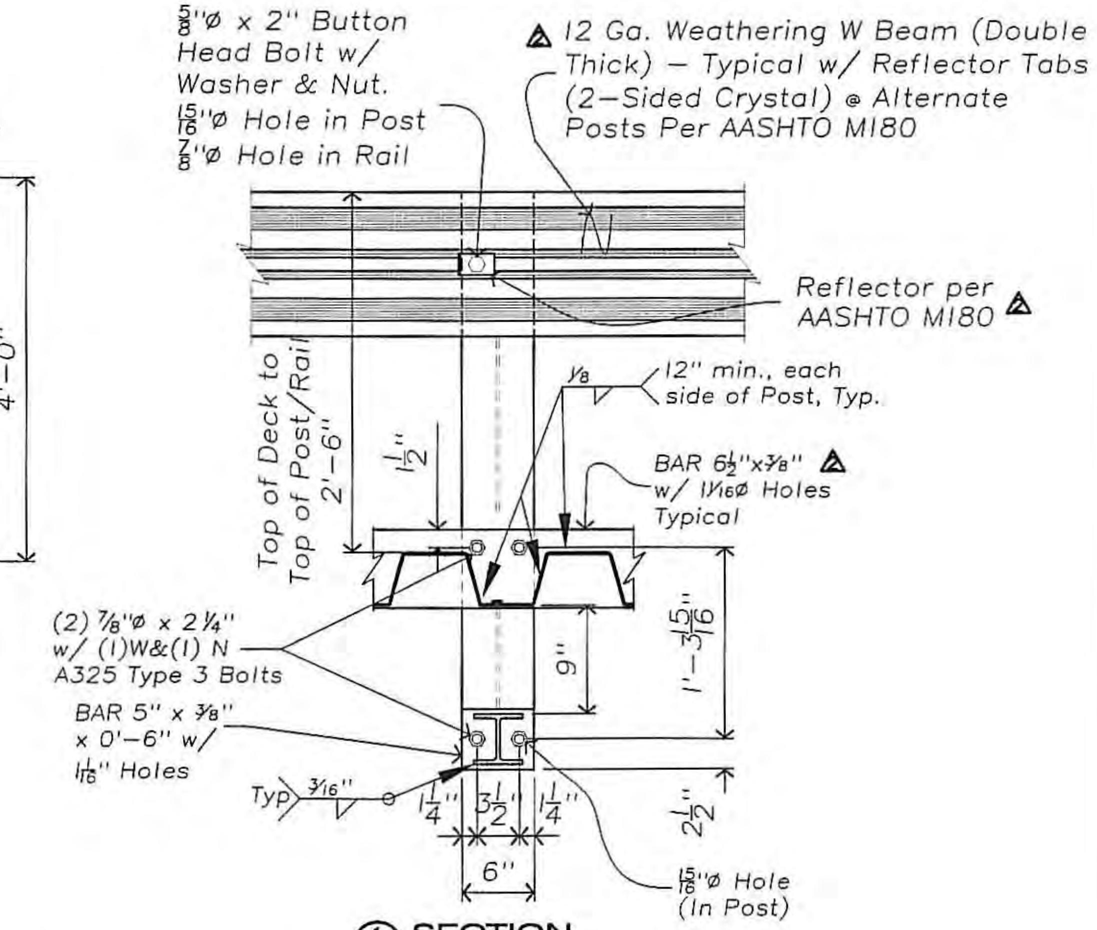
Designed : TWS
Drawn : IML
Checked : FRM
Approved :

Sheet Title :
GENERAL LAYOUT
SECTION 3

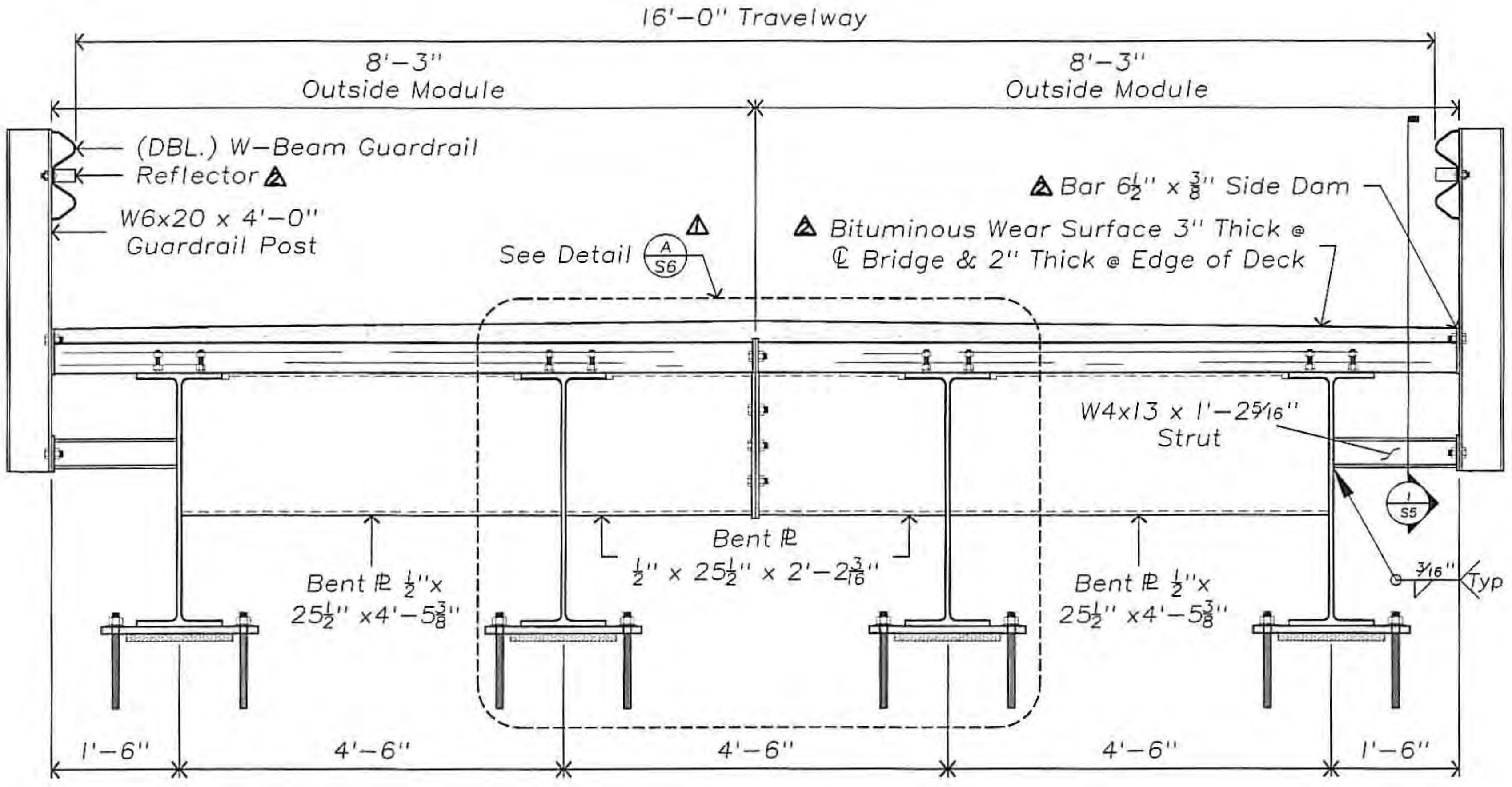
Plot Date: 3/23/2009



MIDSPAN SECTION
Scale: ½" = 1'–0"



① SECTION (S5)
Scale: ¾" = 1'–0"



END SECTION
Scale: ½" = 1'–0"

⚠ Expansion Bearing Detail

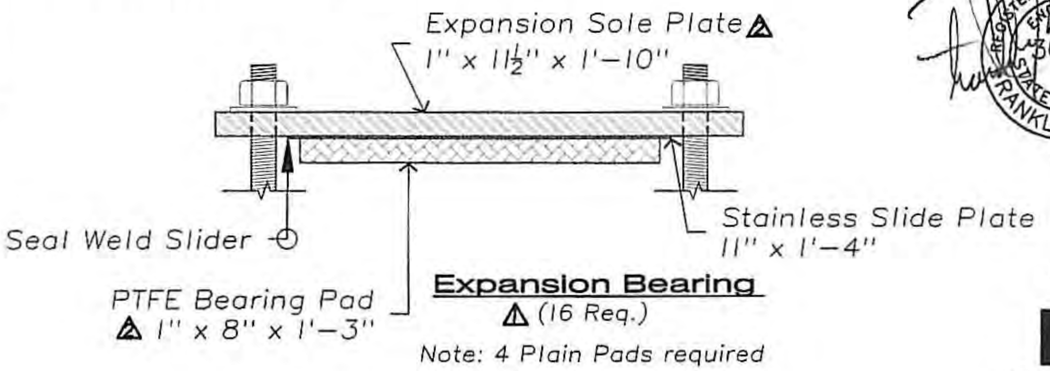
S.S Side Plate: 14 ga. (0.078") x 11" x 1'–4", ASTM A–240, Type 304, max 10 microinch RMS Finish. (Seal Weld to Sole ℙ)

PTFE: $\frac{3}{32}$" Virgin, unfilled per ASTM D–1457–88

S.S Perforated Substrate: 0.06 ASTM A–240, type 304, perforated $\frac{3}{32}$"ø, $\frac{3}{16}$"o/c, 23% open area.

Epoxy: Per Mil A 81236 (OS)

Fabric Pad: 1"x8"x1'–3", ALERT 15175, Per AASHTO 14ed., Div.2 Bearing Pad (Same dimensions for Fixed Pad).



Expansion Bearing
⚠ (16 Req.)

Note: 4 Plain Pads required

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S/N 245MB16HL93-20001-01

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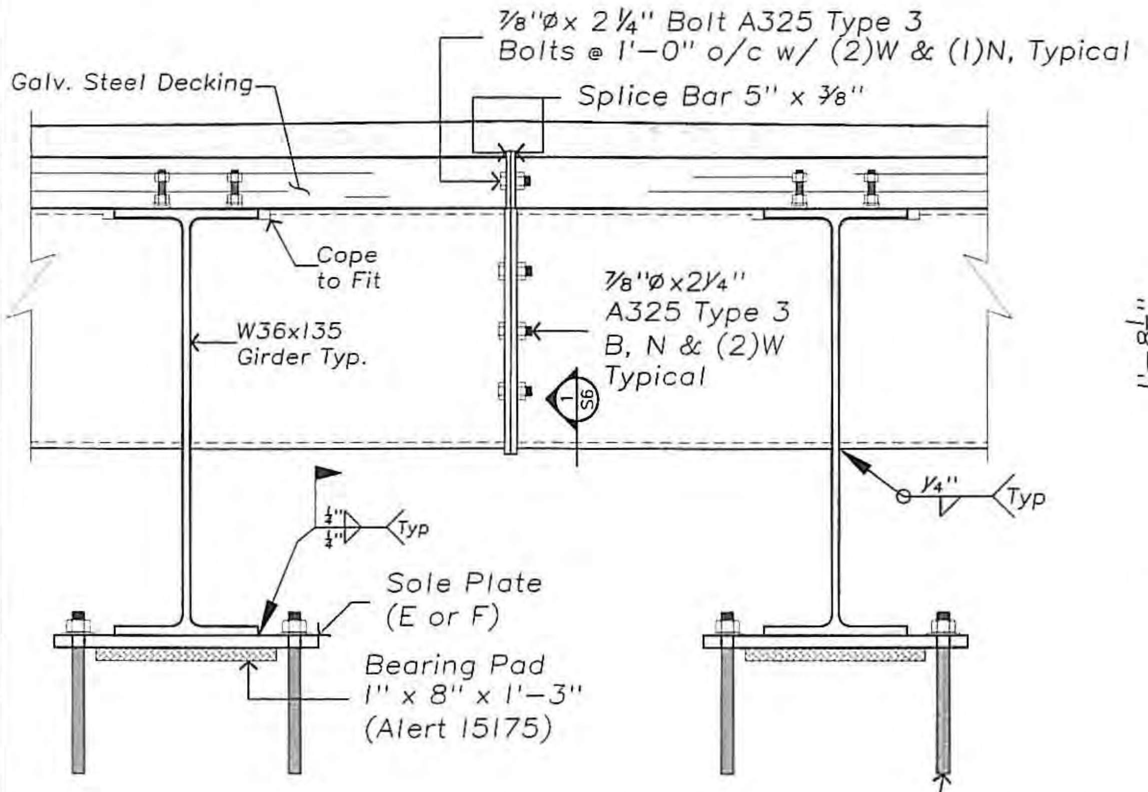
MISSOULA, MONTANA

ROSCOE BRIDGE

C.L Heilman 245'–9 1/2" Length x 16'–0" Width East Fork of the South Fork of the Salmon River	⚠ Date 01.25.09 Revised Callouts / Plate QTY. ⚠ Date 03.13.09 Revised Reflector / Side Dam / Notes Engineers' Project No. : 08–M–303 Sheet S5 of S11 Designed : TWS Drawn : IML Checked : FRM Approved : Sheet Title : SECTIONS

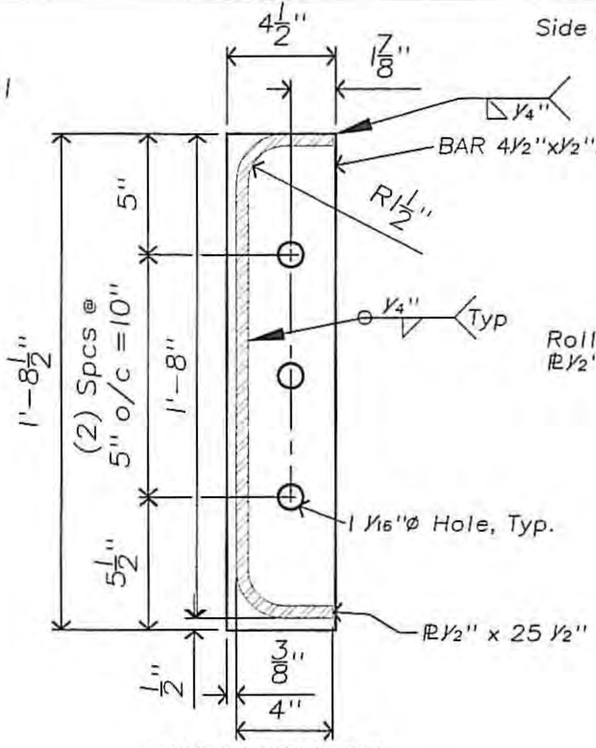
Plot Date: 3/23/2009



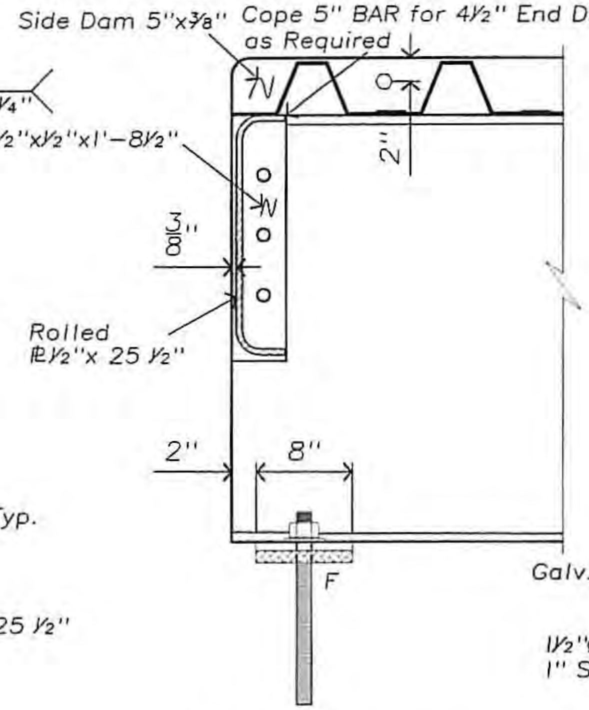
Note: All deck, railing and diaphragm connections shall utilize 1 1/16"Ø oversized holes

1 1/4"Øx16" Anchor Bolts w/ Nuts & Washers
All Thread Rod – A36 Galv.
Set 12" into Masonry
Typical (Leave Nut 1/8" High)

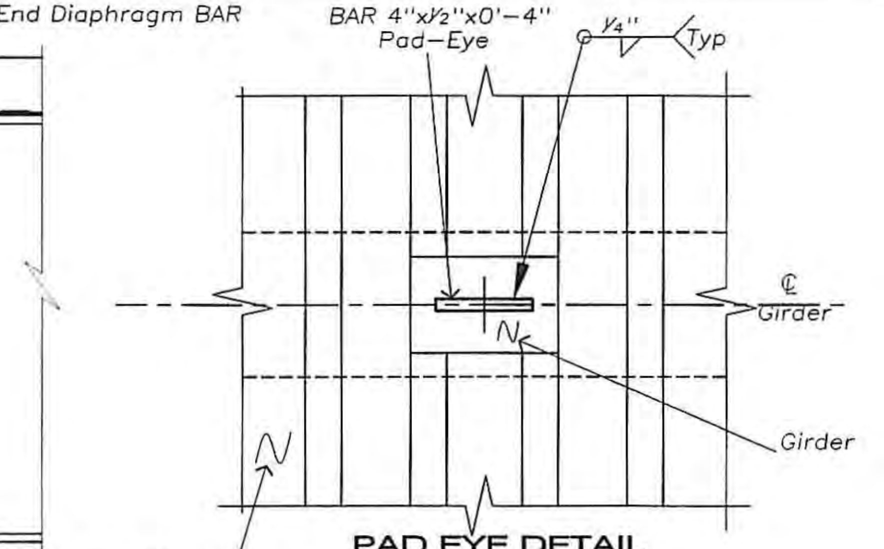
(A/S6) DETAIL @ End Diaphragm
Scale: 3/4"=1'-0"



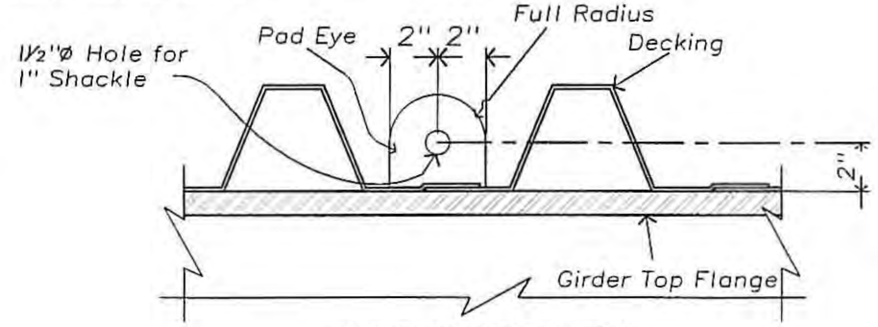
BENT PLATE DETAIL



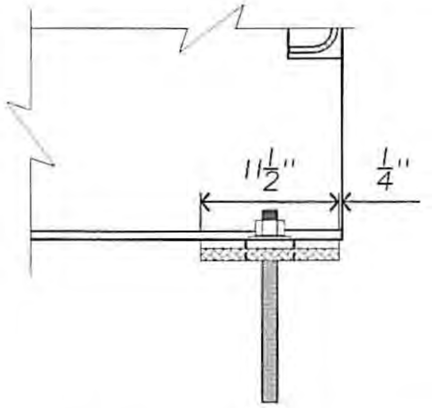
(1/S6) SECTION
Scale: 3/4"=1'-0"



PAD EYE DETAIL
Scale: 1 1/2"=1'-0"

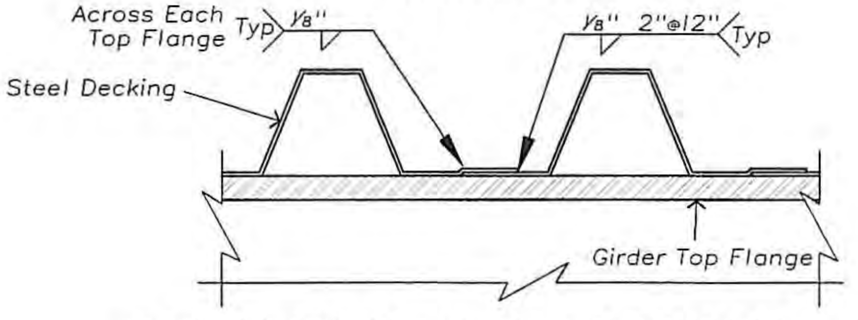


PAD-EYE DETAIL
Scale: 1 1/2"=1'-0"

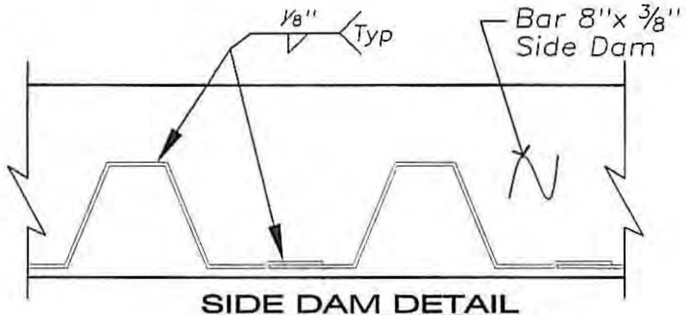


Abut. No.5 Bearing
Scale: 3/4"=1'-0"

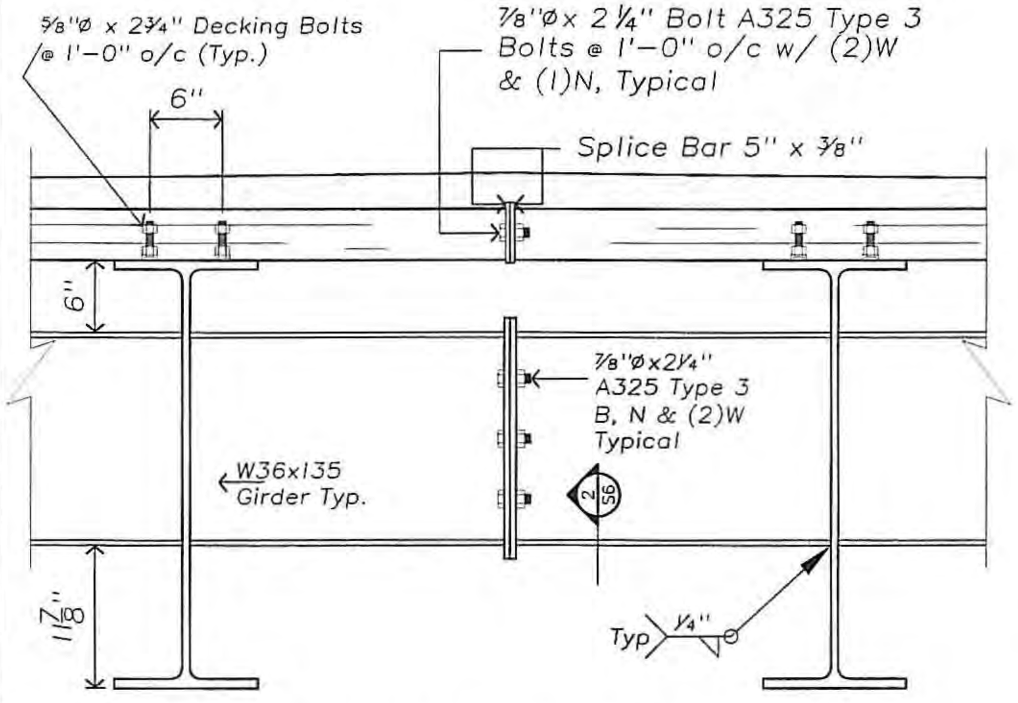
Note:
Shop weld abutment sole ℞'s, all other sole ℞'s to be field welded.



TOP. SECTION - Decking to Girder Conn.
Scale: 1 1/2"=1'-0"

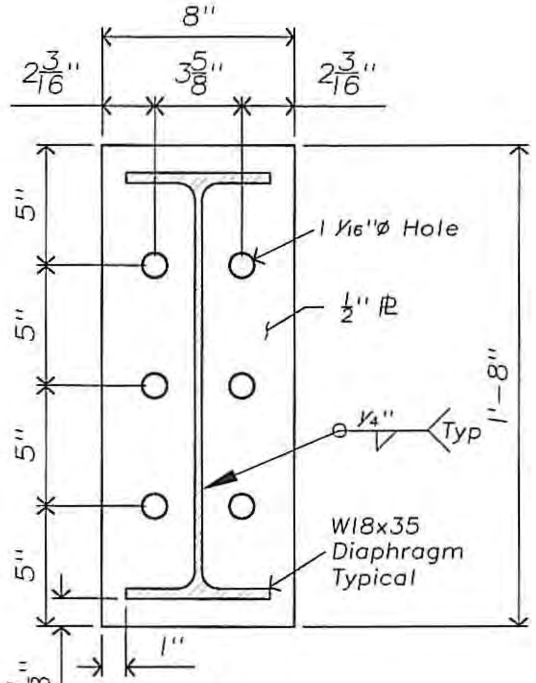


SIDE DAM DETAIL
Scale: 1 1/2"=1'-0"



Note: All deck, railing and diaphragm connections shall utilize 1 1/16"Ø oversized holes

(B/S6) DETAIL @ Midspan Diaphragm
Scale: 3/4"=1'-0"



(2/S6) SECTION
Scale: 1 1/2"=1'-0"

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3/23/09

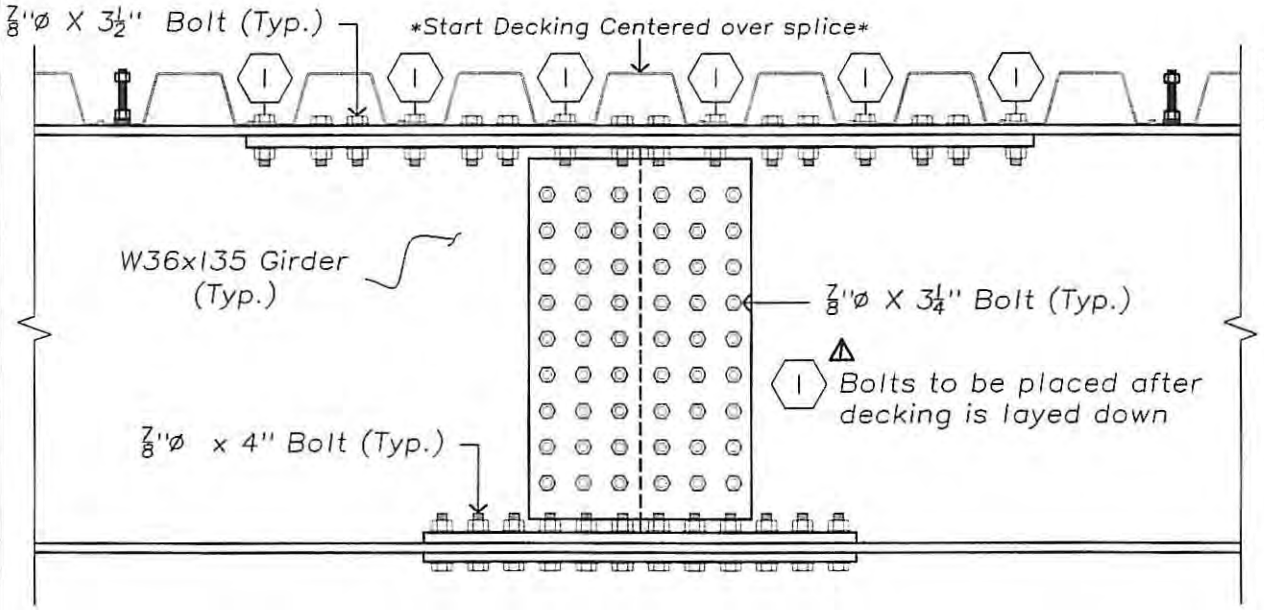
S/N 245MB16HL93-20001-01

ROSCOE BRIDGE

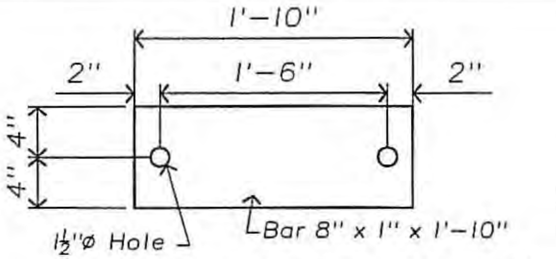
MUTH CONSULTING ENGINEERS
MISSOULA, MONTANA

⚠1 Date 01.25.09 Revised Plate QTY.	
⚠2 Date 03.13.09 Revised Expansion Plate	
C.L Heilman 245'-9 1/2" Length x 16'-0" Width East Fork of the South Fork of the Salmon River	Engineers' Project No. : 08-M-303 Sheet S6 of S11
Designed : TWS Drawn : IML Checked : FRM Approved :	Sheet Title : DETAILS

Plot Date: 3/23/2009

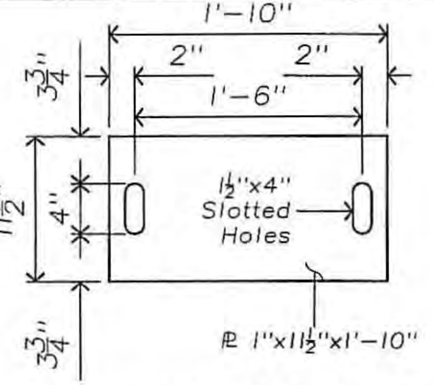


ELEVATION



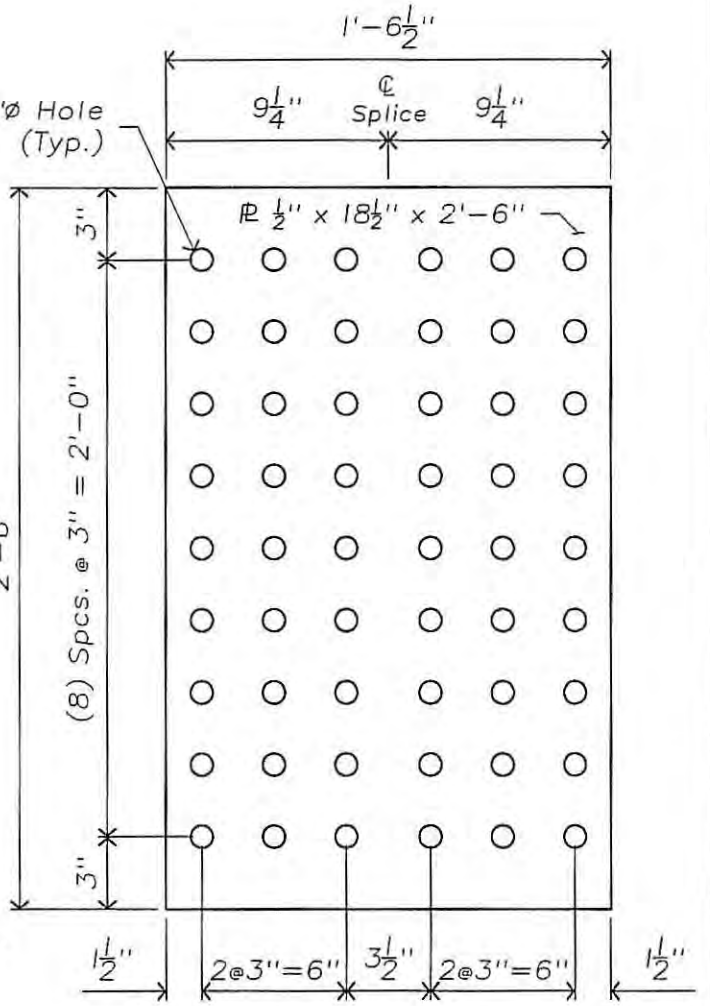
Fixed SOLE PLATE DETAIL

⚠ (4 Req.)



EXPANSION SOLE PLATE

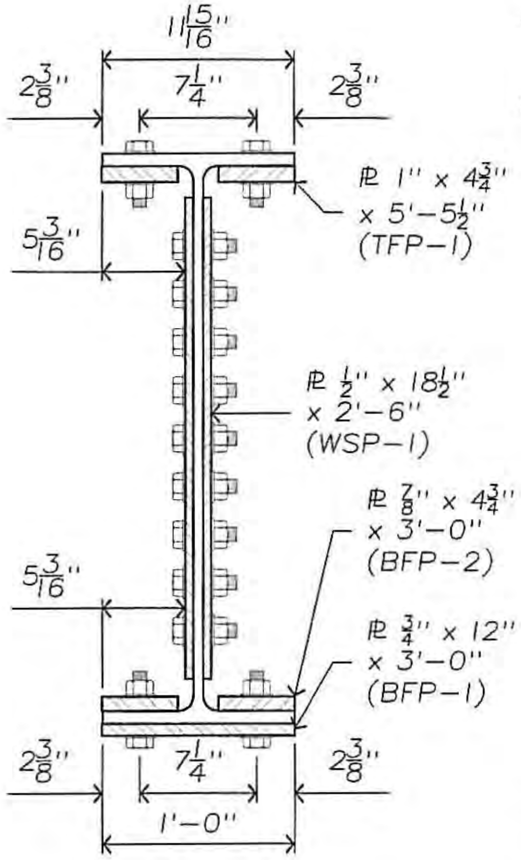
⚠ ⚠ (16 Req.)



WEB SPLICE PLATE (WSP-1)

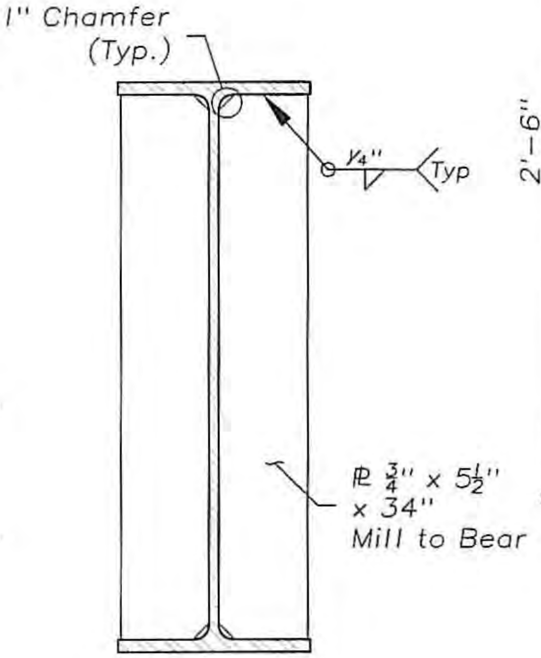
Scale: 1" = 1'-0"

(16 Req.)



SECTION

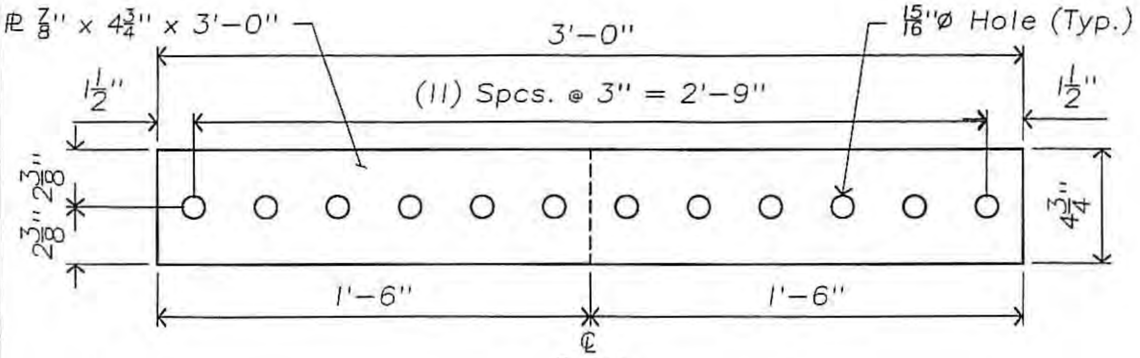
Scale: 1" = 1'-0"



BEARING STIFFENER

Scale: 1" = 1'-0"

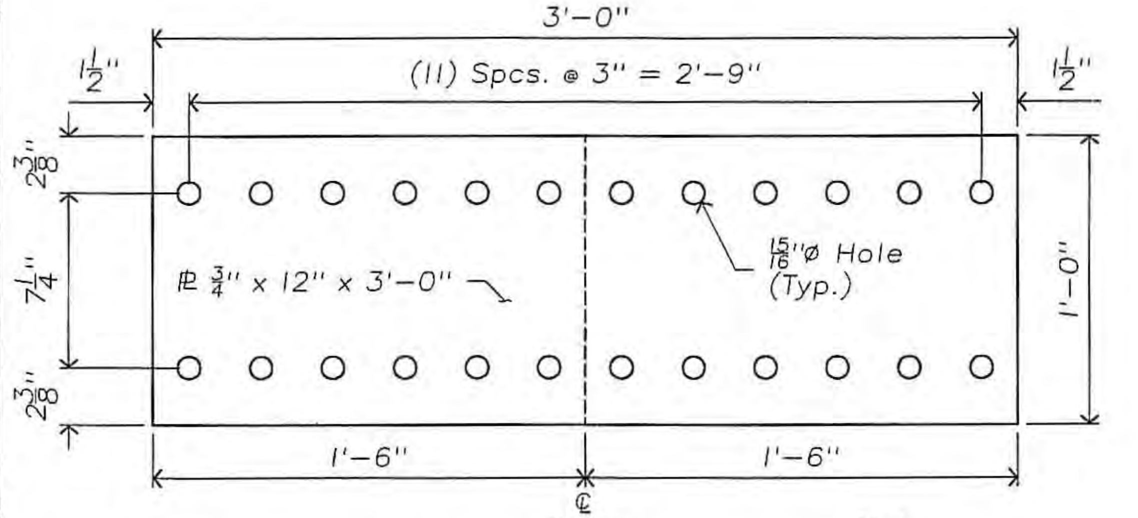
(24 Req.)



BOTTOM FLANGE SPLICE PLATE INSIDE (BFP-2)

Scale: 1" = 1'-0"

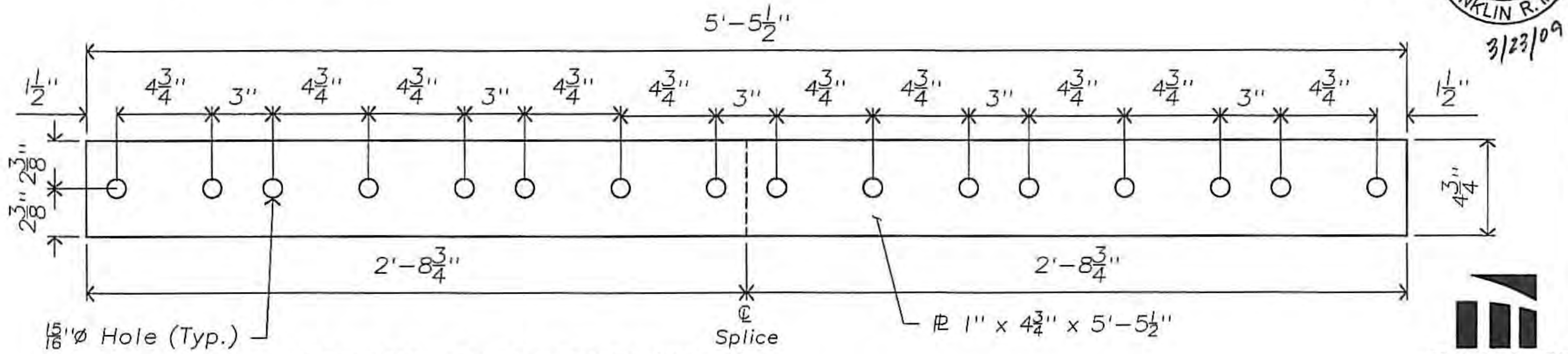
(16 Req.)



BOTTOM FLANGE SPLICE PLATE OUTSIDE (BFP-1)

Scale: 1" = 1'-0"

(8 Req.)



TOP FLANGE SPLICE PLATE (TFP-1)

Scale: 1" = 1'-0"

(16 Req.)

Note:
All splice bolts shall conform to the requirements of ASTM A325 (Type 3) w/ 1 Wash, 1 DTI Wash, & Nut unless otherwise noted

S/N 245MB16HL93-20001-01

3055
FRANKLIN R. MUTH
3/23/09

Plot Date: 3/23/2009

ROSCOE BRIDGE

C.L Heilman
245'-9 1/2" Length x 16'-0" Width
East Fork of the South Fork
of the Salmon River

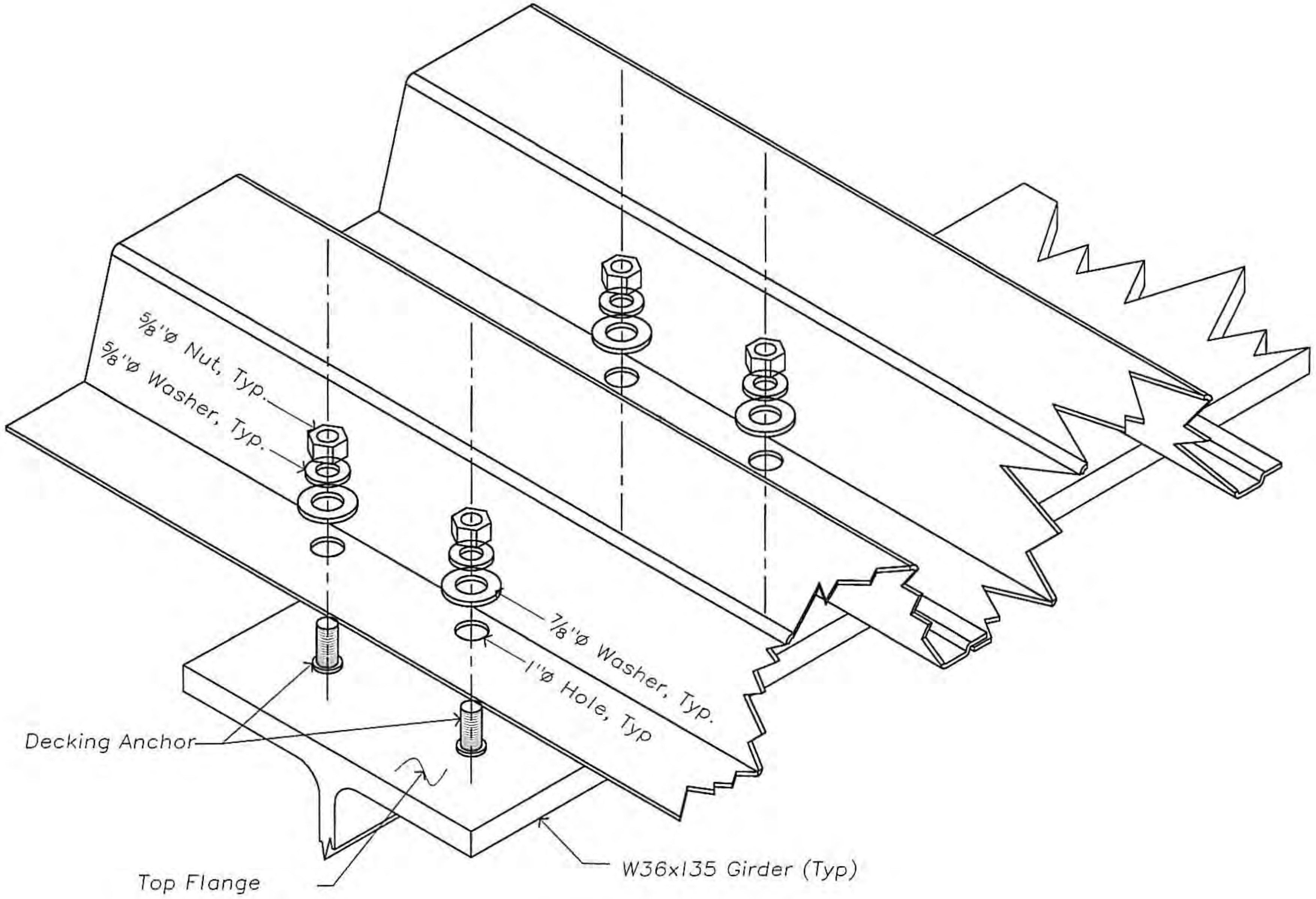
MUTH CONSULTING ENGINEERS
MISSOULA, MONTANA

⚠ Date 01.25.09 Revised Add Note
△ Date ________ Revised ________

Engineers' Project No. : 08-M-303
Sheet S7 of S11

Designed : TWS
Drawn : IML
Checked : FRM
Approved :

Sheet Title :
SPLICE DETAILS



Decking Attachment Detail

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3/23/09

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CONSULTING ENGINEERS
MISSOULA, MONTANA

△ Date_________Revised____________________
△ Date_________Revised____________________

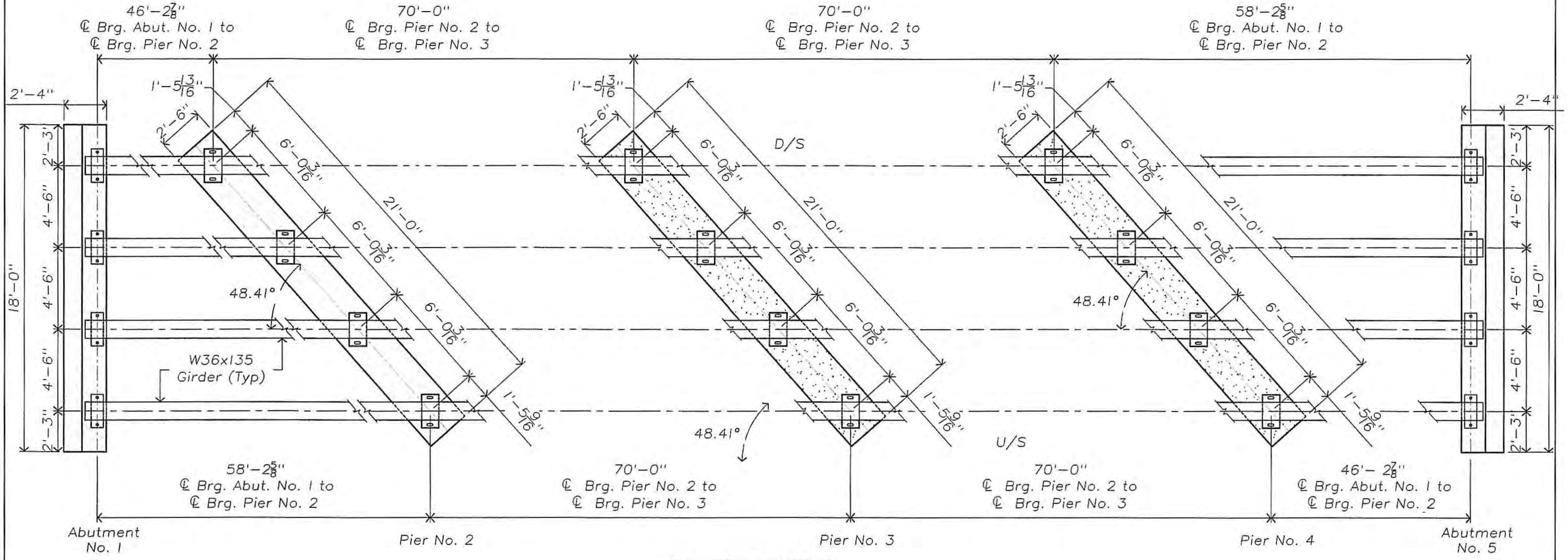
C.L Heilman
245'-9 1/2" Length x 16'-0" Width
East Fork of the South Fork
of the Salmon River

Engineers' Project No. : 08-M-303
Sheet S8 of S11

Designed : TWS
Drawn : IML
Checked : FRM
Approved :

Sheet Title :
DECKING DETAIL

Plot Date: 3/23/2009



BEARING LAYOUT

3055
FRANKLIN R. MUTH
3/23/09

MUTH
CONSULTING ENGINEERS
MISSOULA, MONTANA

△ Date________Revised________
△ Date________Revised________

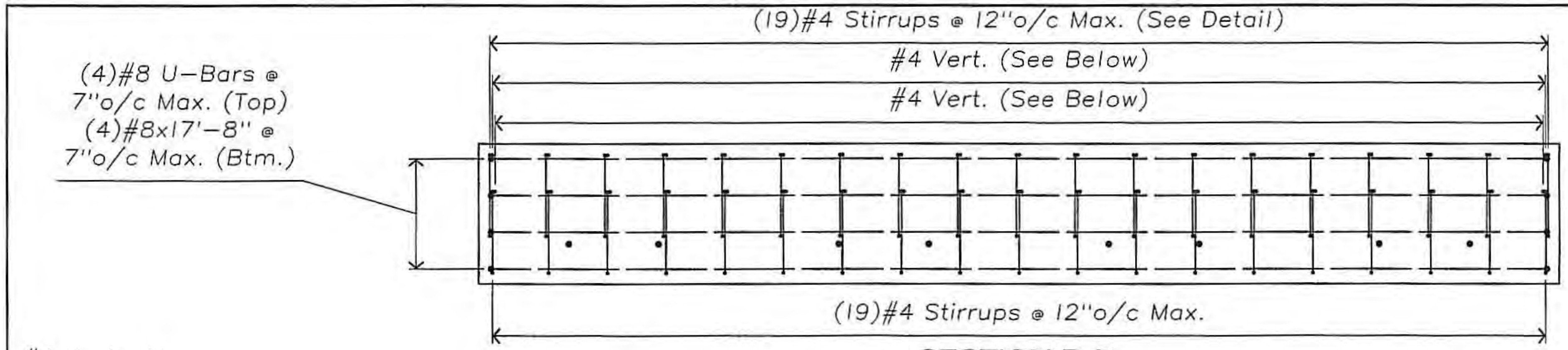
C.L Heilman
245'–9 1/2" Length x 16'–0" Width
East Fork of the South Fork
of the Salmon River

Engineers' Project No. : 08–M–303 Sheet S9 of S11

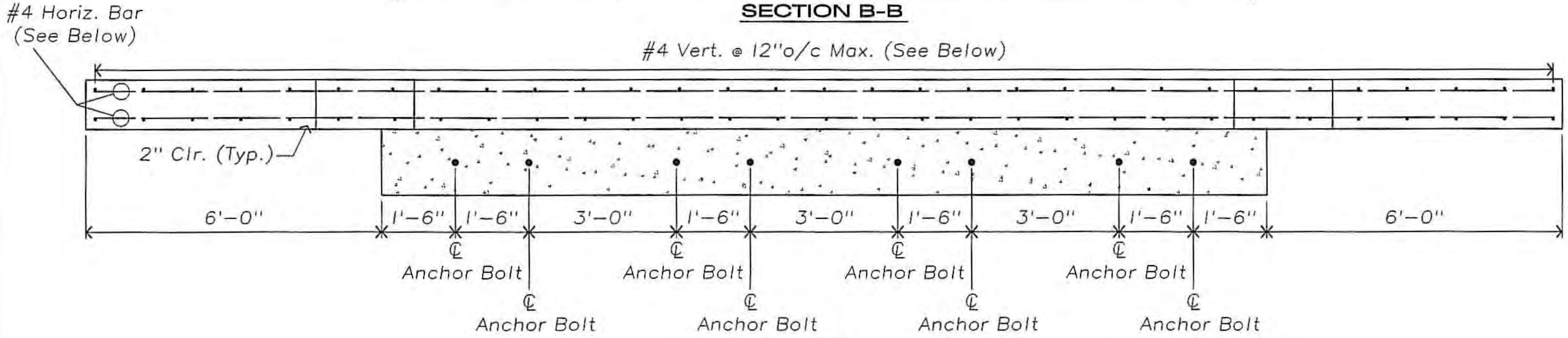
Designed : TWS
Drawn : IML
Checked : FRM
Approved :

Sheet Title :
Bearing Layout

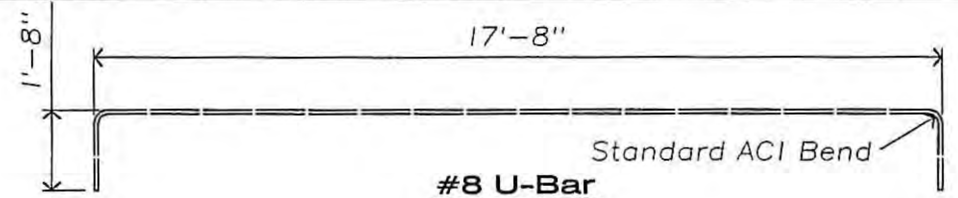
Plot Date: 3/23/2009



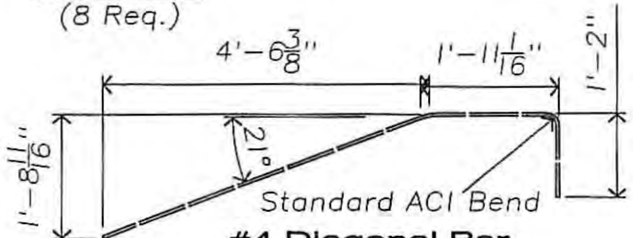
SECTION B-B



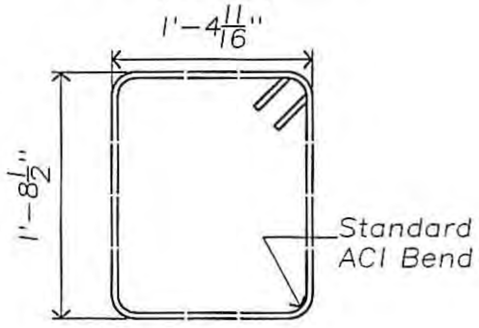
SECTION A-A



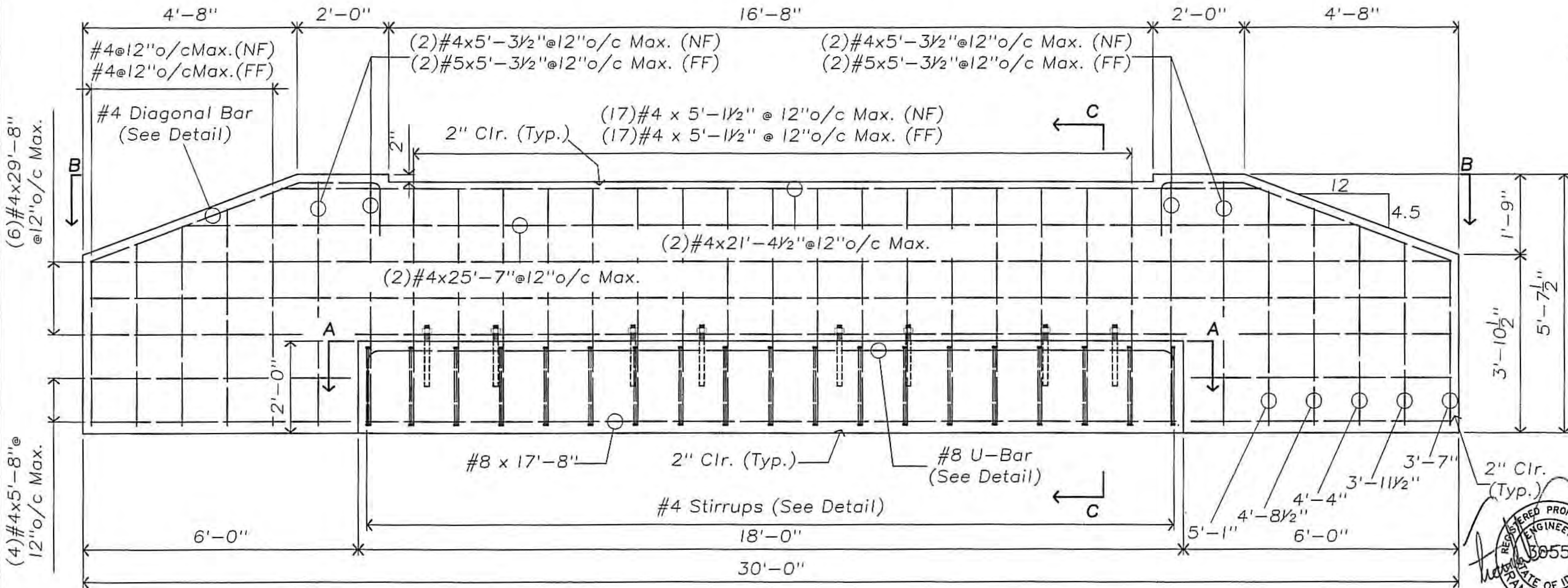
#8 U-Bar
(8 Req.)



#4 Diagonal Bar
(8 Req.)

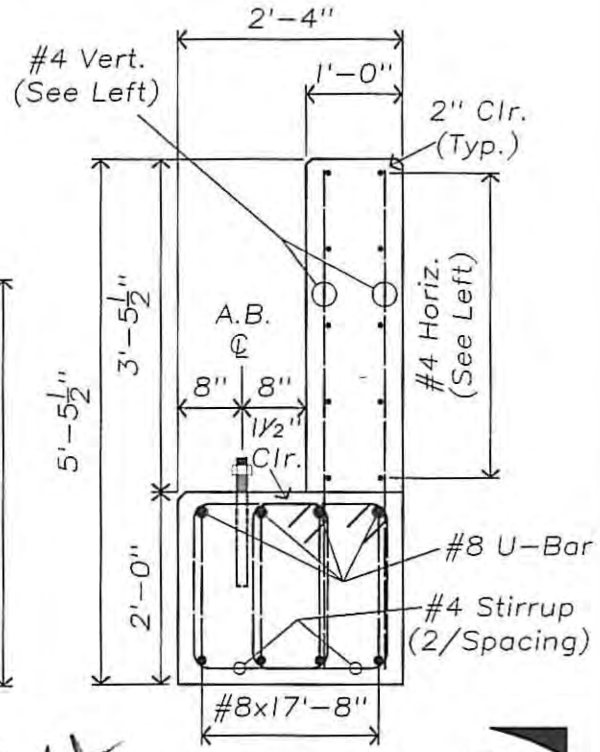


#4 Stirrup
(76 Req.)



TYPICAL ABUTMENT ELEVATION

Scale: ⅜" = 1'-0"



SECTION C-C

Note:
Backwall steel as per original design.
NF – Near Face
FF – Far Face

Plot Date: 3/23/2009

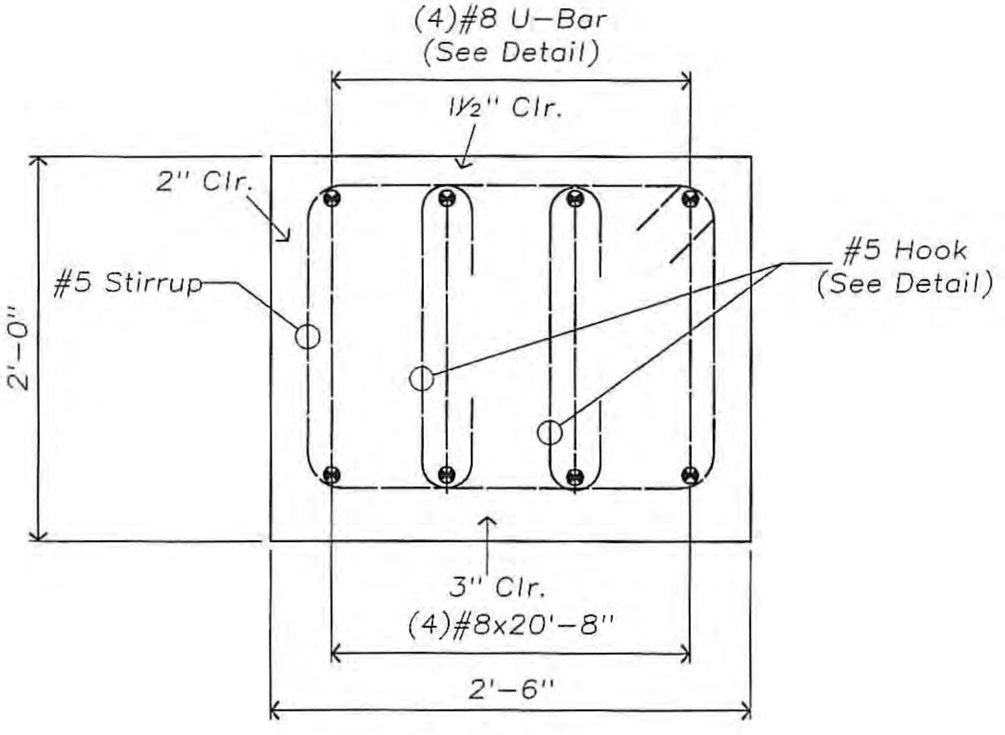
3055
FRANKLIN R. MUTH
3/23/09

MUTH
CONSULTING ENGINEERS
MISSOULA, MONTANA

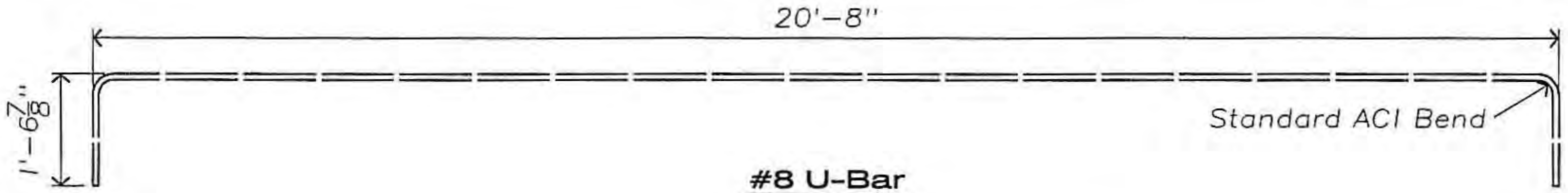
△ Date________Revised________
△ Date________Revised________

C.L Heilman
245'-9 1/2" Length x 16'-0" Width
East Fork of the South Fork
of the Salmon River

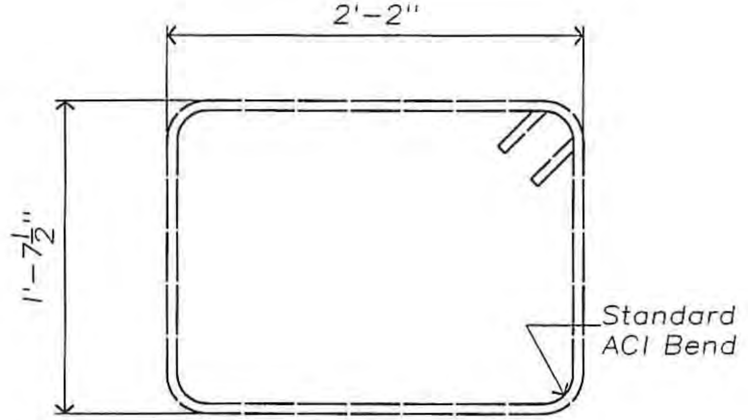
Engineers' Project No. : 08-M-303 Sheet S10 of S11
Designed : TWS
Drawn : IML
Checked : FRM
Approved :
Sheet Title : Abutment Detail



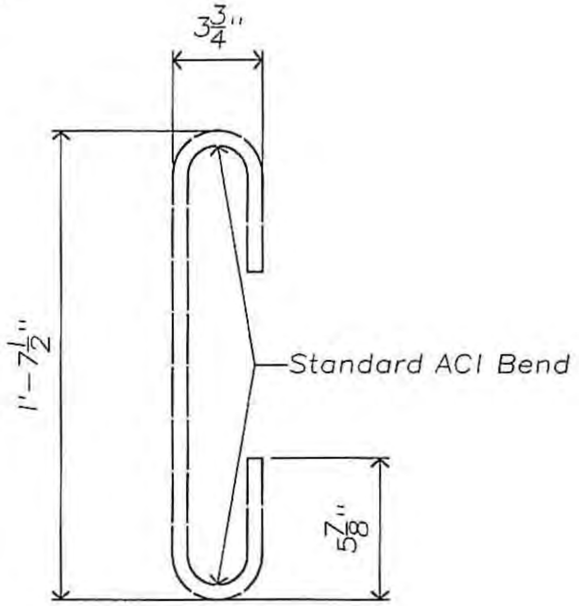
SECTION



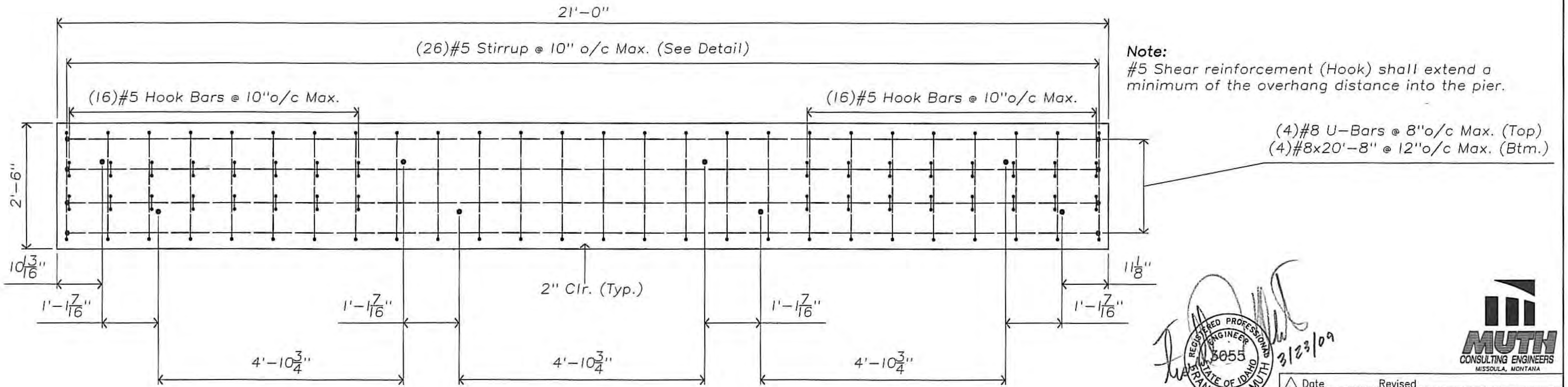
#8 U-Bar
(12 Req.)



#5 Stirrup
(78 Req.)



#5 Hook
(96 Req.)



TYPICAL PIER PLAN
Scale: ½ " = 1'-0"

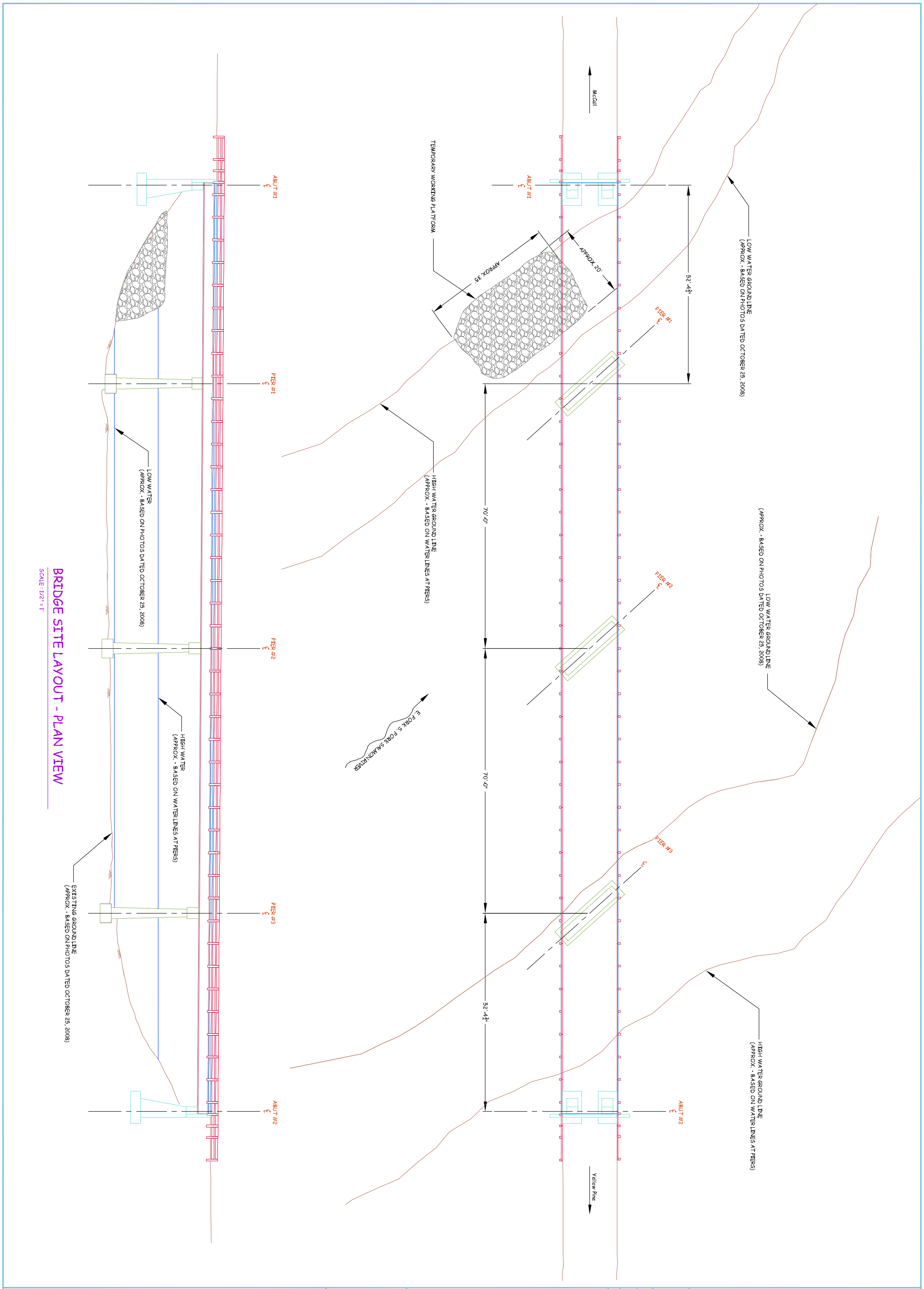
Note:
#5 Shear reinforcement (Hook) shall extend a minimum of the overhang distance into the pier.

FRANKLIN R. MUTH 3055
3/23/09

MUTH
CONSULTING ENGINEERS
MISSOULA, MONTANA

△ Date_______Revised_______	
△ Date_______Revised_______	
C.L Heilman 245'-9 1/2" Length x 16'-0" Width East Fork of the South Fork of the Salmon River	Engineers' Project No. : 08-M-303 Sheet S11 of S11 Designed : TWS Drawn : IML Checked : FRM Approved : Sheet Title : Pier Detail

Plot Date: 3/23/2009



CONSTRUCTION RIP RAP PLATFORM - McCALL SIDE
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 1 OF 1		PROJECT NUMBER	N/A

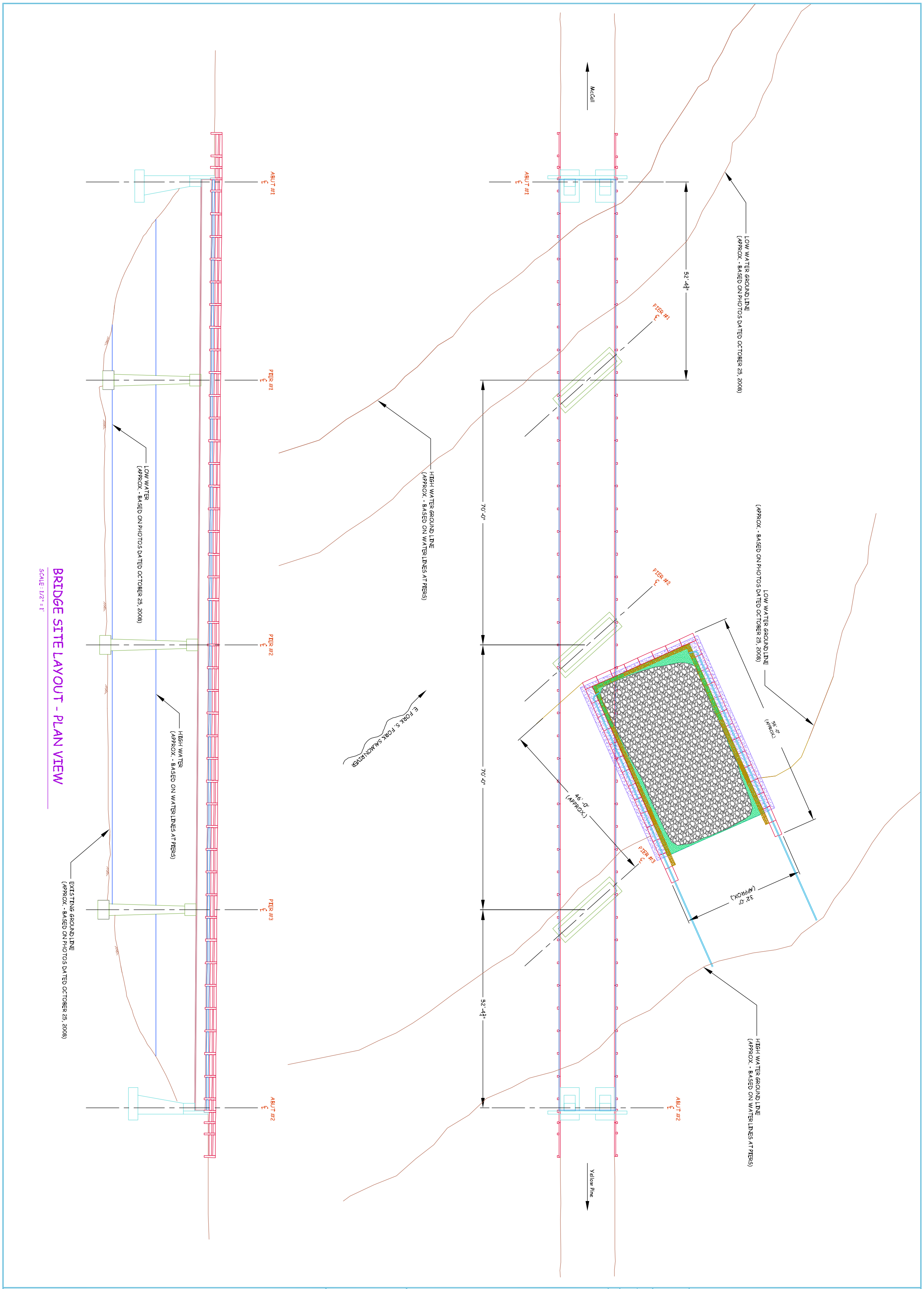
PERMIT REVIEW COPY

REVISIONS

No.	BY	DATE	DESCRIPTION

4/25/2009 8:25 PM

C:\Documents and Settings\BCE\My Documents\Valley County Engineer\East Fork South Fork Bridge\EFSF Bridge rip rap 3.dwg

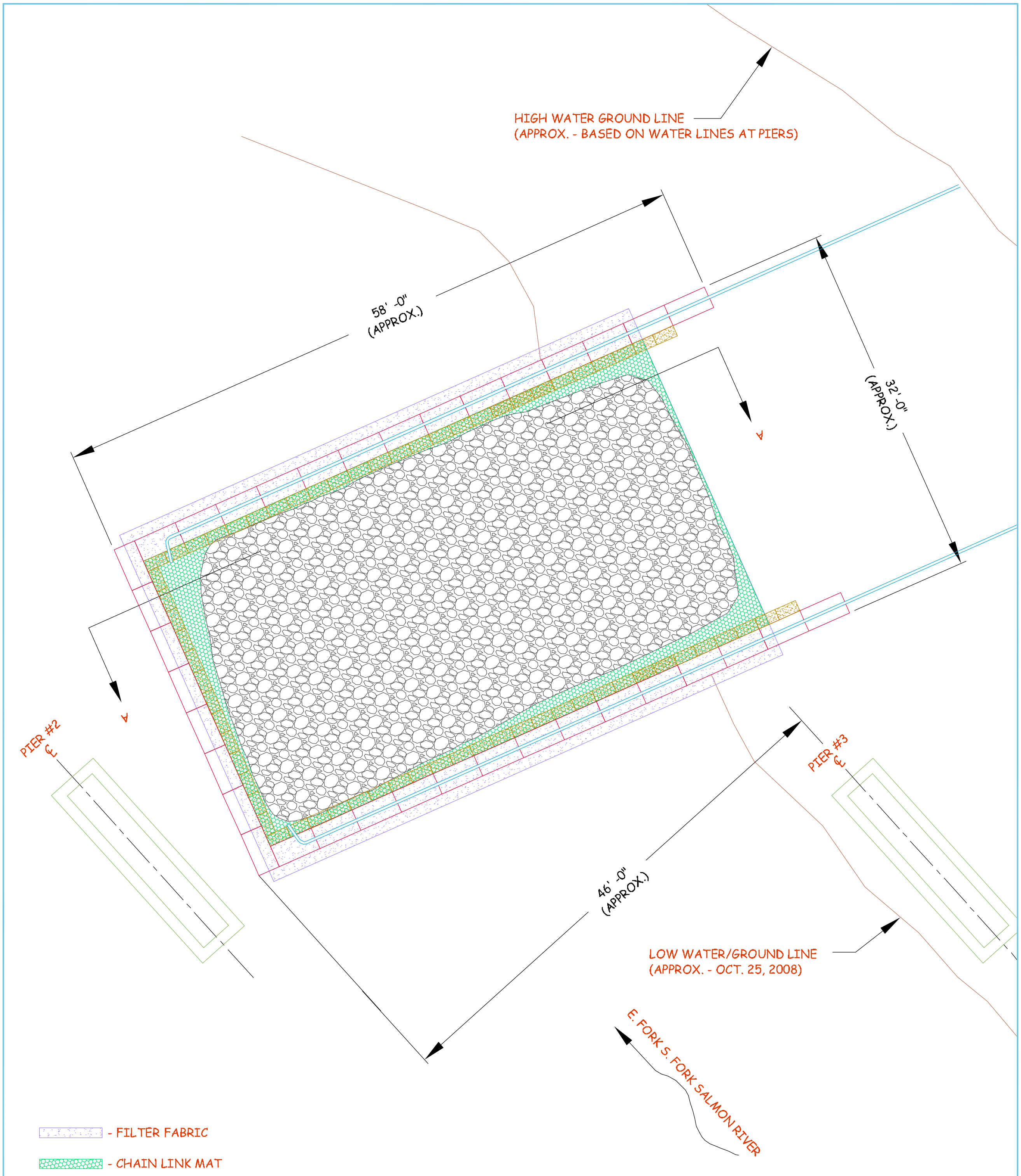


CONSTRUCTION RIP RAP PLATFORM - IN STREAM EAST FORK SOUTH FORK SALMON RIVER BRIDGE			
DESIGNER	DEU	DETAILER	DEU
SHEET 1 OF 1		PROJECT NUMBER	N/A

PERMIT REVIEW COPY

No.	BY	DATE	DESCRIPTION

REVISIONS



▨ - FILTER FABRIC

▨ - CHAIN LINK MAT

▨ - RIP RAP WORKING PLATFORM

▨ - SAND BAGS

▭ - CONCRETE BARRIERS

▭ - DEWATERING HOSE

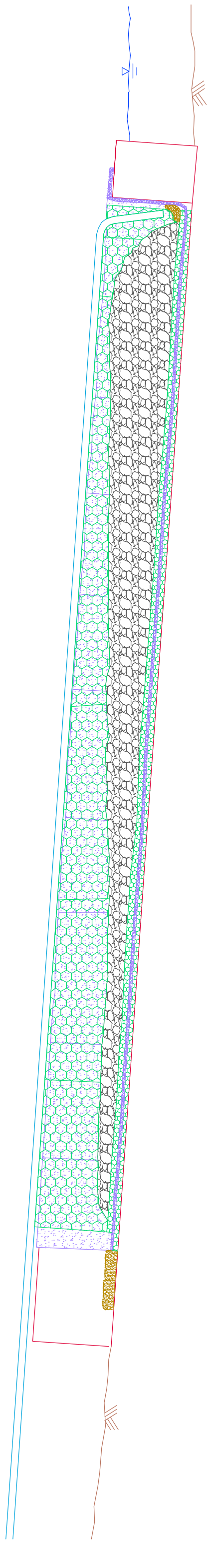
CONSTRUCTION PLATFORM - PLAN VIEW

SCALE : NTS

CONSTRUCTION RIP RAP WORKING PLATFORM EAST FORK SOUTH FORK SALMON RIVER BRIDGE				PERMIT REVIEW COPY
DESIGNER	DEU	DETAILER	DEU	
SHEET 1 OF 2		PROJECT NUMBER	AG-0261-5-09-0006	

REVISIONS

No.	BY	DATE	DESCRIPTION



CONSTRUCTION PLATFORM - SECTION A - A

SCALE : NTS

- ▨ - FILTER FABRIC
- ▨ - CHAIN LINK MAT
- ▨ - RIP RAP WORKING PLATFORM
- ▨ - SAND BAGS
- ☐ - CONCRETE BARRIERS
- ☐ - DEWATERING HOSE

CONSTRUCTION RIP RAP WORKING PLATFORM
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 2 OF 2		PROJECT NUMBER	AG-0261-5-09-0006

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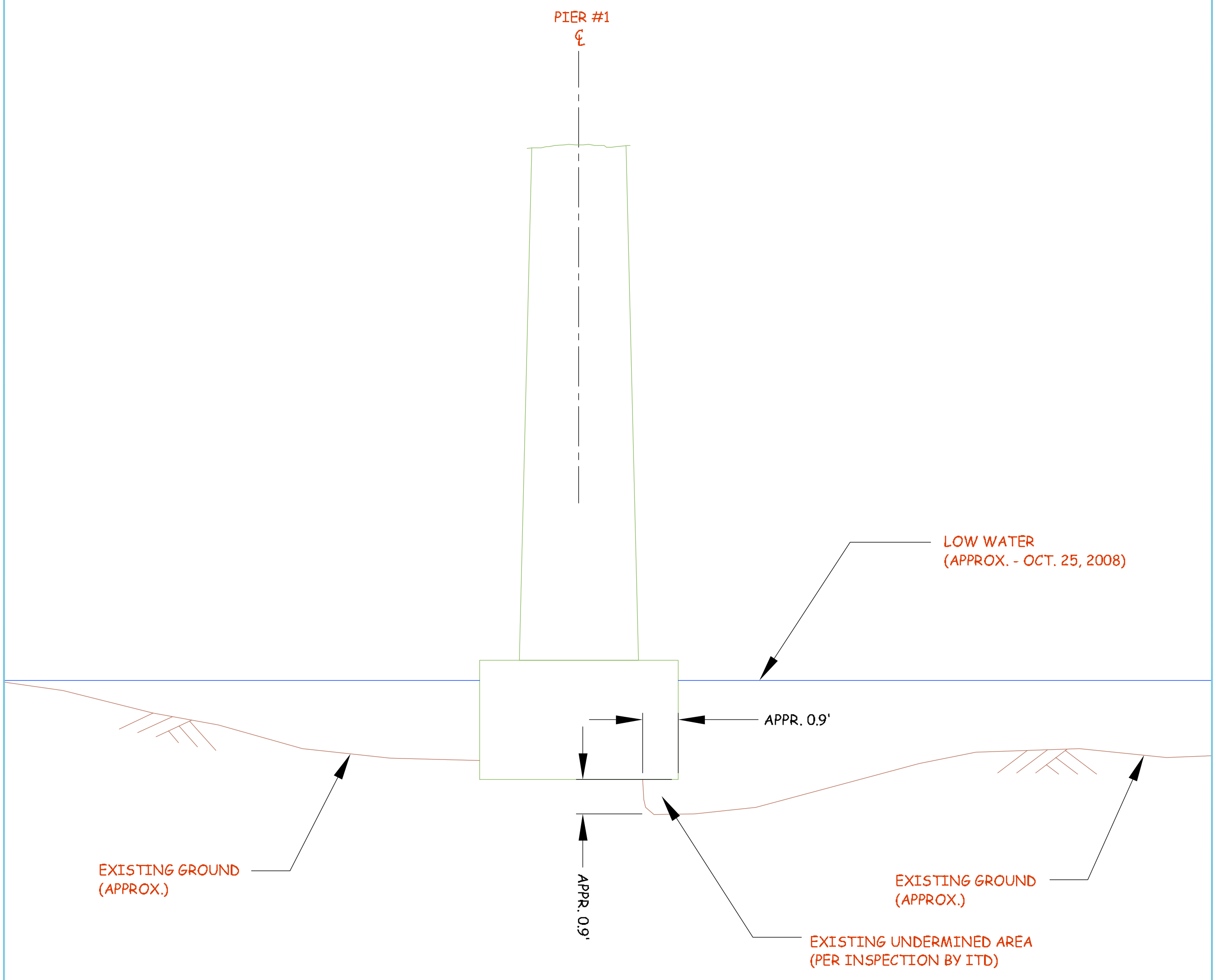
REVIEW
COPY

REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #1 FOUNDATION REPAIR - EXISTING CONDITIONS

SCALE : NTS

FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 1 OF 6		PROJECT NUMBER	AG-0261-5-09-0006

PERMIT
REVIEW
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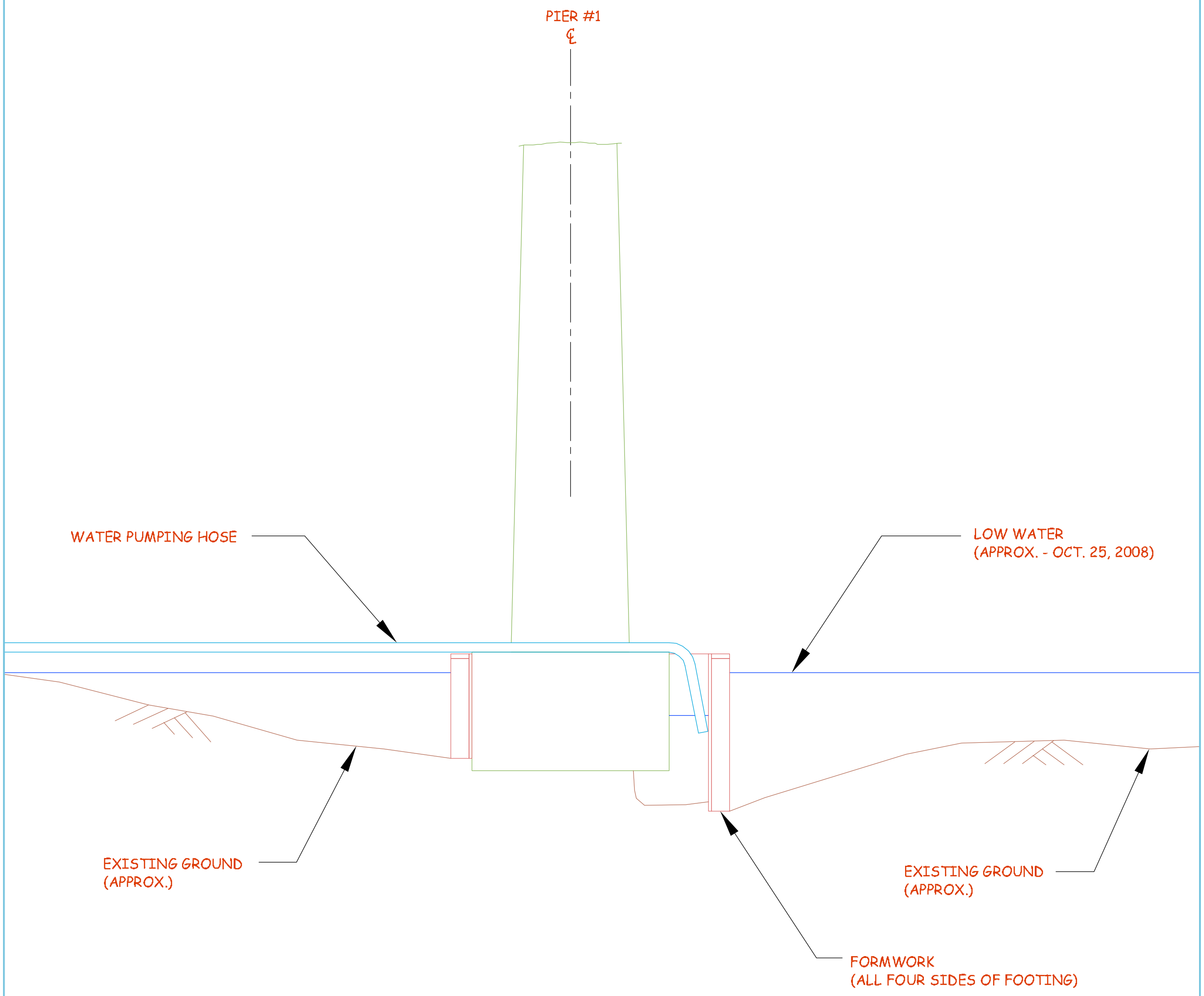
REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #1 FOUNDATION REPAIR - FORMWORK AND PUMPING

SCALE : NTS

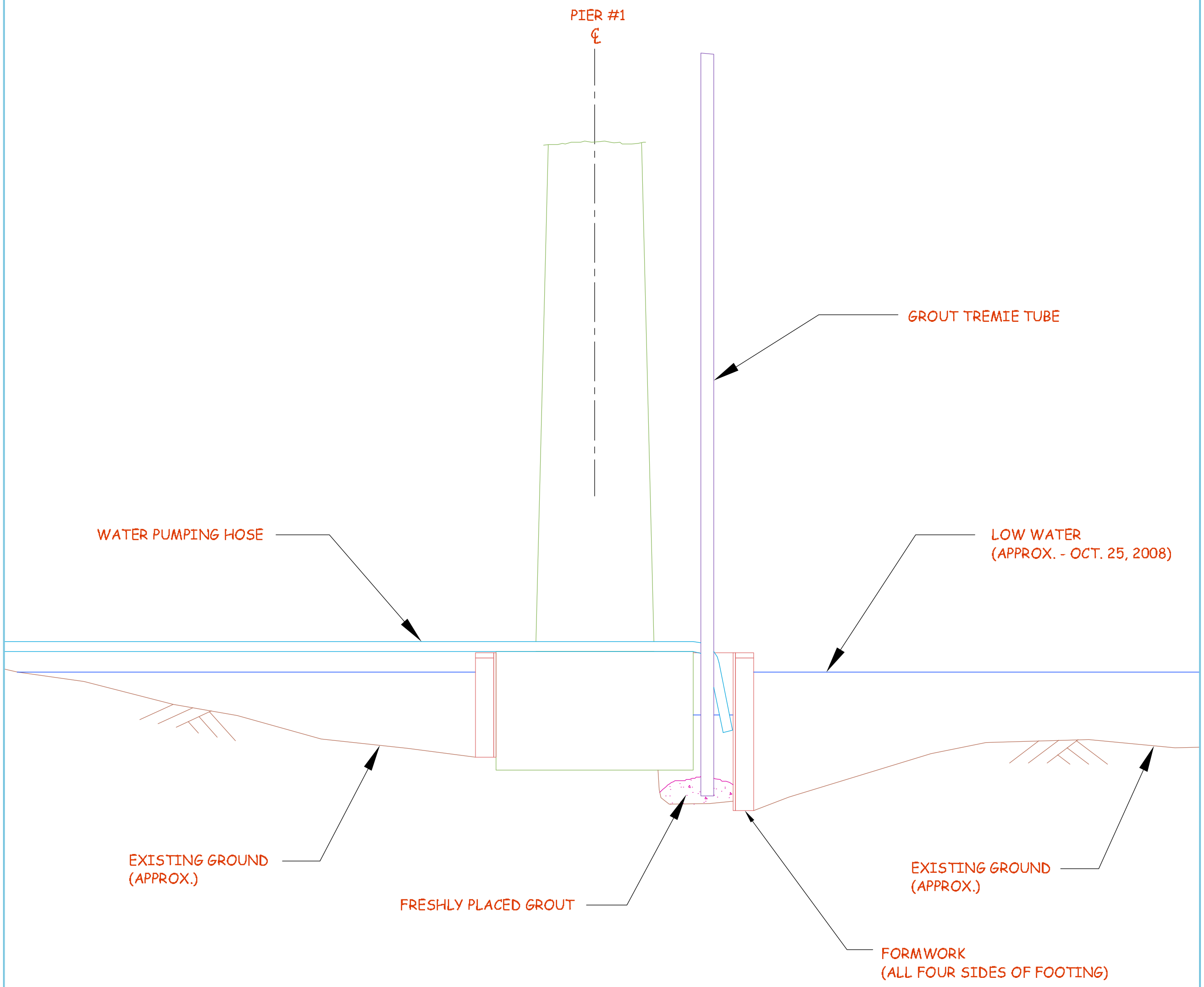
FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 2 OF 6		PROJECT NUMBER	AG-0261-S-09-0006

PERMIT
REVIEW
COPY

REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #1 FOUNDATION REPAIR - PLACING GROUT

SCALE : NTS

FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 3 OF 6		PROJECT NUMBER	AG-0261-S-09-0006

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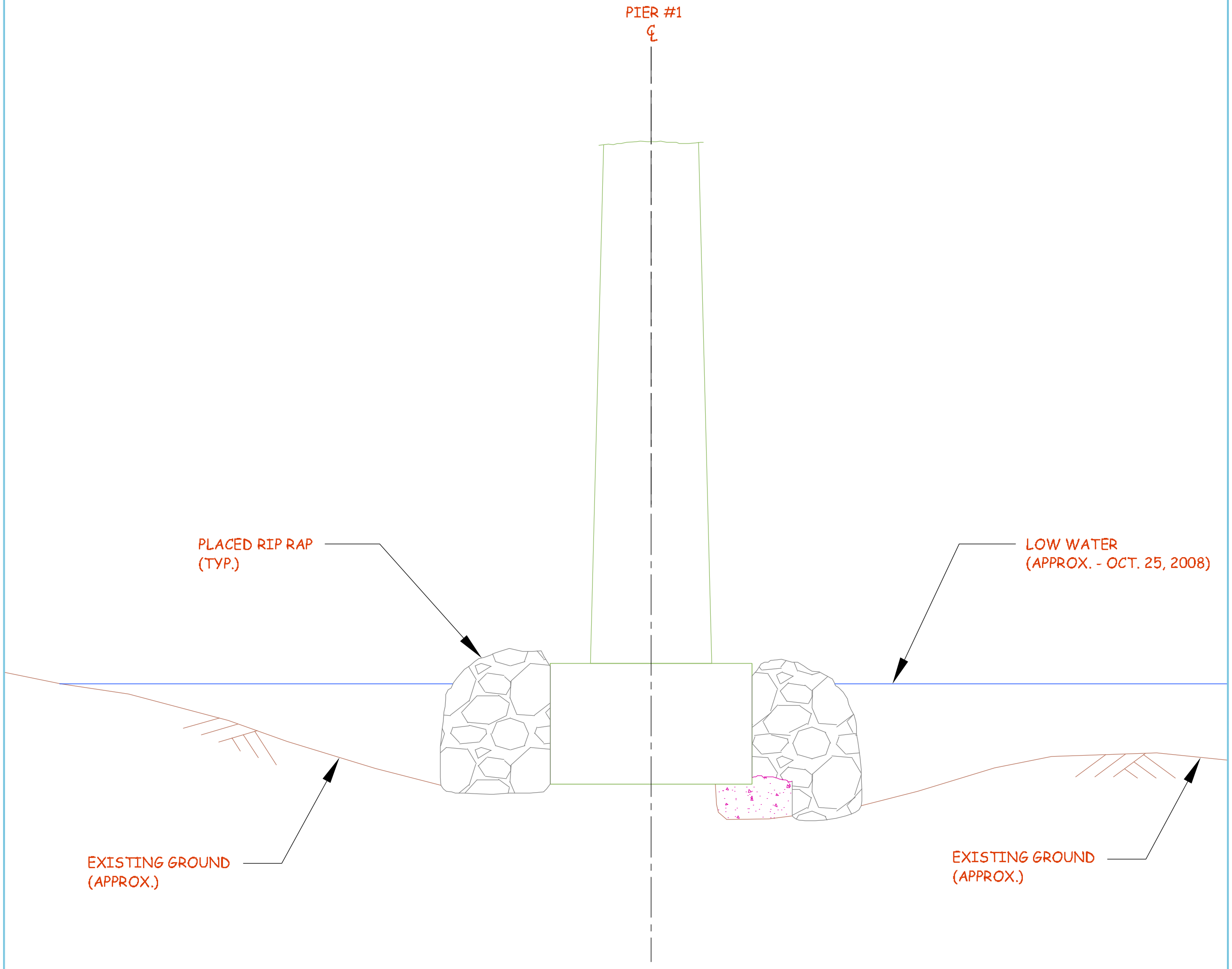
REVIEW
COPY

REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #1 FOUNDATION REPAIR - FINAL CONDITIONS

SCALE : NTS

FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 4 OF 6		PROJECT NUMBER	AG-0261-S-09-0006

PERMIT
REVIEW
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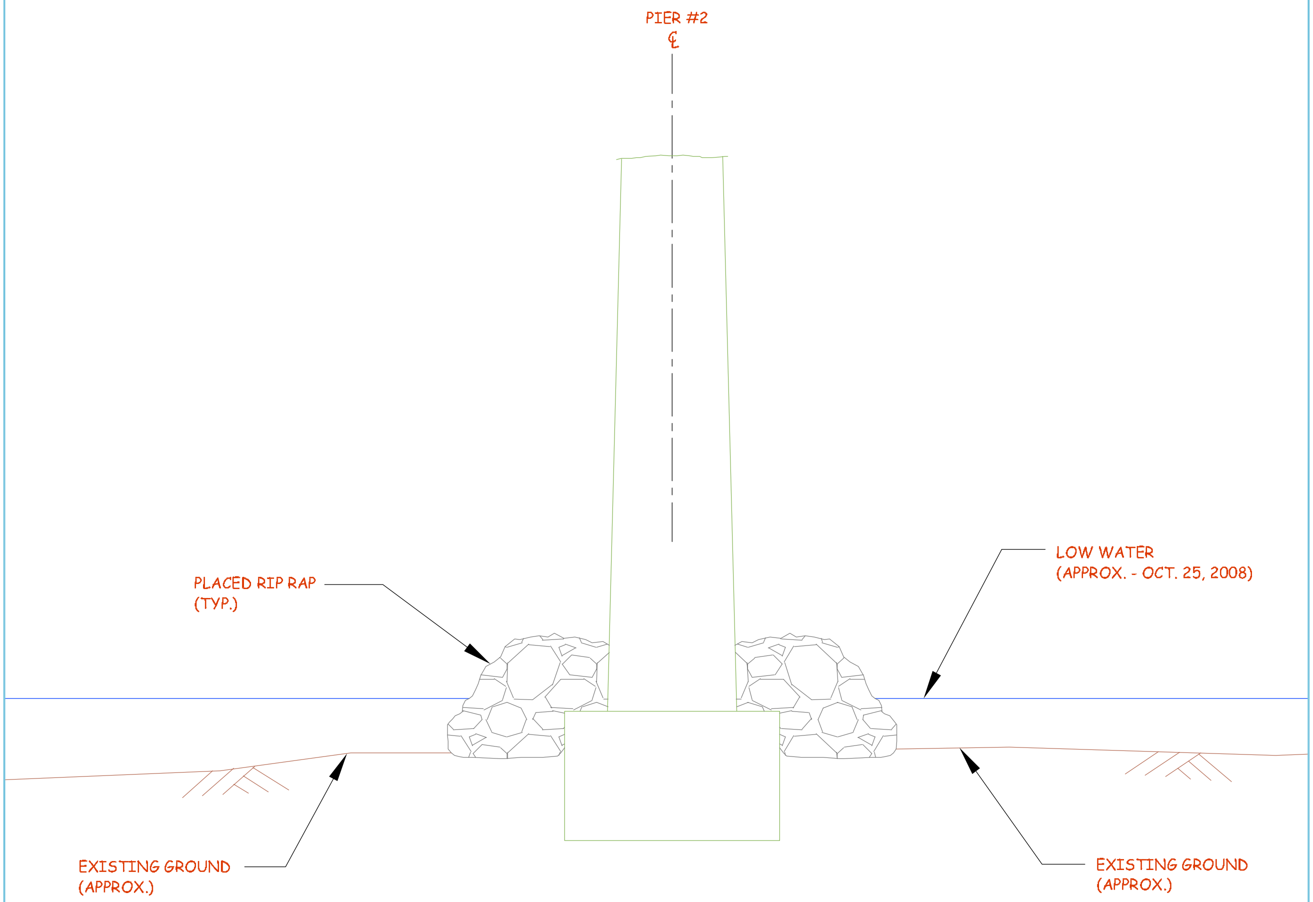
REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #2 FOUNDATION ARMORING - FINAL CONDITIONS

SCALE : NTS

FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 5 OF 6		PROJECT NUMBER	AG-0261-S-09-0006

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REVIEW
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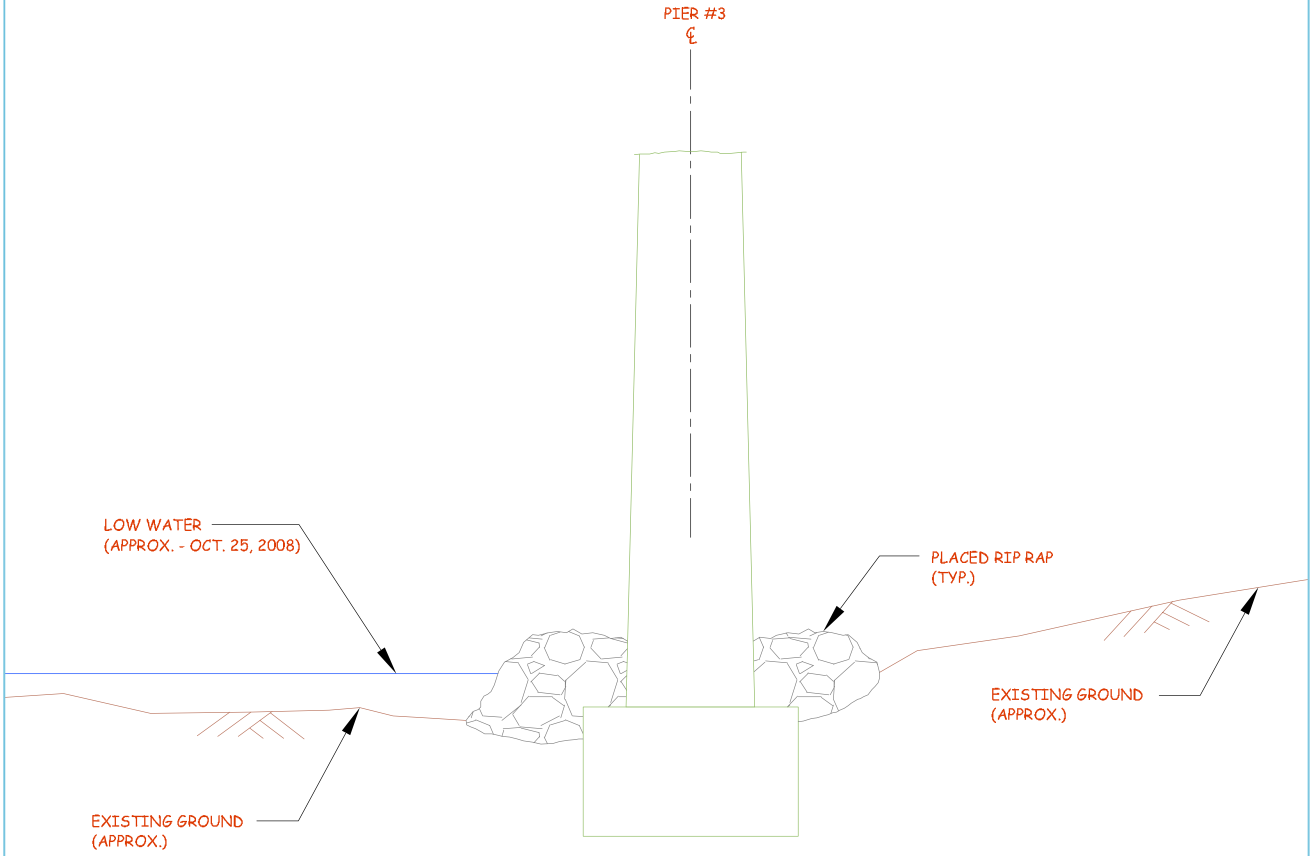
REVISIONS

No.	BY	DATE	DESCRIPTION



PIER #3 FOUNDATION ARMORING - FINAL CONDITIONS

SCALE : NTS

FOOTING RIP RAP WORK
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 6 OF 6		PROJECT NUMBER	AG-0261-S-09-0006

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REVIEW
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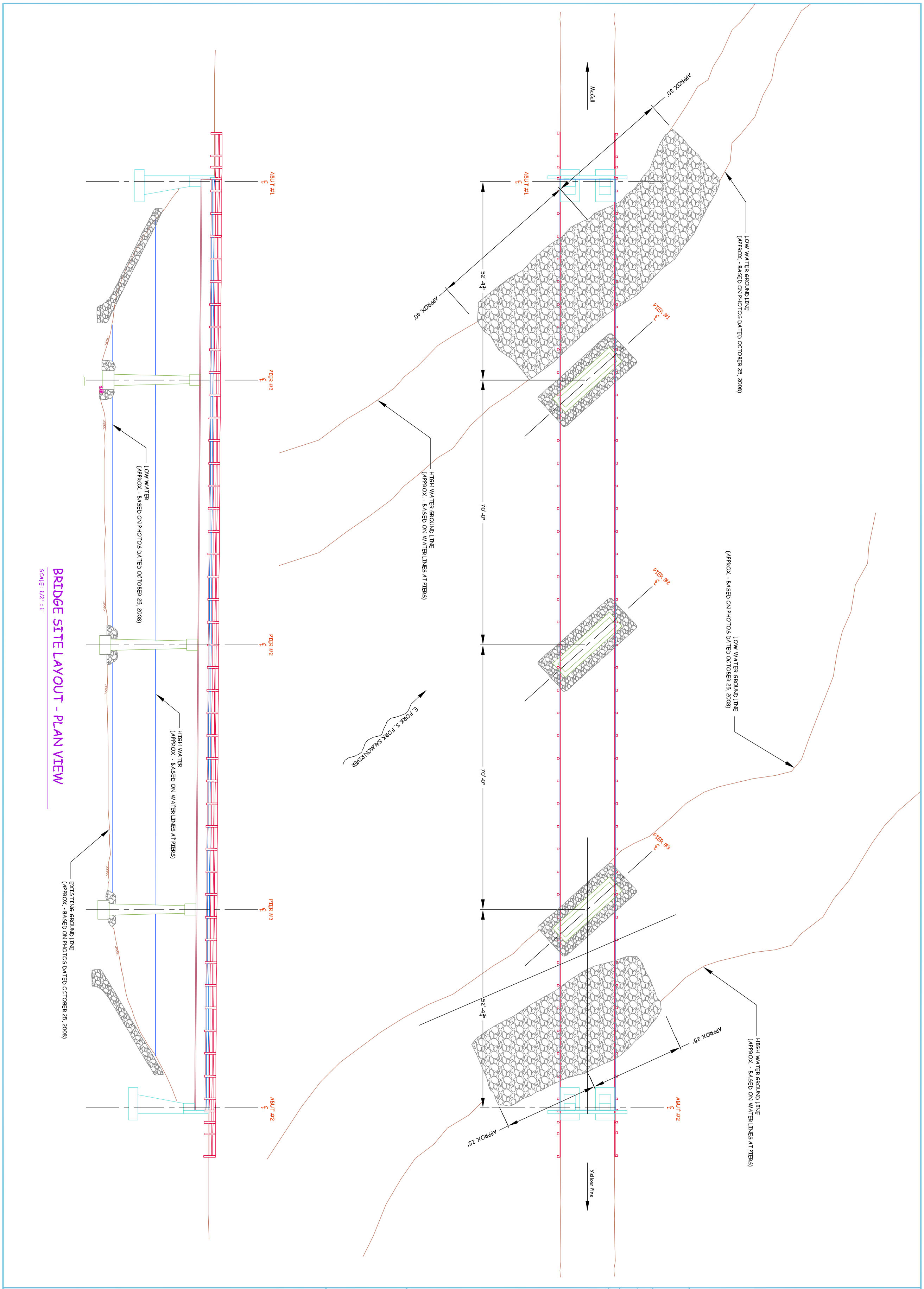
REVISIONS

No.	BY	DATE	DESCRIPTION



FOUNDATION RIP RAP LAYOUT
EAST FORK SOUTH FORK SALMON RIVER BRIDGE

DESIGNER	DEU	DETAILER	DEU
SHEET 1 OF 1		PROJECT NUMBER	N/A

PERMIT
REVIEW
COPY

REVISIONS

No.	BY	DATE	DESCRIPTION

4/15/09

Rodger Nelson
Will Perry
Joe Harper
Dwight Utz - Valley County Engineer

Here is the contractor's schedule for East Fork South Fork Salmon River.

A_1 = abutment 1
P_1 = Pier 1
BM = Beam

You can see he plans to renove the deck starting the week of June 26. The contract says he cannot close the Bridge until Johnson Creek opens, and the County is thinking that will happen in the third week of June.

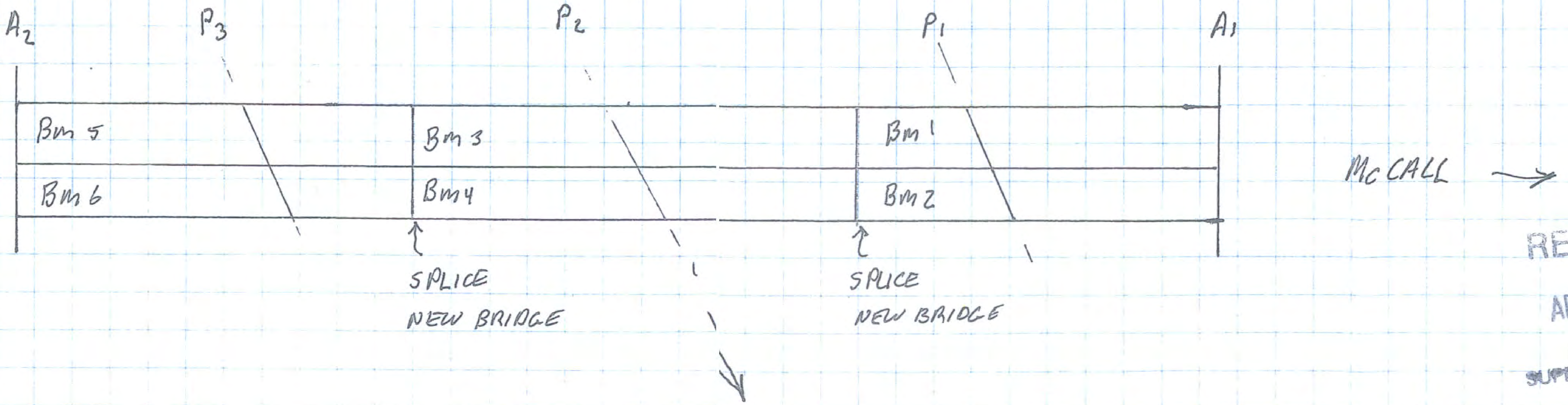
The Contract says he needs to complete the entire project by 9/30/09

You can see he will be busy all summer.

Ben Hipple

EAST FORK SCHEDULE
C.L. HEILMAN CO

3/12/09



107 - Legal Relations and Responsibility to the Public

107.05_nat_us_05_11_2004

107.05 Responsibility for Damage Claims.

Delete the entire subsection.

107.06_nat_us_04_27_2005

107.06 Contractor's Responsibility for Work.

Delete the following:
"except as provided in Subsection 106.07".

107.09_nat_us_05_11_2004

107.09 Legal Relationship of the Parties.

Delete the entire subsection:

107.10_nat_us_02_23_2005

107.10 Environmental Protection.

Add the following:

Design and locate equipment repair shops, stationary refueling sites, or other facilities to minimize the potential and impacts of hazardous material spills on Government land.

Before beginning any work, submit a Hazardous Spill Plan. List actions to be taken in the event of a spill. Incorporate preventive measures to be taken, such as the location of mobile refueling facilities, storage and handling of hazardous materials, and similar information. Immediately notify the CO of all hazardous material spills. Provide a written narrative report form no later than 24 hours after the initial report and include the following:

- Description of the item spilled (including identity, quantity, manifest number, and other identifying information).
- Whether amount spilled is EPA or state reportable, and if so whether it was reported, and to whom.
- Exact time and location of spill including a description of the area involved.
- Containment procedures.
- Summary of any communications contractor had with news media, Federal, state and local regulatory agencies and officials, or Forest Service officials.
- Description of clean-up procedures employed or to be employed at the site including final disposition and disposal location of spill residue.

When available provide copies of all spill related clean up and closure documentation and correspondence from regulatory agencies.

107.10 continued

The Contractor is solely responsible for all spills or leaks that occur during the performance of this contract. Clean up spills or leaks to the satisfaction of the CO and in a manner that complies with Federal, state, and local laws and regulations.

The Government will only be responsible for losses, injuries, and damages to work put in place that was caused by declared enemies and terrorists of the Government and cataclysmic natural phenomenon such as tornadoes, earthquakes, major floods, and other officially declared natural disasters. The Government will only be responsible for costs attributable to repairing or replacing damaged work. The Government will not be responsible for delay costs, impact costs, or extended overhead costs.

107.07 Furnishing Right-of-Way. The Government will obtain all right-of-way.

107.08 Sanitation, Health, and Safety. Follow the requirements of FAR Clause 52.236-13 Accident Prevention.

Observe rules and regulations of Federal, State, and local health officials. Do not permit any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous.

Admit any OSHA inspector or other legally responsible official involved in safety and health administration to the project work site upon presentation of proper credentials.

Report accidents on forms furnished by the Government or, with prior approval, on forms used to report accidents to other agencies or insurance carriers. Maintain a *"Log of Work Related Injuries and Illnesses,"* OSHA Form 300, and make it available for inspection.

Install a reverse signal alarm audible above the surrounding noise level on all motorized vehicles having an obstructed view and on all earth-moving and compaction equipment.

There is a Required WO spec that deletes 107.09

~~**107.09 Legal Relationship of the Parties.** In the performance of the contract, the Contractor is an independent contractor and neither the Contractor nor anyone used or employed by the Contractor shall be an agent, employee, servant, or representative of the Government. The Contractor's independent contractor status does not limit the Government's general rights under the contract.~~

107.10 Environmental Protection. Do not operate mechanized equipment or discharge or otherwise place any material within the wetted perimeter of any waters of the U.S. within the scope of the Clean Water Act (33 USC § 1251 et seq.). This includes wetlands unless authorized by a permit issued by the U.S. Army Corps of Engineers according to 33 USC § 1344, and, if required, by any State agency having jurisdiction over the discharge of material into the waters of the U.S. In the event of an unauthorized discharge:

(a) Immediately prevent further contamination;

(b) Immediately notify appropriate authorities; and

(c) Mitigate damages as required.

Comply with the terms and conditions of any permits that are issued for the performance of work within the wetted perimeter of the waters of the U.S.

Separate work areas, including material sources, by the use of a dike or other suitable barrier that prevents sediment, petroleum products, chemicals, or other liquid or solid material from entering the waters of the U.S. Use care in constructing and removing the barriers to avoid any discharge of material into, or the siltation of, the water. Remove and properly dispose of the sediment or other material collected by the barrier.

Repair leaks on equipment immediately. Do not use equipment that is leaking. Keep a supply of acceptable absorbent materials at the job site in the event of spills. Acceptable absorbent materials are those that are manufactured specifically for the containment and clean up of hazardous materials.

107.11 Protection of Forests, Parks, and Public Lands. Comply with all regulations of the State fire marshal, conservation commission, Forest Service, National Park Service, Bureau of Land Management, Fish & Wildlife Service, Bureau of Indian Affairs, or other authority having jurisdiction governing the protection of land including or adjacent to the project.

Section 157. — SOIL EROSION CONTROL

Description

157.01 This work consists of furnishing, constructing, and maintaining permanent and temporary erosion and sediment control measures.

Material

157.02 Conform to the following Subsections:

Backfill material	704.03
Erosion control bales, wattles, logs, and rolls	713.13
Erosion control culvert pipe	713.15
Fertilizer	713.03
Geotextile	714.01
Mulch	713.05
Plastic lining	725.19
Riprap	251.02
Sandbags	713.14
Seed	713.04
Silt fence	713.16
Water	725.01

12/17/04 [illegible] Washington office SPS that says "Submit a Plan"
There is a [illegible]

Construction Requirements

157.03 General. Provide permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction according to the contract erosion control plan, contract permits, Section 107, and this Section. Contract permits amend the requirements of this Section. Do not modify the type, size, or location of any control or practice without approval.

The contract erosion control plan reflects special concerns and measures to protect resources. An alternate erosion control proposal, with all necessary permits, may be submitted for acceptance according to Subsection 104.03. Submit alternate erosion control proposals at least 30 days before their intended use.

When erosion control measures are not functioning as intended, immediately take corrective action.

Geotextile will be evaluated under Section 207.

Measurement

157.15 Measure the Section 157 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Do not measure replacement items.

Measure temporary turf establishment by the acre on the ground surface. When measurement is by the pound, weigh the seed in pounds.

Measure excavation for diversion channels and sediment basins under Section 204.

Measure riprap under Section 251.

Measure permanent paved waterways under Section 608.

Measure permanent slope paving under Section 616.

Measure topsoil under Section 624.

Measure permanent turf establishment under Section 625.

Measure rolled erosion control products under Section 629.

Payment

157.16 The accepted quantities will be paid at the contract price per unit of measurement for the Section 157 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for erosion control measures will be made as follows:

(a) 50 percent of the unit bid price will be paid upon installation.

(b) An additional 25 percent of the unit bid price will be paid following completion of 50 percent of the contract amount.

(c) Payment of the remaining portion of the unit bid price will be paid when the temporary erosion control measures are removed from the project.

Table 157-1
Application Rates for Temporary Turf Establishment

Material	Application Rate pounds/acre
Seed	35
Fertilizer	335
Mulch	1350

157.12 Inspection and Reporting. Inspect all erosion control facilities at least every 7 days, within 24 hours after more than 3/8 inch of rain in a 24-hour period, and as required by the contract permits.

Within 24 hours, furnish inspection reports to the CO which include all of the following:

(a) Summary of the inspection;

(b) Names of personnel making the inspection;

(c) Date and time of inspection;

(d) Observations made; and

(e) Corrective action necessary, action taken, and date and time of action.

157.13 Maintenance and Cleanup. Maintain temporary erosion control measures in working condition until the project is complete or the measures are no longer needed. Clean erosion control measures when half full of sediment. Use the sediment in the work, if acceptable, or dispose of it according to Subsection 204.14.

Replace erosion control measures that cannot be maintained and those that are damaged by construction operations.

Remove and dispose of temporary erosion control measures when the vegetation is satisfactorily established and drainage ditches and channels are lined and stabilized. Remove and dispose of erosion control measures according to Subsection 203.05.

Restore the ground to its natural or intended condition and provide permanent erosion control measures.

157.14 Acceptance. Material for soil erosion control measures will be evaluated under Subsections 106.02 and 106.03.

Construction, maintenance, and removal of soil erosion control measures will be evaluated under Subsections 106.02 and 106.04.

(b) Sediment basins. Construct sediment basins to store runoff and settle out sediment for large drainage areas. Excavate and construct sediment basins according to Section 204. Construct riser pipes according to Section 602. Provide outlet protection.

157.07 Outlet Protection. Construct riprap aprons or basins to reduce water velocity and prevent scour at the outlet of permanent and temporary erosion control measures. Construct riprap according to Section 251.

157.08 Water Crossings. Construct temporary culvert pipe at temporary crossings where construction vehicles cross a live waterway.

157.09 Diversions. Construct temporary channels, temporary culverts, earth berms, or sandbags to divert water around disturbed areas and slopes. Use temporary channels, temporary culverts, pumps, sandbags, or other methods to divert the flow of live streams for permanent culvert installations and other work. Stabilize channels according to Subsection 157.10. Provide outlet protection.

157.10 Waterway and Slope Protection and Stabilization. Use plastic lining, riprap, check dams, erosion control blankets and mats, and temporary slope drains as follows:

(a) Plastic lining. Use plastic lining to protect underlying soil from erosion. Place the plastic lining loosely on a smooth soil surface free of projections or depressions that may cause the liner to puncture or tear. Lap transverse joints a minimum of 36 inches in the direction of flow. Do not use longitudinal joints. Anchor the lining in place using riprap.

(b) Riprap. Construct riprap for channel lining according to Section 251.

(c) Check dams. Construct riprap, sandbags, or earth berms for temporary dams to reduce the velocity of runoff in ditches and swales.

(d) Rolled erosion control products. Use rolled erosion control products to stabilize waterways and slopes before or after temporary or permanent seeding. Install according to Section 629.

(e) Temporary slope drains. Use drainpipe, riprap, or plastic lined waterway for temporary slope drains to channel runoff down slopes. Channel water into the slope drain with an earth berm constructed at the top of a cut or fill. Anchor slope drains to the slope. Provide outlet protection.

157.11 Temporary Turf Establishment. Apply seed, fertilizer, and mulch for soil erosion protection at the rates shown in Table 157-1. Protect and care for seeded areas, including watering, until permanent turf establishment is in place.

157.04 Controls and Limitations on Work. Before grubbing and grading, construct all erosion controls around the perimeter of the project including filter barriers, diversion, and settling structures.

Limit the combined grubbing and grading operations area to 350,000 square feet of exposed soil at one time.

Construct erosion control and sediment control measures as follows:

(a) Construct temporary erosion controls in incremental stages as construction proceeds.

(b) Construct temporary slope drains, diversion channels, and earth berms to protect disturbed areas and slopes.

(c) Unless a specific seeding season is identified in the contract, apply permanent turf establishment to the finished slopes and ditches within 14 days according to Sections 624 and 625.

(d) Apply temporary turf establishment, mulch, or other approved measures on disturbed areas within 14 days after the last disturbance except where:

(1) The area will be disturbed within 21 days after last disturbance.

(2) When initial stabilization is precluded by snow cover or by seasonal arid conditions in arid or semi-arid areas (average annual rainfall of 20 inches or less).

(e) Construct outlet protection as soon as culverts or other structures are complete.

(f) Construct permanent erosion controls including waterway linings and slope treatments as soon as practical or upon completion of the roadbed.

(g) Construct and maintain erosion controls on and around soil stockpiles to prevent soil loss.

(h) Following each day's grading operations, shape earthwork to minimize and control erosion from storm runoff.

157.05 Filter Barriers. Construct silt fence, bales, wattles, logs, rolls, and brush barriers for filtering sediment from runoff and reducing the velocity of sheet flow. Conserve brush from clearing operations to construct brush barriers.

157.06 Sediment Retention Structures. Construct sediment retention structures of the following types:

(a) Temporary sediment traps. Construct temporary sediment traps to detain runoff from disturbed areas and settle out sediment. Provide outlet protection.

157 - Soil Erosion Control

157.03_forest_05_11_2006

157.03 General.

Delete the first two paragraphs and add the following:

Submit a Dewatering and Sediment Erosion Control Plan detailing permanent and temporary control measures to minimize erosion and sedimentation during and after construction according to the contract specifications, contract permits, Section 107, and this Section. Contract permits amend the requirements of this Section. Do not modify the type, size, or location of any control or practice without approval. Submit the erosion control plan proposal at least 14 days before operations begin to the Contracting Officer for approval.

Reflect in the erosion control plan special concerns and measures necessary to protect resources and government improvements. Include:

1. The construction activities and sequence of implementation relating to specific erosion control measures.

2. The location and type of permanent controls to be implemented during construction.

3. For work in stream channels with running water a detailed dewatering plan.

4. For work in stream channels without flowing water describe level of ground and vegetative disturbance and measures to reduce potential sediment delivery.

5. Describe what monitoring will take place.

Add to the third paragraph:

All sediment barriers must remain in place for the duration of the project and be maintained in proper working condition. Material shall be removed from behind barriers prior to their final removal. Upon completion of construction at the site, all temporary erosion control measures, dewatering materials and equipment are to be removed from Government property.

Add the following:

The Contractor shall adhere to the following standard practices:

a) The Contractor shall operate in a manner that will protect aquatic organisms.
b) Construct the Dewatering and Sediment Control according to the Contractor's approved plan.
c) Maintain the road in a manner that prevents direct entry of surface drainage into the stream.

d) Construct permanent and temporary control features to intercept sediments.
e) Any sanitation facilities established by the Contractor shall be located as designated by the CO.

157.08_forest_05_11_2006

157.08 Water Crossings.

Add the following:

At any channel crossing where there is running water dewater by rerouting water flow around the site before and during excavation and embankment operations.

157.11__forest_05_11_2006

157.11 Temporary Turf Establishment.

Delete this Subsection.

208 – Structure Excavation and Backfill For Selected Major Structures

208.02_forest_05_11_2006

208.02 Material.

Add the following:

Conform to the following Section and Subsections:

Aggregate	703.05

208.04_forest_05_11_2006

208.04 General.

Delete the second paragraph.

Add the following:

A plan of work shall be submitted in writing and shall describe the procedures, methods, materials, and equipment the contractor proposes to use to conduct his excavating operations, including details of shoring and cribbing. Submit the plan of work at least 14 days before operations begin to the Contracting Officer for approval.

Add the following to the sixth paragraph:

Structural backfill necessary to construct the bridge approaches to the lines and grades AS SHOWN ON THE PLANS or AS STAKED ON THE GROUND shall be obtained by utilizing suitable surplus excavation from the bridge construction and/or importing suitable structural backfill from the designated borrow source and/or commercial source.

Ben Hipple/R4/USDAFS
04/03/2009 02:27 PM

To Rodger L Nelson/R4/USDAFS@FSNOTES
cc engineer@co.valley.id.us, Dwight Utz@BCEBC, Thomas Gillins/R4/USDAFS@FSNOTES
bcc
Subject Calculations for riprap sizing

Here is my write up for the sizing of the riprap. Tom Gillins 9 (The Regions Bridge Engineer) found the references for me, and asked that I write up a summary.
The equations compute that D 50 for the riprap should be 1.5 feet, and that corresponds to Riprap Class 5, according to the FP-03 specifications.
I have attached the FP-03 specifications for riprap , which is Section 705. You can see that the largest size rock is 26 inch to 28 inches, and it shows a gradation down to 0 to 8 inches.
Tom also recommended filter cloth be placed under the rip rap on the channel bank at the Abutment 1.
Rodger pointed out to me that we need to say for this project that the riprap cannot have anything smaller than 9 mm (which is approx 0.4 inches.)

size Riprap_forEFkSFkSalmonR.pdf

Ben Hipple
Civil Engineer, Payette National Forest
(208) 634-0760

Ben Hipple/R4/USDAFS
04/02/2009 01:38 PM

To Rodger L Nelson/R4/USDAFS@FSNOTES
cc
bcc
Subject Fw: 100 year flow estimate

For your files.

Ben Hipple
Civil Engineer, Payette National Forest
(208) 634-0760
----- Forwarded by Ben Hipple/R4/USDAFS on 04/02/2009 01:35 PM -----

Ben Hipple/R4/USDAFS
03/25/2009 07:45 AM

To Thomas Gillins/R4/USDAFS@FSNOTES
cc engineer@co.valley.id.us
Subject 100 year flow estimate

I made an estimate of the Q100 at the bridge site to be 8,197 cfs. The drainage area at the bridge is 420 square miles.

I used the Quillian and Harenberg formula to calculate the Q100.
The formula from "An Evaluation of Idaho Stream Gaging Networks" by Quillian and Harenberg for USGS, and the formula for Q100 is
76.9 (Area in Sq Mile) exponent 0.773

There are two gage stations that are near to the East fork of the South Fork of Salmon River site.
There is a Gage station at Johnson Creek that has been collecting data since 1929, and there is a gage station at Krassel ranger Station that has been collecting data since 1967. I looked at the websties for these two sites, adn the sites do not show a '100 year flow' for those sites, they only show historical data.

I checked the two gage stations to see if the QH calculates q 100 that this was in the ballpark compared with historical data.
I did this check by doing a Quillian and Harenberg calculation at the two known gage sites. Then I compared the Q100 that I calculated aginst the historic records at those two gaging stations.
The records of streamflows at those two sites are available at the website :
http://waterdata.usgs.gov/id/nwis/uv/?site_no=13313000&PARAmeter_cd=00065,00060
I selected the option of 'surface-water: peak streamflow', and got a nice chart that shows the max stream flow for eery year.

Krassel Ranger Station Gaging station has a drainage area of 330 sq mile, and Q100 using Q and H is 6,787 cfs.
Johnson creek Gaging station has a drainage of 213 sq mile and q100 using Q and H is 4,900 cfs.

When I checked the streamflow records for Krassel ranger station, I see that the Q and H number of 6,787cfs has not been exceeded. It got close three times.
in 1974 it was 6,740cfs
in 1997 it was,6,090cfs
in 2008 it was6,360 cfs

When I chedked the streamflow records for Johnson Creek , I see that the Q and H number of 4,900 cfs has been exceeded 4 times since 1929.
in 1933 it was 5,150 cfs
in 1956 it was 5,440 cfs
in 1974 it was 6,230 cfs
in 2008 it was 6,250 cfs

It is interesting to note that 2008 was a high flow year for both gaging sites.

In summary, the Q and H formula calculates a Q100 that is near the peak flow that has been recorded at the two gaging stations, therefore the Q and H formula calculation for the E Fk bridge site is close to the peak flow for the bridge site.

Ben Hipple
Civil Engineer, Payette National Forest
(208) 634-0760

BHipple 4/3/09
with Guidance from
Tom Gillins - R4
Structural Engineer

Size Riprap for
Pier 1 and Channel bank at Abut 1

1 of 2

1) Use $Q = VA$
solve for V

$$V = \frac{Q}{A}$$

where Q = 8197 cfs - calculated using Quillian + Harenburg
- see E-Mail from BHipple
dated 3/25/09

A = Cross Section Area below high water mark
= 1448 SF from Cross section sent
from Gillins on 4/2/09

$$V = \frac{8197 \text{ ft}^3/\text{sec}}{1448 \text{ ft}^2} = 5.7 \text{ ft/sec}$$

2) size Riprap for pier

Follow example in HEC-18 Evaluating Scour at Bridges

Chapter 7 - Plan of action for installing scour Countermeasures

use Ishbash equation

$$D_{50} = \frac{0.692(KV)^2}{(s-1)2g}$$

where: D_{50} = median stone diameter ft

K = coefficient for pier shape = 1.5 for Round nose

V = velocity on pier multiply average velocity by 1.7 for a pier in the main current of flow around a bend

V = 5.7 ft/sec x 1.7 = 10.2 ft/sec

s = specific gravity of Riprap use 2.65

g = 32.2 ft/sec

$$D_{50} = \frac{0.692(1.5\ 10.2)^2}{(2.65-1)\,2\,(32.2)} =$$

= 1.5 feet

1) This corresponds to Riprap Class 5 according to FP-03 Specifications, Section 251 and Section 705
2) width of riprap mat shall extend horizontally at least two times pier width (which is approx 5 ft here)
3) The smallest size material allowed in the riprap is 9 mm (0.4 inches) at the E Fk SFk Salmon River
4) Place filter cloth under riprap on Channel Bank at Abutment 1

Section 251. — RIPRAP

Description

251.01 This work consists of furnishing and placing riprap for bank protection, slope protection, drainage structures, and erosion control.

Riprap classes are designated as shown in Table 705-1.

Material

251.02 Conform to the following Subsections:

Geotextile type IV	714.01
Cement grout	725.22(e)
Riprap rock	705.02

Construction Requirements

251.03 General. Perform the work under Section 209. Dress the slope to produce a smooth surface. If earthwork geotextile is required, place according to Section 207.

251.04 Placed Riprap. Placed riprap is rock placed on a prepared surface to form a well-graded mass.

Place riprap to its full thickness in one operation to avoid displacing the underlying material. Do not place riprap material by methods that cause segregation or damage to the prepared surface. Place or rearrange individual rocks by mechanical or hand methods to obtain a dense uniform blanket with a reasonably smooth surface.

251.05 Keyed Riprap. Keyed riprap is rock placed on a prepared surface and set into place by impact pressure.

Place rock for keyed riprap according to Subsection 251.04. Set the riprap into place by exerting impact pressure with a hydraulic-powered bucket or an approximate 5000-pound flat-faced mass. Repeated impacts should be made until the rock is firmly seated and forms a reasonably uniform surface without reducing the effective sizes of the rocks. Do not use impact pressure on riprap below the water surface.

251.06 Grouted Riprap. Grouted riprap is rock placed or keyed on a prepared surface with the voids filled with grout.

Place rock for grouted riprap according to Subsections 251.04 or 251.05. Thoroughly moisten the rocks and wash excess fines from the riprap or to the underside of the riprap. Place grout only when the air temperature is no less than 35 °F within the near-surface voids of the riprap. Place the grout in a manner to prevent segregation. Begin placing grout at the lowest elevation of the riprap. Fill all voids without unseating the rocks. Do not exceed 5-foot thickness for each layer of grouted riprap. Allow 3 days curing time before adding the next layer of riprap and grout. Provide weep holes through the grouted riprap as required. Keep the grouted riprap moist for 3 days after the work is completed and protect it from freezing for a minimum of 7 days after grouting.

251.07 Acceptance. See Table 251-1 for sampling and testing requirements.

Rock for riprap will be evaluated under Subsection 106.02 and 106.03.

Rock placement for riprap will be evaluated under Subsections 106.02 and 106.04.

Structure excavation and backfill will be evaluated under Section 209.

Geotextile will be evaluated under Section 207.

Material for grout will be evaluated under Subsections 106.02 and 106.03. Grout will be evaluated under Subsections 106.02 and 106.04. Grout placement will be evaluated under Subsection 106.02.

Measurement

251.08 Measure the Section 251 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure riprap by the cubic yard in place.

Payment

251.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 251 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 705. — ROCK

705.01 Gabion and Revet Mattress Rock. Furnish hard, durable rock that is resistant to weathering and reasonably free of organic and spoil material. Conform to the following:

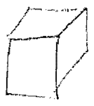
(a) Coarse durability index, AASHTO T 210	52 min.
(b) Unit mass of a filled basket	100 pounds per cubic foot min.
(c) Gradation:	
(1) Baskets 1 foot or greater in the vertical dimension.	
(a) Maximum dimension	8 inches
(b) Minimum dimension	4 inches
(2) Baskets less than 1 foot in the vertical dimension.	
(a) Maximum dimension	6 inches
(b) Minimum dimension	3 inches

705.02 Riprap Rock. Furnish hard, durable, angular rock that is resistant to weathering and water action and free of organic or other unsuitable material. Do not use shale, rock with shale seams, or other fissile or fissured rock that may break into smaller pieces in the process of handling and placing. Conform to the following:

(a) Apparent specific gravity, AASHTO T 85	2.50 min.
(b) Absorption, AASHTO T 85	4.2% max.
(c) Coarse durability index, AASHTO T 210	50 min.
(d) Gradation for the class specified	Table 705-1

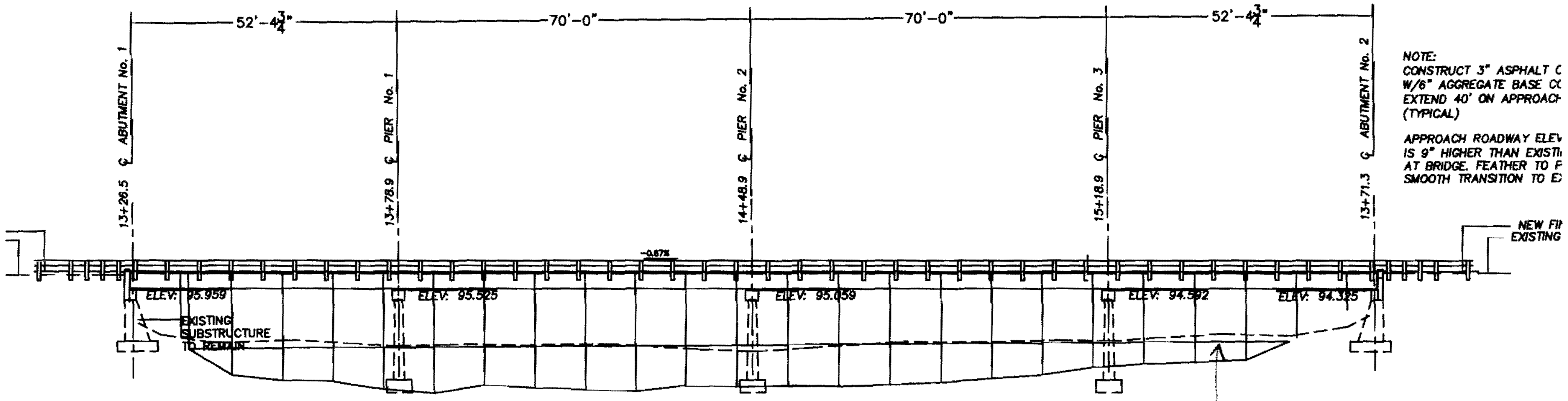
Table 705-1
Gradation Requirements for Riprap

Class	Percent of Rock by Mass	Mass (pounds)	Approximate Cubic Dimension(2)(3) (inches)
1	20	22 to 33	6 to 8
	30	11 to 22	5 to 6
	40	1 to 11	2 to 5
	10 (1)	0 to 1	0 to 2
2	20	55 to 110	8 to 10
	30	22 to 55	6 to 8
	40	2 to 22	3 to 6
	10 (1)	0 to 2	0 to 3
3	20	220 to 330	14 to 16
	30	110 to 220	10 to 14
	40	11 to 110	5 to 10
	10 (1)	0 to 11	0 to 5
4	20	550 to 770	18 to 20
	30	220 to 550	14 to 18
	40	22 to 220	6 to 14
	10 (1)	0 to 22	0 to 6
5	20	1540 to 2200	26 to 28
	30	770 to 1540	20 to 26
	40	55 to 770	8 to 20
	10 (1)	0 to 55	0 to 8
6	20	1870 to 3530	28 to 34
	30	1100 to 1870	22 to 28
	40	110 to 1100	10 to 22
	10 (1)	0 to 110	0 to 10



(1) Furnish spalls and rock fragments graded to provide a stable dense mass.
(2) The volume of a rock with these cubic dimensions has a mass approximately equal to the specified rock mass.
(3) Furnish rock with breadth and thickness at least one-third its length.

Sent from Gillins
on 4/2/09
Measurements to chanel
taken 3/27/09 by Ben Hipple



NOTE:
CONSTRUCT 3" ASPHALT C
W/6" AGGREGATE BASE CC
EXTEND 40' ON APPROACH
(TYPICAL)

APPROACH ROADWAY ELEV
IS 9" HIGHER THAN EXISTI
AT BRIDGE. FEATHER TO F
SMOOTH TRANSITION TO E

High water mark
evidence from 2008 flows

ELEVATION VIEW
NO SCALE

Q_{100} = 8,197 cfs

CHANNEL AREA = 1448.43 SF AT 15.1' BELOW CURB, HIGHWATER MARK

$Q = VA$

$V = \frac{Q}{A} = \frac{8{,}197\ ft^3/sec}{1448\ ft^2} = 5.7\ ft/sec$ call 6 ft/sec

From: Meehan, W. (Ed) 1991. Influences of Forest + Rangeland Mgt. of Salmonid Fishes and Their Habitat. Amer. Fisheries Society Special Publication 19.

#24

2002 303(d) List Update
Ref. #76

Chapter 4

Habitat Requirements of Salmonids in Streams

T. C. Bjornn and D. W. Reiser

Habitat needs of salmon, trout, and char in streams vary with the season of the year and stage of the life cycle. The major life stages of most salmonid species are associated with different uses of fluvial systems: migration of maturing fish from the ocean (anadromous fishes), lakes, or rivers to natal streams; spawning by adults; incubation of embryos; rearing of juveniles; and downstream migration of juveniles to large-river, lacustrine, or oceanic rearing areas. We present information from the literature and from our own research on the range of habitat conditions for each life stage that allow the various species to exist. When possible, we attempt to define optimum and limiting conditions. Anadromous salmonids of the Pacific drainages of North America are our primary focus, but we have included information on other salmonids to illustrate the ranges of temperature, water velocities, depths, cover, and substrates preferred by salmon, trout, and char in streams. The scientific names of species identified by common names here are listed in the book's front matter.

Upstream Migration of Adults

Adult salmonids returning to their natal streams must reach spawning grounds at the proper time and with sufficient energy reserves to complete their life cycles. Stream discharges, water temperatures, and water quality must be suitable during at least a portion of the migration season. Native stocks of salmon, trout, and char that have evolved in stream systems with fluctuations in flow, turbidity, and temperature have often developed behaviors that enable survival despite the occurrence of temporarily unfavorable conditions. Native salmonids usually have sufficient extra time in their maturation, migration, and spawning schedules to accommodate delays caused by normally occurring low flows, high turbidities, or unsuitable temperatures. When upstream migration is not delayed, the fish in some stocks that migrate long distances arrive in the spawning areas 1–3 months before they spawn. Some stocks of fish that migrate short distances may not move into natal streams until shortly before spawning, but they must often wait in the ocean, lake, or river for flows or temperatures in the spawning streams to become suitable.

The flexibility in maturation and migration schedules observed in many stocks of native salmonids is not unlimited and has evolved for the specific environment

Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats
American Fisheries Society Special Publication 19:83–138. 1991

TABLE 4.1.—Water temperatures (Bell 1986) and depths and velocities (Thompson 1972) that enable upstream migration of adult salmon and trout.

Species of fish	Temperature range (°C)	Minimum depth (m)	Maximum velocity (m/s)
Fall chinook salmon	10.6–19.4	0.24	2.44
Spring chinook salmon	3.3–13.3	0.24	2.44
Summer chinook salmon	13.9–20.0	0.24	2.44
Chum salmon	8.3–15.6	0.18	2.44
Coho salmon	7.2–15.6	0.18	2.44
Pink salmon	7.2–15.6	0.18[a]	2.13
Sockeye salmon	7.2–15.6	0.18	2.13
Steelhead		0.18	2.44
Large trout		0.18	2.44
Trout		0.12	1.22

[a] Estimate based on fish size.

of each stock. Natural or human-caused changes in the environment can be large enough to prevent fish from completing their maturation or migration to spawning areas; the proportion affected depends on the extent of the change. Transplanted stocks of fish may be less successful than native stocks in reproducing themselves if they do not possess the flexibility in migration timing required in their new environment.

Temperature

Salmon and trout respond to stream temperatures during their upstream migrations. Delays in upstream migration because natal streams were too warm have been observed for sockeye salmon (Major and Mighell 1966), chinook salmon (Hallock et al. 1970), and steelhead (Monan et al. 1975). Bell (1986) reported that Pacific salmon and steelhead have migrated upstream at temperatures between 3 and 20°C (Table 4.1).

Streams can be too cold as well as too warm for upstream-migrating salmonids. Cutthroat and rainbow trout have been observed waiting for tributaries to warm in spring before entering them to spawn. Adult steelhead that return from the sea in summer and autumn, and then spend the winter in inland rivers before spawning the following spring, overwinter in larger rivers downstream from their natal streams because the smaller headwater streams are often ice-choked during winter. We believe adult steelhead overwinter in the larger rivers because survival is higher there and the slightly higher temperatures in the rivers enable timely maturation (Reingold 1968).

Stream temperatures can be altered by removal of streambank vegetation, withdrawal and return of water for agricultural irrigation, release of water from deep reservoirs, and cooling of nuclear power plants. Unsuitable temperatures can lead to disease outbreaks in migrating and spawning fish, altered timing of migration, and accelerated or retarded maturation. Most stocks of anadromous salmonids have evolved with the temperature patterns of the streams they use for migration and spawning, and deviations from the normal pattern could adversely affect their survival.

Dissolved Oxygen

Reduced concentrations of dissolved oxygen (DO) can adversely affect the swimming performance of migrating salmonids. Maximum sustained swimming speeds of juvenile and adult coho salmon at temperatures of 10–20°C were reduced when DO dropped below air-saturation levels, and performance declined sharply when DO fell to 6.5–7.0 mg/L, at all temperatures tested (Davis et al. 1963). Swimming performance of brook trout declined similarly (Graham 1949). Low DO may also elicit avoidance reactions (Whitmore et al. 1960; Hallock et al. 1970), and may halt migration. Hallock et al. (1970) observed that adult migration ceased when DO fell below 4.5 mg/L, and did not resume until it exceeded 5 mg/L. Minimum DO recommended for spawning fish (at least 80% of saturation, and not even temporarily less than 5.0 mg/L) should provide the minimum needs of migrating salmonids.

Turbidity

Migrating salmonids avoid waters with high silt loads, or cease migration when such loads are unavoidable (Cordone and Kelley 1961). Bell (1986) cited a study in which salmonids did not move in streams where the suspended sediment concentration exceeded 4,000 mg/L (as a result of a landslide). Timing of arrival at spawning grounds by chinook salmon that migrate upstream during snowmelt runoff can vary by a month or more, depending on the concentration of suspended solids in rivers along their migration route (Bjornn 1978). In the lower Columbia River, the upstream migration of salmon may be retarded when secchi disk readings are less than 0.6 m (Figure 4.1).

High turbidity in rivers may delay migration, but turbidity alone generally does not seem to affect the homing of salmonids very much. In studies after the eruption of Mount St. Helens in 1980, Whitman et al. (1982) found that salmon preferred natal stream water without volcanic ash in an experimental flume, but that they recognized their natal streams despite the ash and attempted to ascend them. Quinn and Fresh (1984) reported that the rate of straying of chinook salmon to the Cowlitz River Hatchery was low and unaffected by the 1980 eruption, but that many coho salmon in the Toutle River, the Cowlitz River tributary most affected by the eruption, did stray to nearby streams in 1980 and 1981. Olfaction is a primary sense salmonids use for homing during upstream migration (Hasler and Larsen 1955; Hasler et al. 1978). Each stream may have a unique bouquet, and the extent to which that bouquet can be altered—by the addition of exotic chemicals, trans-basin diversions, and unnatural suspended sediments—without affecting the homing of salmonids is not known.

Barriers

Waterfalls, debris jams, and excessive water velocities may impede migrating fish. Falls that are insurmountable at one time of the year may be passed by migrating fish at other times when flows have changed. Stuart (1962) determined in laboratory studies that leaping conditions for fish are ideal when the ratio of height of falls to depth of pool below the falls is 1 : 1.25 (Figure 4.2). Given suitable conditions, salmon and steelhead can get past many obstacles that appear to be barriers. Both Jones (1959) and Stuart (1962) observed salmon jumping over

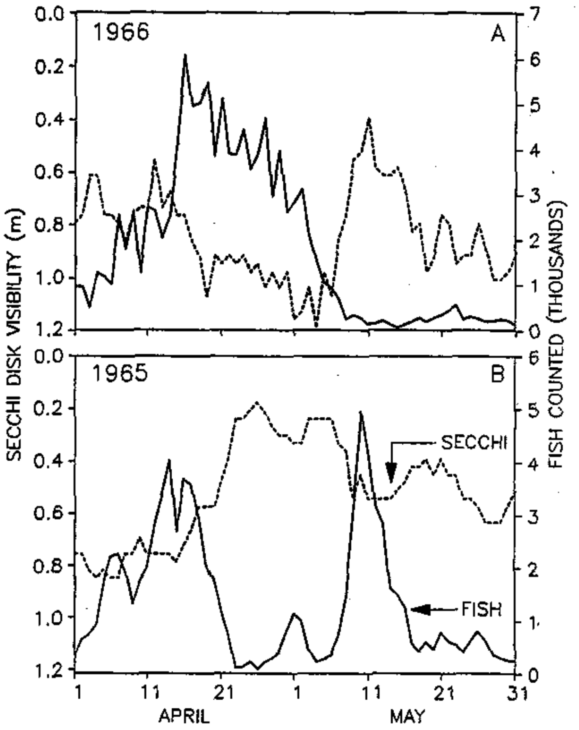


FIGURE 4.1.—Secchi disk visibility (broken line) and number of chinook salmon adults (solid lines) migrating up the Columbia River past Bonneville Dam during April and May of 1965, when high turbid flows interrupted the migration, and of 1966, when turbidities were low and the timing of migration was normal.

obstacles 2–3 m in height. Powers and Orsborn (1985) analyzed barriers to upstream-migrating fish in terms of barrier geometry, stream hydrology, and fish capabilities. They reported the abilities of salmon and trout to pass over barriers depended on the swimming velocity of the fish, the horizontal and vertical distances to be jumped, and the angle to the top of the barrier (Figure 4.3). Reiser and Peacock (1985) computed maximum jumping heights of salmonids on the basis of darting speeds; these heights ranged from 0.8 m for brown trout to more than 3 m for steelhead (Table 4.2).

The swimming abilities of fish are usually described in three categories of speed: cruising speed, the speed a fish can swim for an extended period of time, usually ranging from 2 to 4 body lengths/s; sustained speed, the speed a fish can maintain for a period of several minutes, ranging from 4 to 7 body lengths/s; and darting or burst speed, the speed a fish can swim for a few seconds, ranging from 8 to 12 body lengths/s (Watts 1974; Bell 1986; Table 4.2). According to Bell (1986), cruising speed is used during migration, sustained speed for passage through difficult areas, and darting speed for escape and feeding. Water velocities of 3–4 m/s approach the upper sustained swimming ability of large fish like salmon and steelhead.

Debris jams, whether natural or caused by human activities, can prevent or delay upstream migration. Chapman (1962b) cited a study in which a 75% decrease in number of spawning salmon in one stream was attributed to blockage by debris. On the other hand, many debris jams can be easily passed by fish and they often form pools and provide cover for fish. Removal of debris barriers

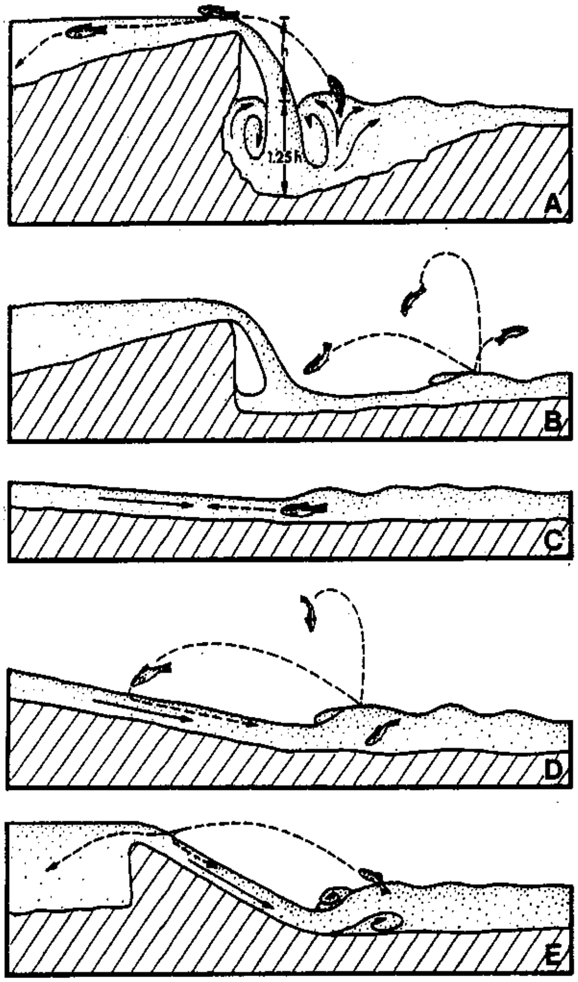


FIGURE 4.2.—Leaping ability of salmonids. (From Eiserman et al. 1975, diagrams drawn after Stuart 1962). (A) Falling water enters the pool at nearly a 90° angle. A standing wave lies close to the waterfall, where fish can use its upward thrust to leap the falls. Plunge-pool depth is 1.25 times the distance (h) from the crest of the waterfall to the water level of the pool. (B) The height of fall is the same as in A, but pool depth is less. The standing wave is formed too far from the ledge to be useful to leaping fish. (C) Flow down a gradual incline is slow enough to allow passage of ascending fish. (D) Flow over an incline steeper than fish can negotiate. Fish may even be repulsed in the standing wave at the foot of the incline. They sometimes leap futilely from the standing wave. (E) A shorter barrier with outflow over a steep incline may be ascended by some fish with difficulty.

should be done with care to avoid sedimentation of downstream spawning and rearing areas and loss of hydraulic stability.

Streamflow

Fish migrating upstream must have streamflows that provide suitable water velocities and depths for successful upstream passage. A variety of techniques have been used to estimate the flows required for migrating fish. Baxter (1961) reported that salmon needed 30–50% of the average annual flow for passage through the lower and middle reaches in Scottish rivers and up to 70% for passage up headwater streams. Thompson (1972) developed a procedure for estimating minimum flows required for migrating fish on the basis of minimum depth and maximum velocity criteria (Table 4.1) and measurements in critical stream reaches, usually shallow riffles. Stream discharges that provide suitable depths and velocities for upstream passage of adults can be estimated by the techniques he described (Thompson 1972):

[redacted]

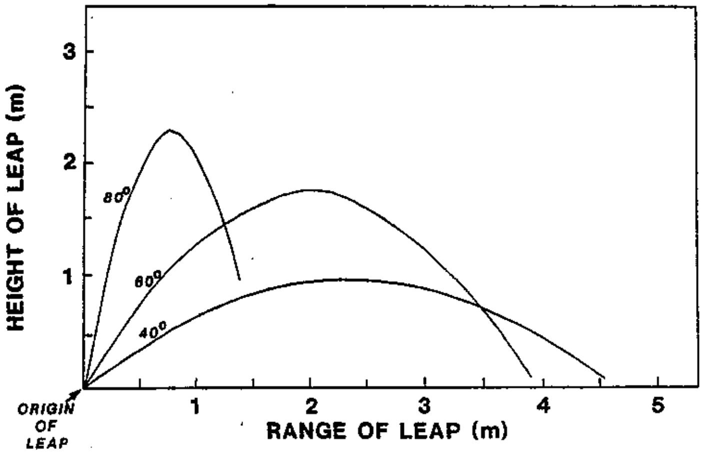


FIGURE 4.3.—Leaping curves for chinook, coho, and sockeye salmon swimming with a maximum burst speed of 6.8 m/s and jumping at various angles. (Adapted from Powers and Orsborn 1985.)

> . . . shallow bars most critical to passage of adult fish are located and a linear transect marked which follows the shallowest course from bank to bank. At each of several flows, the total width and longest continuous portion of the transect meeting minimum depth and maximum velocity criteria are measured. For each transect, the flow is selected that meets the criteria on at least 25% of the total transect width and a continuous portion equaling at least 10% of its total width.

The mean selected flow from all transects is recommended as the minimum flow for passage.

Sautner et al. (1984) reported that passage of chum salmon spawners through sloughs and side channels of the Susitna River, Alaska, depended primarily on water depth, length of the critical stream reach, and size of substrate particles. Fish could successfully pass any stream reach of reasonable length if the depth was greater than 0.12 m when substrate particles averaged larger than 7.6 cm in diameter, or if the depth was greater than 0.09 m when particles were less than 7.6 cm.

TABLE 4.2.—Swimming (Bell 1986) and jumping abilities (Reiser and Peacock 1985) of average-size adult salmonids.

Taxon	Swimming speed (m/s)			Maximum jumping height (m)
	Cruising	Sustained	Darting	
Chinook salmon	0–1.04	1.04–3.29	3.29–6.83	2.4
Coho salmon	0–1.04	1.04–3.23	3.23–6.55	2.2
Sockeye salmon	0–0.98	0.98–3.11	3.11–6.28	2.1
Steelhead	0–1.40	1.40–4.18	4.18–8.08	3.4
Trout	0–0.61	0.61–1.95	1.95–4.11	
Brown trout	0–0.67	0.67–1.89	1.89–3.87	0.8

Spawning

Substrate composition, cover, water quality, and water quantity are important habitat elements for salmonids before and during spawning. The number of spawners that can be accommodated in a stream is a function of the area suitable for spawning (suitable substrate, water depth, and velocity), area required for each redd, suitability of cover for the fish, and behavior of the spawners. Cover is important for species that spend several weeks maturing near spawning areas.

The amount of suitable stream substrate for spawning varies with the size (order) of the stream and species of salmonid using it, as Boehne and House (1983) learned from study of two coastal and two Cascade Range watersheds in Oregon. First-order streams (small headwater streams without tributaries) were not used by salmonids. Less than half the second-order streams (streams resulting from the junction of two or more first-order streams) were used by salmonids; those that were contained nonanadromous cutthroat trout. Most of the third-order streams (steams resulting from the junction of two or more second-order streams) in the coastal watersheds, but only 37% of those in the Cascade Range drainages, were used by cutthroat trout. The larger anadromous steelhead, coho salmon, and chinook salmon spawned in a few third-order streams, but most were found in fourth- and fifth-order streams. As stream order increased, gradient decreased but stream length, width, and depth increased. The amount of spawning gravel per kilometer of stream was greatest in fourth-order coastal watersheds and fifth-order Cascade Range watersheds. Platts (1979b) found similar relations between stream size (order) and use of the streams by fish in an Idaho drainage.

Streamflow

Streamflow regulates the amount of spawning area available in any stream by regulating the area covered by water and the velocities and depths of water over the gravel beds. D. H. Fry (in Hooper 1973) summarized the effect of discharge on the amount of spawning area in a stream.

> As flows increase, more and more gravel is covered and becomes suitable for spawning. As flows continue to increase, velocities in some places become too high for spawning, thus cancelling out the benefit of increases in usable spawning area near the edges of the stream. Eventually, as flows increase, the losses begin to outweigh the gains, and the actual spawning capacity of the stream starts to decrease. If spawning area is plotted against streamflow, the curve will usually show a rise to a relatively wide plateau followed by a gradual decline.

Relations between flow and amount of suitable spawning area have been assessed or predicted by methods based primarily on measurements of water depths and velocities in areas with suitable substrate. Collings (1972, 1974) used a process of depth and velocity contouring to determine the area suitable for spawning at a given discharge. Thompson (1972) quantified the width of the stream at cross-channel transects on spawning bars that met minimum criteria of depth (18 cm) and velocity (0.3–3.0 m/s) at different flows. When measurements have been taken over a wide range of flows, a graph can be plotted of flow versus suitable spawning areas (Figure 4.4) or usable width (Figure 4.5). A method

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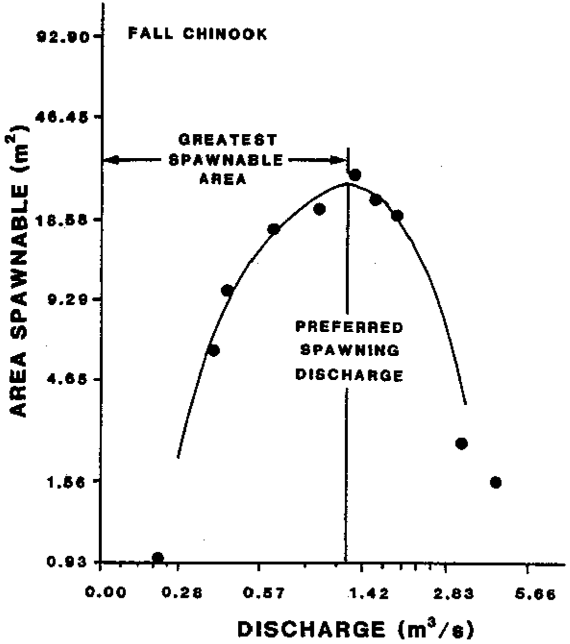

FIGURE 4.4.—Usable-area technique for selecting preferred spawning discharge, North Nemah River. (From Collings 1972.)

similar to that used by Waters (1976), termed the instream flow incremental methodology (IFIM), was developed by U.S. Fish and Wildlife Service personnel to estimate the amount of suitable habitat (for spawning, in this instance); the method relates variations in a stream's water velocity, depth, substrate, and other variables to use of the stream by fishes (Stalnaker and Arnette 1976b; Bovee 1978, 1982, 1986; Bovee and Milhous 1978; Trihey and Wegner 1981). An IFIM analysis results in an index of suitable habitat (weighted usable area, WUA) for a range of streamflows (Figure 4.6). Wesche and Rechard (1980) and EA Engineering, Science and Technology, Inc. (1986) reviewed and evaluated a variety of methods that could be used for estimating the quantity and quality of spawning habitat for salmonids.

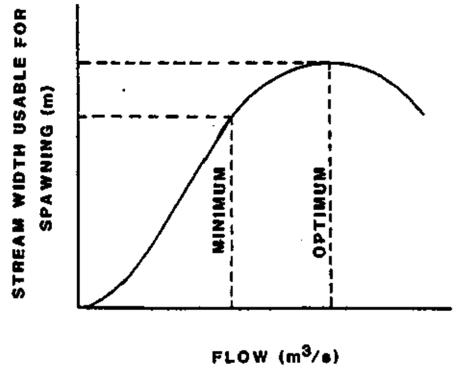

FIGURE 4.5.—Usable-width technique for determining spawning flow. (From Thompson 1972.)

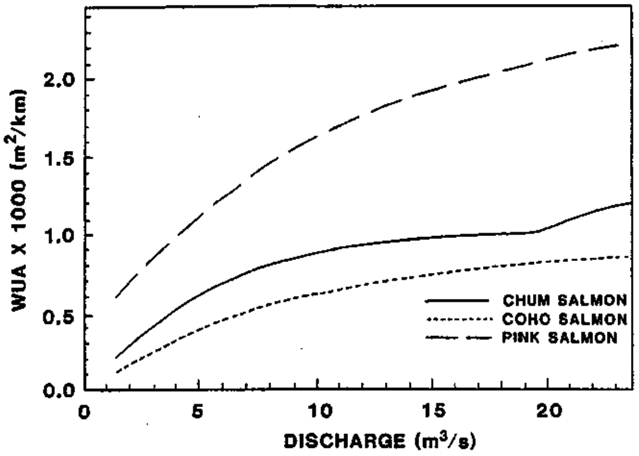

FIGURE 4.6.—Relation of available chum, coho, and pink salmon spawning habitat (weighted usable area, WUA) to streamflow, Upper Tunnel Creek. (From Reiser and Ramey 1984.)

Temperature

Timing of salmonid spawning has likely evolved in response to water temperatures in each stream before, during, and after spawning, and, in some streams, to the occurrence of flows that allow upstream migration of maturing adults. Salmonids have spawned when water temperatures have ranged from 1.0 to 20.0°C, but the favorable range of temperatures for spawning is much narrower (Table 4.3). In British Columbia (Shepherd et al. 1986b), salmon were observed spawning over a wide range of temperatures, but most of the pink, chum, and

TABLE 4.3.—Recommended temperatures for spawning and incubation of salmonid fishes (Bell 1986).

Species	Temperature (°C)[a]	
	Spawning	Incubation[a]
Fall chinook salmon	5.6–13.9	5.0–14.4
Spring chinook salmon	5.6–13.9	5.0–14.4
Summer chinook salmon	5.6–13.9	5.0–14.4
Chum salmon	7.2–12.8	4.4–13.3
Coho salmon	4.4–9.4	4.4–13.3
Pink salmon	7.2–12.8	4.4–13.3
Sockeye salmon	10.6–12.2	4.4–13.3
Kokanee	5.0–12.8	
Steelhead	3.9–9.4	
Rainbow trout	2.2–20.0	
Cutthroat trout	6.1–17.2	
Brown trout	7.2–12.8[b]	

[a] The higher and lower values are threshold temperatures beyond which mortality increases. Eggs survive and develop normally at lower temperatures than indicated, provided initial development of the embryo has progressed to a stage that is tolerant of cold water.

[b] From Hunter (1973).

sockeye salmon spawned in water of 8–13°C, chinook salmon in water of 10–17°C, and coho salmon in water of less than 10°C (mode, 5–6°C).

Each native fish stock appears to have a unique time and temperature for spawning that theoretically maximizes the survival of their offspring. Temperatures before and during spawning must allow the spawners to survive and deposit their eggs, but temperatures during incubation of the embryos (which regulates timing of juvenile emergence from the redd) may be the primary evolutionary factor that has determined the time of spawning (Heggberget 1988). In the case of fall spawners, newly spawned embryos must reach a critical stage of development before the water becomes too cold (Brannon 1965), and emergence of fry must occur at a suitable time during the following spring (Sheridan 1962a; Miller and Brannon 1982; Godin 1982; Burger et al. 1985; Heggberget 1988). Spring spawners must not spawn before the water has warmed sufficiently to permit normal development of embryos, but there may be a survival advantage for the fish to spawn as early as possible to allow the offspring to emerge and grow before the onset of winter. Support for the latter hypothesis can be found in Idaho streams, where steelhead usually spawn before the peak of the snowmelt runoff in spring (thereby risking destruction of their redds by the high flows) rather than after the peak, which would delay the emergence of their offspring until late summer.

Areas with upwelling groundwater have been selected as spawning areas by salmonids such as chum salmon, brown trout, and brook trout (Benson 1953; Bakkala 1970; Witzel and MacCrimmon 1983; Vining et al. 1985). Use of areas with groundwater flow may have survival advantages if the water quality (suitable temperatures and dissolved gases, and lack of damaging heavy metals and sediments) in such areas is more suitable than in areas without groundwater.

Space

The amount of space required by salmonids for spawning depends on the size and behavior of the spawners and the quality of the spawning area. Large fish make large redds; tolerance of nearby fish varies by species; and poor-quality spawning areas may force females to make several redds. Redds range in size from 0.6 m^2 to more than 10 m^2 for anadromous salmonids, and from 0.09 m^2 to 0.9 m^2 for smaller nonanadromous trout and salmon (Table 4.4).

Many salmonids prefer to spawn in the transitional area between pools and riffles (Hazzard 1932; Hobbs 1937; Smith 1941; Briggs 1953; Stuart 1953). Tautz and Groot (1975) reported that chum salmon spawned in an accelerating flow, such as that found at a pool–riffle transition. By placing crystals of potassium permanganate on the gravel surface, Stuart (1953) demonstrated the presence of downwelling currents in these transitional areas (Figure 4.7) and noted that the gravel there was easy to excavate and relatively free of silt and debris. Vaux (1962, 1968) reported that downwelling currents normally occurred in areas where the streambed was convex (such as the pool–riffle transition), and upwelling currents occurred in concave areas (such as the downstream end of a riffle).

The density of redds in streams depends on the amount of stream area suitable for spawning, the number and size of spawners, and the area required for each redd. In two Lake Michigan tributaries with alternating pool–riffle habitat, the densities of spawning chinook salmon ranged from about 80 to 250 fish per hectare of stream area (Carl 1984). The average velocities at the preferred spawning sites in the two streams

TABLE 4.4.—Average area of salmonid redds and area recommended per spawning pair of fish in channels.

Species	Average area of redd (m^2)	Area recommended per spawning pair[a] (m^2)	Source
Chinook salmon	9.1–10.0		Neilson and Banford (1983)
Spring chinook salmon	3.3	13.4	Burner (1951)
Spring chinook salmon	6.0		Reiser and White (1981a)
Fall chinook salmon	5.1	20.1	Burner (1951)
Summer chinook salmon	5.1	20.1	Burner (1951)
Summer chinook salmon	9.4		Reiser and White (1981a)
Coho salmon	2.8	11.7	Burner (1951)
Chum salmon	2.3	9.2	Burner (1951)
Sockeye salmon	1.8	6.7	Burner (1951)
Pink salmon	0.6	0.6	Hourston and MacKinnon (1957)
Pink salmon	0.6–0.9		Wells and McNeil (1970)
Steelhead	5.4		Orcutt et al. (1968)
Steelhead	4.4		Hunter (1973)
Steelhead	4.4		Reiser and White (1981a)
Rainbow trout	0.2		Hunter (1973)
Cutthroat trout	0.09–0.9		Hunter (1973)
Brown trout	0.5		Reiser and Wesche (1977)

[a] Modified from Clay (1961).

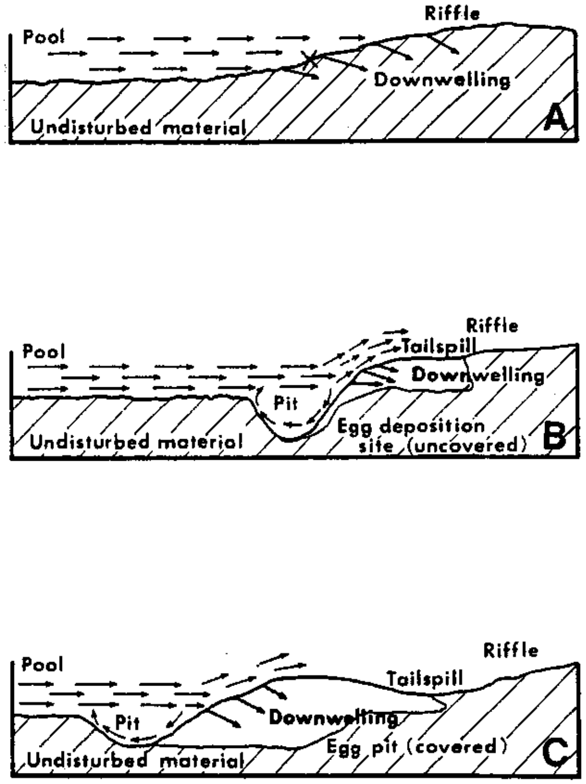

FIGURE 4.7.—Longitudinal sections of a spawning area. (From Reiser and Wesche 1977.) (A) Convexity of the substrate at the pool–riffle transition induces downwelling of water into the gravel. The area likely to be used for spawning is marked with a ×. (B) Redd construction results in negligible currents in the pit (facilitating egg deposition) and increased currents over and through (downwelling) the tailspill. (C) Egg-covering activity results in the formation of a second pit upstream, which may also be used for spawning. Increased permeability and the convexity of the tailspill substrate induces downwelling of water into the gravel, creating a current past eggs. The current brings oxygen to the eggs and removes metabolic wastes.

were 0.42 m/s and 0.50 m/s—similar to those reported by Burner (1951) in the Toutle River, Washington. In the Nechako River, British Columbia, Neilson and Banford (1983) reported that the area of chinook salmon redds averaged 9.1 and 10.0 m^2 and that densities were 1 redd per 235 m^2 and 1 per 112 m^2 in two areas with water depths of at least 0.45 m (the shallowest water in which redd construction was seen). Water depth in the deepest part (pit) of 47 completed redds was 0.46–1.20 m (mean, 0.87 m). Water velocity over the pit of the redds was 15–100 cm/s (mean, 56 cm/s). In a small Oregon coastal tributary, coho salmon constructed 1.7 redds per female and produced a density of 194 redds per hectare of stream (R. A. House, U.S. Bureau of Land Management, unpublished data).

The number of redds that can be built in a stream depends on the amount of suitable spawning habitat and the area required per spawning pair of fish (Reiser and Ramey 1984, 1987; IEC Beak 1984; Reiser 1986). The area suitable for spawning (defined by water depth, velocity, and size of substrate) is usually less than the total area of gravel substrate in the stream, and spatial requirements for each spawning pair may exceed the area of a completed redd. Surface areas of redds can be readily measured, but the spatial requirement for each spawning pair may require additional information such as area of suitable spawning habitat, number of spawners in a given area, and the size and behavior of spawners. Burner (1951) suggested that a conservative estimate of the number of salmon a stream could accommodate could be obtained by dividing the area suitable for spawning by four times the average area of a redd.

In an Oregon stream, gravel substrate made up 25% of the total stream area, but only 30% of that gravel substrate was suitable for spawning by coho salmon (R. A. House, unpublished data). The main stem of the Tucannon River in southeastern Washington contained nearly 200,000 m^2 of gravel substrate (D. W. Kelley and Associates 1982); however, only a small fraction of the river bed was suitable for anadromous fish spawning in the judgment of one of us (T.C.B.), who surveyed 9,000 linear meters of the river and estimated that 3,200 salmon or steelhead redds could be constructed without serious superimposition of redds. If the total area of gravel substrate in the stream (200,000 m^2) had been divided by the average size of salmon or steelhead redds (about 5 m^2), the capacity of the river would have been erroneously estimated to be about 40,000 redds. If Burner's (1951) formula (four times the average redd area) had been used, the estimate would be about 10,000 redds. Much of the river was unsuitable for spawning because water depths and velocities were outside the range acceptable to spawning salmon.

Water Depth and Velocity

Preferred water depths and velocities for various spawning salmonids have been determined from measurements of water depth and velocity at redds (Cope 1957; Sams and Pearson 1963; Orcutt et al. 1968; Thompson 1972; Hooper 1973; Hunter 1973; Smith 1973; Reiser and Wesche 1977; Reiser and White 1981a; Neilson and Banford 1983; Shepherd et al. 1986b). Water depths measured at redd sites varied with species and size of fish and ranged from 6 to 300 cm. In general, the water was at least deep enough to cover the fish during spawning; large salmon required 15–35 cm and smaller trout 6–10 cm (Table 4.5). Many fish spawned in water deeper than necessary to submerge them, but it is not known if the fish preferred the greater depths or were merely using what was available. Water

TABLE 4.5.—Water depth, velocity, and substrate size criteria for anadromous and other salmonid spawning areas.

Species	Depth (cm)	Velocity (cm/s)	Substrate size (cm)	Source
Fall chinook salmon	≥24	30–91	1.3–10.2[a]	Thompson (1972)
Spring chinook salmon	≥24	30–91	1.3–10.2[a]	Thompson (1972)
Summer chinook salmon	≥30	32–109	1.3–10.2[a]	Reiser and White (1981a)
Chum salmon	≥18	46–101	1.3–10.2[a]	Smith (1973)
Coho salmon	≥18	30–91	1.3–10.2[b]	Thompson (1972)
Pink salmon	≥15	21–101	1.3–10.2[a]	Collings (1974)
Sockeye salmon	≥15	21–101[b]	1.3–10.2[a]	[b]
Atlantic salmon	≥25	25–90		Beland et al. (1982)
Kokanee	≥6	15–73		Smith (1973)
Steelhead	≥24	40–91	0.6–10.2[c]	Smith (1973)
Rainbow trout	≥18	48–91	0.6–5.2	Smith (1973)
Cutthroat trout	≥6	11–72	0.6–10.2	Hunter (1973)
Brown trout	≥24	21–64	0.6–7.6[c]	Thompson (1972)

[a] From Bell (1986).
[b] Estimated from criteria for other species.
[c] From Hunter (1973).

velocities at the redd sites ranged from 3 to 152 cm/s, but most were from 20 to 100 cm/s (Table 4.5).

Measurements of depth and velocity were usually taken at the upstream edge of the redd because that point most closely approximated conditions before the redd was constructed and reflected the depths and velocities selected by the fish. Two locations in the water column have been used for making estimates of preferred velocity: 0.6 × depth from the surface to the streambed, and nose velocity (which approximates the location of the fish close to the bed surface). Most velocity criteria have been developed for 0.6 × depth. The ranges of preferred depths and velocities have been defined in a variety of ways. Thompson (1972) used the depths and velocities within a 90–95% confidence interval. Hunter (1973) used the middle 80–90% of the measurements. Smith (1973) used a two-sided tolerance limit within which there was 95% confidence that 80% of the measurements would occur within a normal distribution. Others have simply listed the ranges of depth and velocity measured.

More recently, investigators have developed a series of index curves to depict the suitability of selected variables for different species of fish and life history stages (Figure 4.8). Such curves, used primarily in IFIM, have usually been developed from empirical measurements of depth, velocity, and substrate at the redd site. The curves were based on the assumption that fish select areas in a stream with optimal combinations of physical and hydraulic conditions. The development and limitations of these types of curves were discussed by various investigators (Bovee and Cochnauer 1977; Waters 1976; Baldridge and Amos 1982; Bovee 1982, 1986; Theilke 1985; EA Engineering, Science and Technology, Inc. 1986).

Substrate

The suitability of gravel substrate for spawning depends mostly on fish size; large fish can use larger substrate materials than can small fish. Bell (1986) stated that substrate for anadromous salmon and trout should range from 1.3 to 10.2 cm

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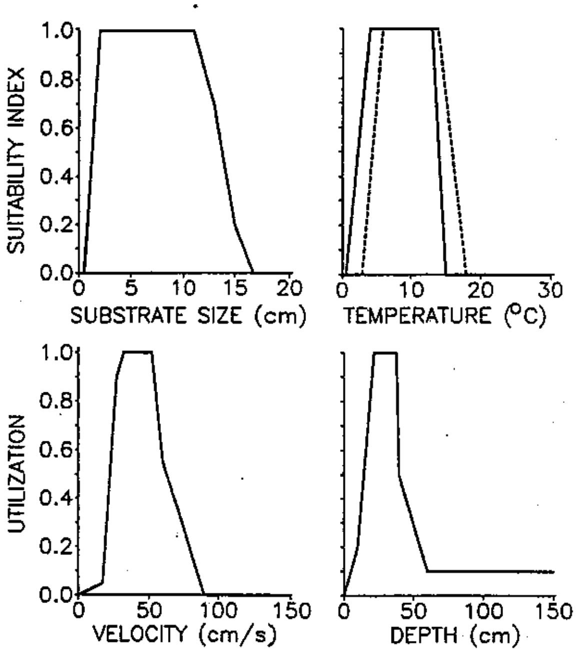

FIGURE 4.8.—Suitability index curves for average substrate particle size and temperature, and use curves for mean current velocity in the water column and water depth, in a spawning area used by chinook salmon. Solid line indicates spawning, dashed line incubation. (Redrawn from Raleigh et al. 1986.)

in diameter (Table 4.5). For smaller fish, other investigators have recommended that the materials not exceed 5.2 or 7.6 cm, depending on size of the fish. The criteria presented above are in general agreement with the sizes of substrate particles found in redds (Orcutt et al. 1968; Hooper 1973; Hunter 1973; Smith 1973; Reiser and Wesche 1977). Salmon have been observed spawning in areas with substrate particles larger than 30 cm, but most often in areas where the majority of particles were smaller than 15 cm (Shepherd et al. 1986b).

To determine the composition of substrate used by salmonids, investigators have collected substrate samples from active redds or known spawning areas and graded them through a series of sieves (Burner 1951; Cope 1957; Warner 1963; Orcutt et al. 1968; Hunter 1973; Reiser and Wesche 1977; Tagart 1976; Corley and Burmeister 1979; Huntington 1985). In such studies, various techniques have been used for the collection of substrate materials (McNeil and Ahnell 1964; Tagart 1976; Walkotten 1976; Platts and Penton 1980; Lotspeich and Everest 1981) and for their characterization (Platts et al. 1979b; Lotspeich and Everest 1981; Shirazi and Seim 1981; Tappel and Bjornn 1983). The particle makeup of redds or spawning areas has been characterized by the proportions within specified size ranges (Tappel and Bjornn 1983), the geometric mean particle diameter (dg: Shirazi and Seim 1981), and the Fredle index (Fi: Lotspeich and Everest 1981).

Substrates used in artificial spawning channels represent the particle sizes best suited for selected species in the judgment of those who designed the channels. Gravel from 2 to 10 cm in diameter was used in the Robertson Creek (British Columbia) spawning channels for pink, coho, and chinook salmon (Lucas 1960). Gravel from 0.6 to 3.8 cm was used in the Jones Creek (British Columbia) spawning channel for anadromous fish (MacKinnon et al. 1961). The Tehama–Colusa spawning channels in California, designed primarily for chinook salmon, contained gravel 1.9–15.2 cm in diameter (Pollock 1969). Bell (1986) stated that, in general, up to 80% of the substrate in artificial spawning channels should be gravel with diameters of 1.3–3.8 cm; the balance should be of sizes up to 10.2 cm.

Cover

Cover for salmonids waiting to spawn or in the process of spawning can be provided by overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Giger 1973). Cover can protect fish from disturbance and predation and also can provide shade. Some anadromous fish—chinook salmon and steelhead, for example—enter freshwater streams and arrive at the spawning grounds weeks or even months before they spawn. If the holding and spawning areas have little cover, such fish are vulnerable to disturbance and predation over a long period. Nearness of cover to spawning areas may be a factor in the selection of spawning sites by some species. In three studies, for example, brown trout selected spawning areas that were adjacent to undercut banks and overhanging vegetation (Johnson et al. 1966; Reiser and Wesche 1977; Witzel and MacCrimmon 1983).

Incubation

Although incubation is inextricably tied to spawning, the habitat requirements of embryos during incubation are different from those of spawning adults and thus warrant a separate discussion. When an adult fish selects a spawning site, it is also selecting the incubation environment. Successful incubation of embryos and emergence of fry, however, depend on many extragravel and intragravel chemical, physical, and hydraulic variables: DO, water temperature, biochemical oxygen demand (BOD) of material carried in the water and deposited in the redd, substrate size (including the amount of fine sediment), channel gradient, channel configuration, water depth (head) above the redd, surface water discharge and velocity, permeability and porosity of gravel in the redd and surrounding streambed, and velocity of water through the redd. Chapman (1988) reviewed the literature and discussed the primary factors involved in the incubation of salmonid embryos.

The relations between number of spawners, eggs deposited in redds, and juveniles that emerge from the redds take a variety of forms, depending on the species, life history, stream, and incubation conditions. The number of eggs deposited may increase linearly with the number of spawners as long as the amount of suitable spawning area is not limiting, but level off when suitable habitat becomes in short supply. Usually the number of fry emerging is directly related to the number of eggs deposited; if these two numbers are plotted against each other, differences in the linear slope between areas or streams probably reflect differing qualities of the incubation environment. Some species such as pink or chum salmon occasionally aggregate in extraordinarily large numbers on limited spawning grounds; if redds are superimposed and high egg densities result in oxygen depletion and poor incubation conditions, the number of emerging fry could be inversely related to the number of spawners.

Substrate

Streambed particles in the redd at the end of spawning, and organic and inorganic particles that settle into the redd and surrounding substrate during incubation, affect the rate of water interchange between the stream and the redd, the amount of oxygen available to the embryos, the concentration of embryo wastes, and the movement of alevins (especially when they are ready to emerge from the redd). During redd construction and spawning, the spawners displace streambed particles, deposit eggs and sperm in one or several pockets (Hawke 1978; Chapman 1988), and then cover the embryos with hydraulically displaced particles. During this process, fine sediments and organic materials in the stream substrate tend to be washed downstream; consequently the redd environment is as favorable for the embryos immediately after construction as it will ever be. Conditions for embryos within redds may change little or greatly during incubation depending on weather, streamflows, spawning by other fish in the same area at a later time, and fine sediments and organic materials transported in the stream.

Redds may be disturbed by late-spawning fish constructing redds, or by floods that displace the streambed containing the redd. Redds that remain intact during incubation may become less suitable for embryos if inorganic fine sediments (Figure 4.9) and organic materials are deposited in the interstitial spaces between the larger particles. The fine particles impede the movement of water and alevins in the redd, and the organic material (or the microbe community on it) consumes oxygen during decomposition; if the oxygen is consumed faster than the reduced intragravel water flow can replace it, the embryos or alevins will asphyxiate.

The redd construction process reduces the amounts of fine sediments and organic matter in the pockets where eggs are deposited (McNeil and Ahnell 1964; Ringler 1970; Everest et al. 1987a). If fine sediments are being transported in a stream either as bedload or in suspension, some of them are likely to be deposited in the redd. The amount of fine sediment deposited and the depth to which it intrudes depend on the size of substrate in the redd, flow conditions in the stream, and the amount and size of sediment being transported (Cooper 1965; Beschta and Jackson 1979). In general, intrusion into the redd increases as particle size decreases. When fine sediments are large relative to the spaces (pores) between gravel particles in the redd, they may only settle into the surface layer of the redd, where they can block other sediments from the deeper egg pockets (Hobbs 1937; Beschta and Jackson 1979; Chapman 1988). Under certain conditions, a layer of fine sediments may form above the egg pocket during redd construction or later. Such a layer can be beneficial (if it prevents deposition of fine organic or inorganic materials in the pocket), detrimental (if it impedes emergence of the alevins), or both. Deposition of fine sediments in redds may reduce survival more if it occurs early rather than late in the incubation period (Wickett 1954) because young embryos take up oxygen less efficiently than advanced embryos (Shaw and Maga 1943; Reiser and White 1988).

Depth of the egg pockets below the surface of the streambed varies with the size of fish and the size of streambed material. Large fish like chinook salmon may dig as deep as 43 cm below the streambed surface, but average pocket depths are in the 20- to 30-cm range (Hobbs 1937; Hawke 1978; Chapman 1988). The egg pockets of smaller fish tend to be closer to the streambed surface. Hawke (1978)

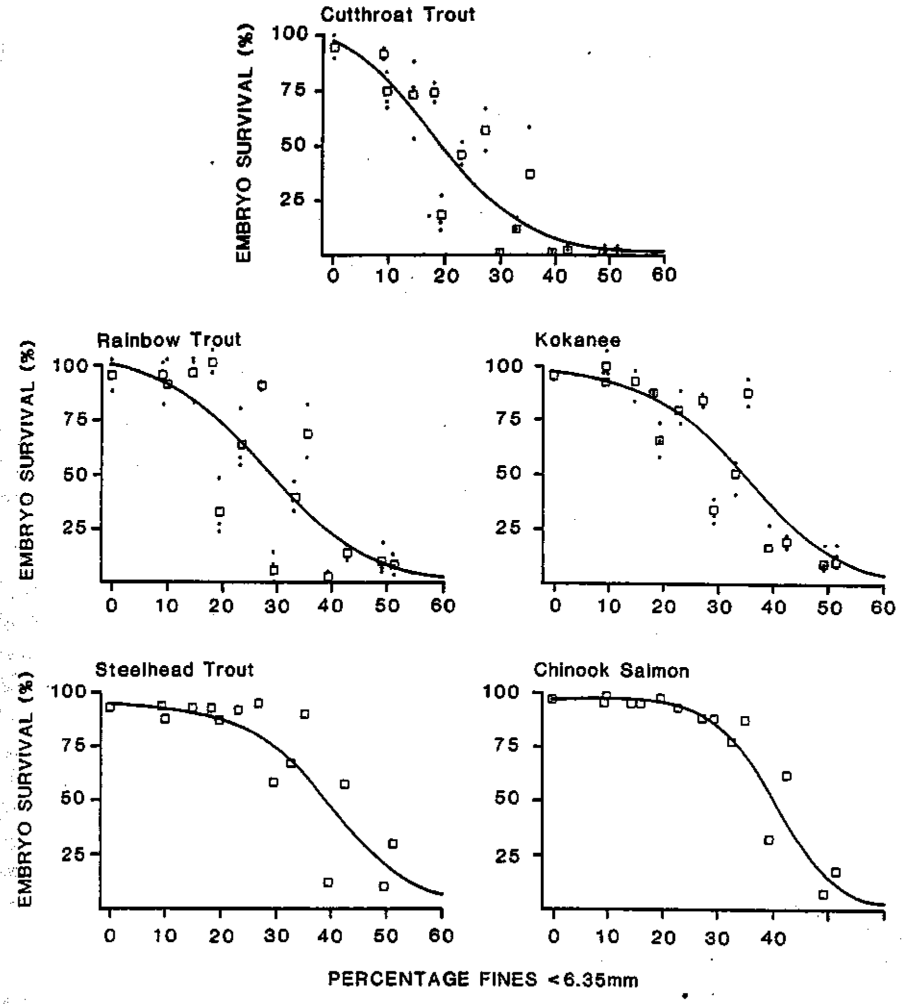

FIGURE 4.9.—Relation between embryo survival and percentage of substrate particles smaller than 6.35 mm for several salmonid species. Chinook salmon and steelhead data are from Tappel and Bjornn (1983); the others are from Irving and Bjornn (1984). Curves were fitted to the data by exponential equations. Squares indicate mean values and dots denote individual replicates.

and Everest et al. (1987a) found that the eggs tended to be near the bottom of the pocket and adjacent to the undisturbed streambed at the bottom of the redd.

During incubation, sufficient water must circulate through the redd as deep as the egg pocket to supply the embryos with oxygen and carry away waste products. Circulation of water through redds is a function of the porosity (ratio of pore space to total volume of redd) of the particles in the redd, hydraulic gradient at the redd, and temperature of the water. Porosity is highest in newly constructed redds and declines during the incubation period as the interstitial spaces acquire fine sediments. The hydraulic gradient through a redd is enhanced by the mounded tailspill created during construction (Figure 4.7). Permeability (ability of

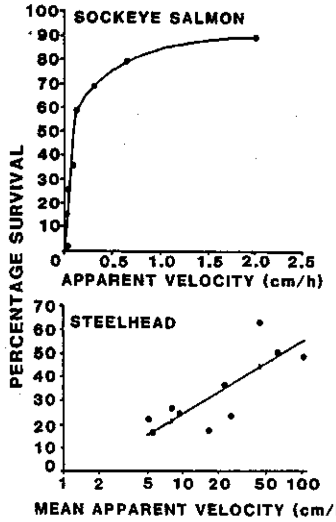

FIGURE 4.10.—Relations between rate of flow of water through a gravel bed and the survival of eyed sockeye salmon eggs (redrawn from Cooper 1965) and steelhead embryos (from Coble 1961).

particles in the redd to transmit water per unit of time) and apparent velocity (volume of water passing through a given area of redd per unit of time) are two commonly used measures of the suitability of a redd for successful incubation of salmonid embryos (Wickett 1954, 1958; Pollard 1955; Terhune 1958; Coble 1961; Vaux 1968). When the permeability and apparent velocity of water in the redd have been too low, reduced embryo survival has been measured for sockeye salmon (Pyper in Cooper 1965), steelhead (Coble 1961), chinook salmon (Gangmark and Bakkala 1960), pink salmon (Wickett 1958), and coho salmon and steelhead (Phillips and Campbell 1961). Survival of embryos decreases as apparent velocities (an indication of the amount of DO reaching the embryos) decrease (Figure 4.10).

Interchange of water between a stream and its streambed particles (Figure 4.7) has been repeatedly demonstrated (Stuart 1953; Sheridan 1962b; Vaux 1962; Cooper 1965). Sheridan (1962b) showed that groundwater in salmon spawning areas in southeast Alaska contains little oxygen, and that the oxygen content of intragravel water decreases with gravel depth. He concluded that the major source of oxygen in intragravel water was the interchange of that water with the surface flow. Cooper (1965) used dyes to demonstrate the influence of streambed configuration on intragravel flow patterns (Figure 4.11). Wells and McNeil (1970) attributed the high intragravel DO in Alaskan pink salmon spawning beds to high permeability of the substrate and to stream gradient. McNeil and Ahnell (1964) reported high permeabilities (>24,000 cm/h) in salmon spawning areas when sands and silts smaller than 0.84 mm made up less than 5% of the particles, and lower permeabilities (<1,300 cm/h) when they made up more than 15%. In sloughs of the Susitna River in central Alaska, Vining et al. (1985) noted that DO concentrations in intragravel water were consistently lower than in surface waters; in the main channel, however, differences in DO concentrations between surface and intragravel waters were slight.

Apparent velocity of water in redds may increase or decrease with the depth (and quantity) of the surface water (Reiser and White 1981a). Early evidence of

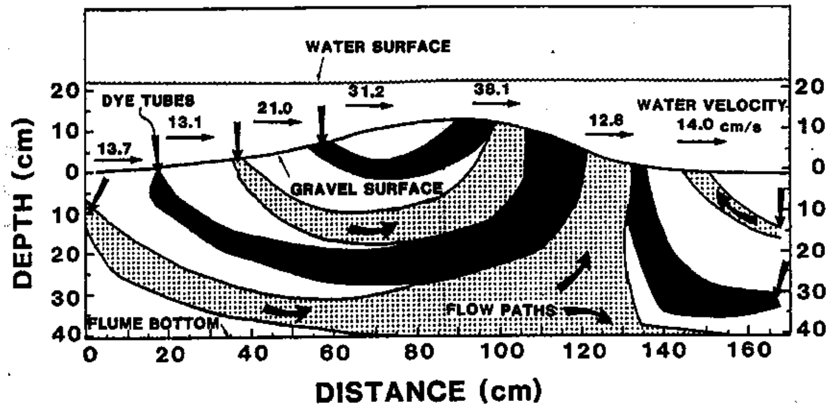

FIGURE 4.11.—Water flow through homogeneous gravel in a flume with a surface similar to that of a new salmon redd. Shadings indicate dispersions of injected dyes. (Redrawn from Cooper 1965.)

this was reported by Wickett (1954), who found a direct relation between gage-height readings in a stream and subsurface flow. Chapman et al. (1982) also observed decreases in apparent velocity when flow decreased from 1,982 to 1,019 m^3/s in the Columbia River.

Salmonid embryos have survived dewatering of redds when the dewatering occurred before hatching, temperatures were kept within a suitable range, fine sediment concentrations did not impede air flow, and humidity was maintained near 100% in the redds (Reiser and White 1981b, 1983; Becker et al. 1982; Stober et al. 1982; Becker and Neitzel 1985; Neitzel and Becker 1985). In a moist environment, unhatched embryos are able to get the oxygen they need from air in the redds (Figure 4.12). Several examples have been reported. Hobbs (1937) found that 80% of the brown trout eggs he observed were still alive in redds that had had no surface flow for 5 weeks, and Hardy (1963) found similar results in brown trout redds after 2–5 weeks of dewatering. Chinook salmon embryos survived in redds that had been dewatered for 3 weeks (Hawke 1978). Steelhead and chinook salmon embryos tolerated 1–5 weeks of dewatering (water flowed through the gravel 10 cm below the eggs) with no significant reduction in survival to hatching, alevin quality, growth rate, or quality of emerged fry (Reiser and White 1983). Survival through hatching of dewatered eggs of chinook, chum, pink, and coho salmon and steelhead was high during a study by Stober et al. (1982). Chinook salmon embryos survived 24 h of dewatering when relative humidity was kept at 100%, but all died if humidity was lowered to 90% (Neitzel and Becker 1985).

In streams with substantial groundwater inflows, DO concentrations and flow patterns of intragravel water may not relate in the usual way to substrate composition and permeability (Hansen 1975; Sowden and Power 1985). Upwelling areas are reportedly favored for spawning by chum, sockeye (Lister et al. 1980; Wilson 1984; Vining et al. 1985), and pink salmon (Krueger 1981). Embryo incubation is improved because upwelling reduces the chances that embryos will become dewatered or frozen, provides a stable incubation environment, and increases the water exchange rate past the embryos, thereby enhancing the

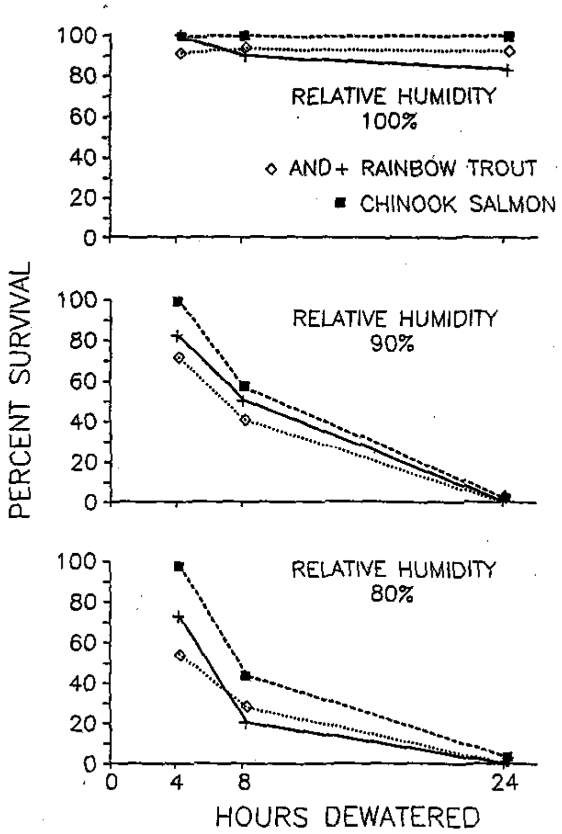

FIGURE 4.12.—Percent survival for dewatered embryos of rainbow trout and chinook salmon under conditions of reduced relative humidity. (From Becker et al. 1986.)

replenishment of DO (if the upwelling water has sufficient amounts) and removal of metabolic waste (Vining et al. 1985).

Egg densities in natural redds are relatively low compared to those in artificial culture facilities; they typically do not affect embryo and alevin survival unless the incubation environment is of marginal quality. If a large chinook salmon deposited 5,000 eggs in a single redd that covered 10 m^2, the density in that redd would be 500 eggs/m^2. However, the density in the actual egg pocket or pockets would be higher, perhaps as high as 2,000–5,000 eggs/m^2 if most of the eggs were deposited in one or two pockets. McNeil (1969) reported that production of pink salmon fry approached 500 fry/m^2 of spawning area when egg deposition was 2,000–3,000 eggs/m^2. In shallow matrix incubators, Kapuscinski and Lannan (1983) found that chum salmon could be incubated at densities as high as 43,000 eggs/m^2 without sacrificing quality of the fry produced.

Once incubation is complete and the alevins are ready to emerge from the redd and begin life in the stream, they must move from the egg pocket up through interstitial spaces to the surface of the streambed. Nunan and Noakes (1985) concluded that emergence of salmonid alevins was a response primarily to gravitational cues rather than to light or intragravel water flow. Emergence can be a problem if the interstitial spaces are not large enough to permit passage of the alevins. In laboratory studies, alevins of chinook salmon and steelhead (Bjornn

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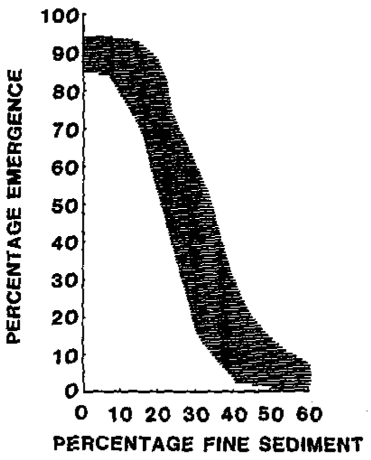

FIGURE 4.13.—Percentage emergence of swim-up fry placed in gravel–sand mixtures in relation to the percentage of sediment smaller than 2–6.4 mm in studies by Bjornn (1968), Phillips et al. (1975), Hausle and Coble (1976), and McCuddin (1977). The stippled area includes data from eight tests on brook trout, steelhead, and chinook and coho salmon.

1968) and coho salmon and steelhead (Phillips et al. 1975) had difficulty emerging from gravel-filled troughs when the percentage of fine sediments exceeded 30–40% by volume (Figure 4.13). Particle sizes that reduce embryo survival and impede emergence have been defined as those less than 6.4 mm (Bjornn 1968; McCuddin 1977), less than 4.6 mm (Platts et al. 1979b), less than 3.3 mm (Koski 1966), less than 2.0 mm (Hausle and Coble 1976), and less than 0.84 mm (McNeil and Ahnell 1964; Hall and Lantz 1969; Cloern 1976; Tagart 1976). Witzel and MacCrimmon (1981) tested rainbow trout in vertical-flow incubators filled with particles of 2, 4, 8, 16, and 26.5 mm, and found that emergence was impeded when particles were less than 8 mm in diameter. Stowell et al. (1983) defined the harmful size range of particles as those less than 6.4 mm, when at least 20% were less than 0.84 mm in diameter. As we previously mentioned, the particle size composition of redds can be characterized in numerous ways (Platts et al. 1979b; Lotspeich and Everest 1981; Shirazi and Seim 1981; Tappel and Bjornn 1983).

Fine sediments that impede intragravel flow and alevin movements may also affect the size of emergent fry (Koski 1966, 1981; Phillips et al. 1975; Tappel and Bjornn 1983; Tagart 1984; MacCrimmon and Gots 1986) and the time of emergence (Koski 1966, 1975; MacCrimmon and Gots 1986), but such effects were not seen in all studies (Hausle and Coble 1976; McCuddin 1977). Silver et al. (1963) reported that the size of newly emerged steelhead and chinook salmon depended on apparent velocities, even at velocities as high as 740–1,350 cm/h. Shumway et al. (1964) found that reduced velocities (3–10 cm/h) resulted in decreased size of fry at all DO levels tested (2.5–11.5 mg/L), and that hatching was delayed at low DO concentrations.

Dissolved Oxygen

Critical concentrations of DO that barely satisfy respiratory demands have been experimentally determined for salmonid embryos at different developmental stages (Table 4.6). Alderdice et al. (1958) found that embryos generally were most sensitive to hypoxial conditions during the early stages of development, when they had received 200–390 temperature units (a temperature unit is one degree

TABLE 4.6.—Critical levels of dissolved oxygen (DO; minimum that satisfies respiratory demand) for salmonid embryos at various stages of development.

Species	Stage of development	Age (d)	Critical DO (mg/L)
Chum salmon (Wickett 1954)	Pre-eyed	0	0.72
	Pre-eyed	5	1.67
	Pre-eyed	12	1.14
	Faintly eyed	85	3.70
Chum salmon (Alderdice et al. 1958)		<1	0.72[a]
		<1	1.67[a]
		4	1.14[a]
		12	3.96
		16	3.70[a]
		27	5.66
		35	6.60
	Nearly hatching	45	7.19
Atlantic salmon (Lindroth 1942)	Died		0.76
	Nearly hatching		5.80
	Hatching		10.00
Atlantic salmon (Hayes et al. 1951)	Eyed	25	3.1
	Hatching	50	7.1

[a] From Wickett (1954).

above zero for one day). Wickett (1954) showed that larval development during the early stage of development depended wholly on diffusion for satisfying oxygen requirements. Once the circulatory system is functional, oxygen transfer to the embryo becomes more efficient.

Embryos may survive when DO concentrations are below saturation (but above the critical level), but their development often deviates from normal. Doudoroff and Warren (1965) found that when DO was below saturation throughout development, embryos were smaller than usual and that hatching was either delayed or premature. Alderdice et al. (1958) showed that low DO concentrations in the early stages of development of chum salmon delayed hatching and increased

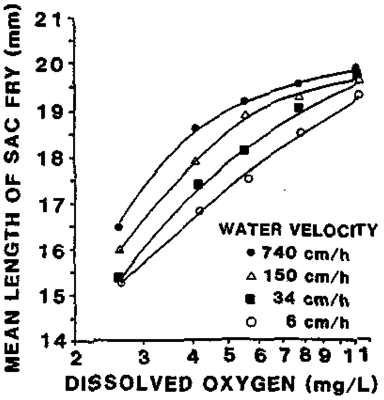

FIGURE 4.14.—Relation between mean length of steelhead sac fry when hatched and dissolved oxygen concentration at which the embryos were incubated, for several water velocities during incubation and a temperature of 9.5°C. (From Silver et al. 1963.)

TABLE 4.7.—Characteristics of sockeye salmon alevins at hatching after embryos were incubated in water at three oxygen concentrations. (From Brannon 1965.)

	O_2 concentration (mg/L)		
Characteristic	3.0	6.0	11.9
Temperature units[a] to 50% hatching	670	670	670
Length (mm)	16.3	18.6	19.7
Yolk-sac shape	Spherical	Longitudinal	Longitudinal
Pigmentation	Lightly on head	On head and starting on back	On head and back
Visibility of the dorsal and anal fin rays	Not visible	Distinguishable	Readily visible
Caudal fin development	Forming	Forming	Well advanced

[a] Degree-days above 0°C.

the incidence of morphological anomalies. Silver et al. (1963) reported that newly hatched steelhead and chinook salmon alevins were smaller and weaker when they had been incubated as embryos at low and intermediate DO concentrations than when they were incubated at higher concentrations (Figure 4.14). Shumway et al. (1964) found that reduced DO lengthened the incubation period of coho salmon embryos, which hatched into smaller alevins than normal. Brannon (1965) found differences in length and other anatomical features among newly hatched sockeye salmon fry that had developed at three DO levels (Table 4.7); however, weights of the emergent fry were similar among treatment groups.

In field studies, survival of steelhead embryos (Coble 1961) and coho salmon embryos (Phillips and Campbell 1961) was positively correlated with intragravel DO in redds (Figure 4.15). Phillips and Campbell (1961) concluded that intragravel DO must average 8 mg/L for embryos and alevins to survive well. Stober et al. (1982) and Fast and Stober (1984) reported that newly hatched alevins in the gravel are able to detect oxygen gradients and migrate to areas containing more DO.

Intragravel DO concentrations are functions of many factors: water temperature, surface and intragravel water interchange, apparent velocity of water flow in

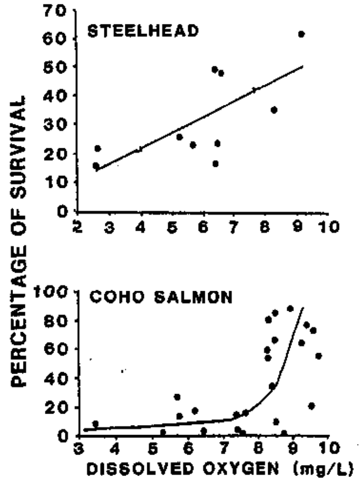

FIGURE 4.15.—Relation between dissolved oxygen concentration and survival of steelhead embryos (from Coble 1961) and coho salmon embryos (Phillips and Campbell 1961) in natural redds.

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the redd, permeability of the substrate, and oxygen demand of organic material in the redd, among others. Hall and Lantz (1969), Ringler and Hall (1975), and Moring (1975a) reported that intragravel DO concentrations were reduced in some Oregon streams after adjacent areas had been logged. They attributed such reductions to elevated stream temperatures after removal of the riparian canopy and to increased concentrations of fine sediment that reduced substrate permeability and apparent velocity. Tagart (1976) and Reiser and White (1981b) found direct relations between DO and permeability and inverse relations between DO and percentage of fines in stream substrates. Coble (1961) generalized his experience with this subject by stating that when apparent water velocities are low, DO is low; when they are high, DO is usually high.

All streams transport particulate and dissolved organic matter. The amount transported and the timing of transport varies with the productivity of the stream, the source and type of organic matter, and streamflow (Fisher and Likens 1973; Hobbie and Likens 1973; Liaw and MacCrimmon 1977; Naiman and Sibert 1978; Bilby and Likens 1979; Dance et al. 1979; Naiman and Sedell 1979). Organic matter that settles into redds can reduce the DO concentration as it decomposes; the extent of oxygen depletion depends on the amount and type of organic debris (Hargrave 1972) and the chemical, physical, and hydraulic characteristics (DO content, temperature, permeability, and reaeration capability) of the stream and its substrate. Excessive recruitment of organic material to a stream can result in reduced DO concentrations and intragravel water flow, leading to reduced survival of incubating embryos (Olssen and Persson 1986).

Although DO concentrations required for successful incubation depend on both species and developmental stage, we recommend that concentrations should be at or near saturation, and that temporary reductions should drop to no lower than 5.0 mg/L, for anadromous salmonids. Apparent velocities of water flowing through redds also must be maintained at acceptable rates because high DO alone does not guarantee optimum embryo development. In redds with similar DO concentrations, but different apparent velocities, embryonic development may be better in the redds with the higher rate of water exchange (Coble 1961). Mathematical models have been developed to estimate apparent velocity in redds (Bovee and Cochnauer 1977) and to assess transfer of DO between the stream and substrate (Chevalier and Carson 1985), concentrations of intragravel DO (Chevalier and Murphy 1985), salmonid egg respiration (Carson 1985), and fry emergence (Miller 1985).

Temperature

Water temperature during incubation affects the rate of embryo and alevin development and the capacity of water for dissolved oxygen, and (beyond certain limits) survival of the young fish. There are upper and lower temperature limits (thresholds) for successful incubation of salmonid eggs (Table 4.3). In general, the higher the temperature (within the acceptable range), the faster the rate of development and the shorter the incubation period and time to emergence. The amount of time required for embryos to hatch and for alevins to emerge from redds varies by species and perhaps by location. For example, time to 50% hatch for Pacific salmon species ranges from 115 to 150 d at 4°C and from 35 to 60 d at 12°C; coho salmon require the least time and sockeye salmon the most (Alderdice

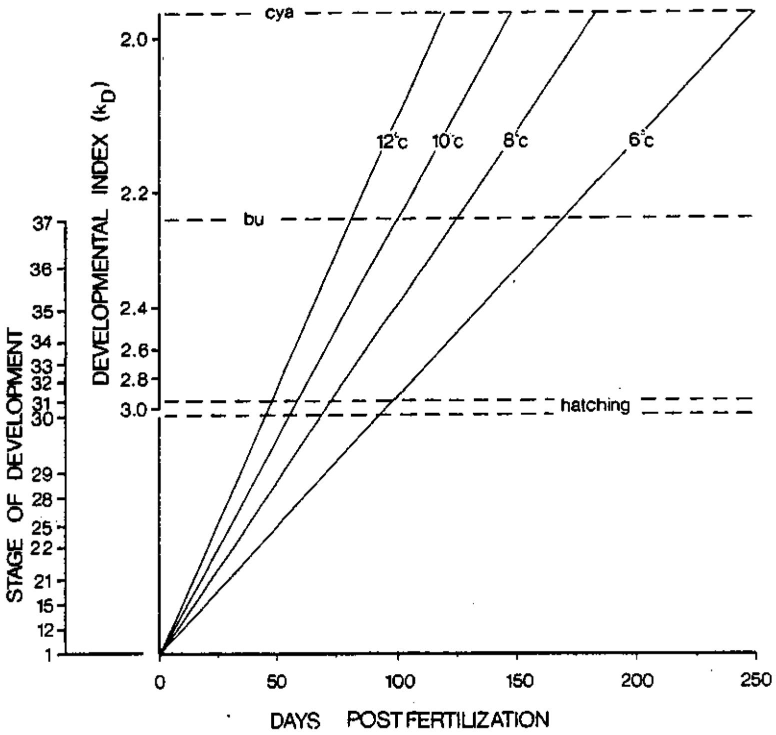

FIGURE 4.16.—Effect of temperature on the development of chinook salmon according to Vernier's (1969) stages of development and Bams's (1970) developmental index (k_D) in a graph from Heming (1982). In the graph, bu = button-up stage of development and cya = complete yolk absorption.

and Velsen 1978; Tang et al. 1987; Velsen 1987). Steelhead and rainbow trout require about 85 d at 4°C and 26 d at 12°C to reach 50% hatch. Heming (1982) graphed stage of development against time (Figure 4.16) for chinook salmon raised experimentally at several temperatures; from these graphs, he estimated emergence at 192 d at 6°C and 85 d at 12°C, about twice the time to 50% hatch. In field studies on the Columbia River, Chapman et al. (1982) found that Heming's curves were reasonable predictors of the time chinook salmon fry emerge. Time to hatch for lake trout is similar to that of chinook salmon, 80–90 d at 6°C (Dwyer 1987).

In many streams in which salmonids spawn, winter temperatures are lower than the 4.4°C minimum recommended for incubation in Table 4.3, but the eggs develop normally because spawning and initial embryo development occur when temperatures are within the suitable range. Combs and Burrows (1957) and Combs (1965) reported that pink and chinook salmon embryos could tolerate long periods of low temperature if the initial temperature was above 6.0°C and embryogenesis had proceeded to a critical developmental stage before the onset of lower water temperatures. Combs and Burrows (1957) believed that salmon produced from eggs deposited in water colder than 4.5°C would be less viable than fish produced from eggs spawned in warmer water. Wangaard and Burger (1983) reported 3.4°C as the temperature below which some newly spawned chum and pink salmon

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embryos would be killed. Bailey and Evans (1971) defined the lower threshold temperature for pink salmon embryos as 4.5°C. In a summarization of available data, Velsen (1987) reported high mortalities for all Pacific salmon and steelhead when water temperatures were lower than 2–3°C after fertilization. Jungwirth and Winkler (1984) reported that embryos of fall-spawning fishes develop more slowly at any temperature, and have lower upper lethal incubation temperatures, than progeny of spring spawners. Incubation temperatures can also affect the size of newly hatched alevins. When Beacham and Murray (1985) incubated chum salmon eggs at temperatures of 4, 8, and 12°C, the newly hatched alevins incubated at 4°C were the longest, and those at 12°C were the heaviest, but there was no difference in size at emergence. Reiser and White (1981b) observed similar early differences among chinook salmon, which then reached equivalent sizes after 57 d of rearing.

Intragravel water temperatures are influenced by temperatures of the surface water, the thermal mass of the substrate, and the interchange rate of surface and intragravel water. Ringler and Hall (1975) observed that temperatures of intragravel water reached diurnal maxima 2–6 h after those of surface waters in an Oregon stream. Chapman et al. (1982) observed temperature lags of 2–8 h between surface and intragravel waters. There are seasonal as well as daily differences: intragravel water temperatures often are lower than surface water temperatures during summer, and higher during winter (Shepherd et al. 1986a). When salmonids spawn in areas close to groundwater inflows (Hansen 1975; Witzel and MacCrimmon 1983; Wilson 1984; Vining et al. 1985), embryos experience reduced extremes in water temperatures than they would otherwise.

Incubating embryos and alevins can be killed when frazil or anchor ice forms in streams and reduces water interchange between the stream and the redd. Anchor ice normally forms in shallow water typical of spawning areas and may completely blanket the substrate. Ice dams may impede flow or even dewater spawning areas. When such dams melt, the released water may, floodlike, displace the streambed and scour the redds. In an experiment by Reiser and Wesche (1977), eggs placed in plastic-mesh boxes 15 cm below the surface of the streambed completely froze even though the stream above was more than 13 cm deep. Anchor ice had formed at least twice during the incubation period. Neave (1953) and McNeil (1966b) also reported that embryo survival was poor at freezing temperatures.

Rearing in Fresh Water

The abundance of juvenile salmon, trout, and char in streams is a function of many factors, including abundance of newly emerged fry, quantity and quality of suitable habitat, abundance and composition of food, and interactions with other fish, birds, and mammals. Fausch et al. (1988) reviewed many of the models developed in recent years to predict the abundance of fish in streams from habitat variables. We next discuss variables of habitat quantity and quality, and where possible, list the preferences of juvenile salmonids.

The abundance of older fish generally increases as the abundance of juveniles increases until an upper limit (here termed carrying capacity) is reached. We believe that the relation between the seeding level—the number of young fish emplaced in a stream by adult fish or humans—and the abundance of older fish is

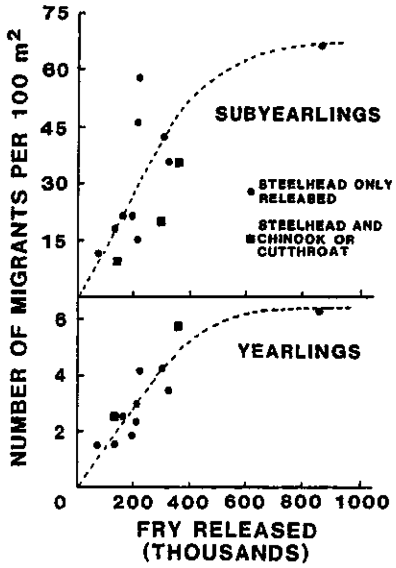

FIGURE 4.17.—Relation between the number of steelhead fry released in Big Springs Creek, Idaho, and the number of subyearling and yearling rainbow trout and steelhead per 100 m² that migrated from the stream. Each point represents one of the 1962–1974 year-classes (1962–1973 for yearlings); curves were fitted by inspection. (From Bjornn 1978.)

asymptotic for most salmonids that spend an extended period in streams. At relatively low seeding levels, environmental conditions that set the carrying capacity of a stream for a given age group of fish will place little constraint on the abundance of juveniles and older fish. As spawner abundance (or stocking) approaches that needed for full seeding, the biotic or physical factors that set the carrying capacity come into full play. Habitat variables we discuss here may set the carrying capacity of streams for salmonid fishes, but interactions among many of the relevant physical and biotic variables have not been well defined. In addition, variables that are important in one stream or season may be relatively unimportant in another.

Changes in spawner abundance and variation in the success of incubation and emergence affect the number of young fish entering a stream. Changes in the abundance of newly emerged fry can result in large or insignificant changes in abundance of older fish, depending on the shape of the reproduction curve and actual fry abundance. In two productive Idaho streams, the abundance of older steelhead was primarily a function of the number of newly emerged juveniles placed in the stream at seeding rates up to about 6 fish/m² (Bjornn 1978) (Figure 4.17). When steelhead were stocked at a rate of 12/m² in Big Springs Creek (right-most point in Figure 4.17), no more subyearlings or yearlings were produced than when 6/m² were stocked—evidence that the carrying capacity had been reached. In the Lemhi River, about the same number of steelhead smolts were produced (75,000–80,000) from releases of 2.5 and 4.6 million newly emerged juveniles—additional evidence that carrying capacity had been achieved. The carrying capacity for chinook salmon in the Lemhi River was not reached during 12 years of study in which natural egg-deposition rates ranged from 2 to 8/m² (Figure 4.18).

In less-productive Idaho streams, seeding rate (abundance of spawners) was the main factor regulating the abundance of juvenile steelhead (Figure 4.19) and chinook salmon when spawner abundance was relatively low. In Marsh Creek,

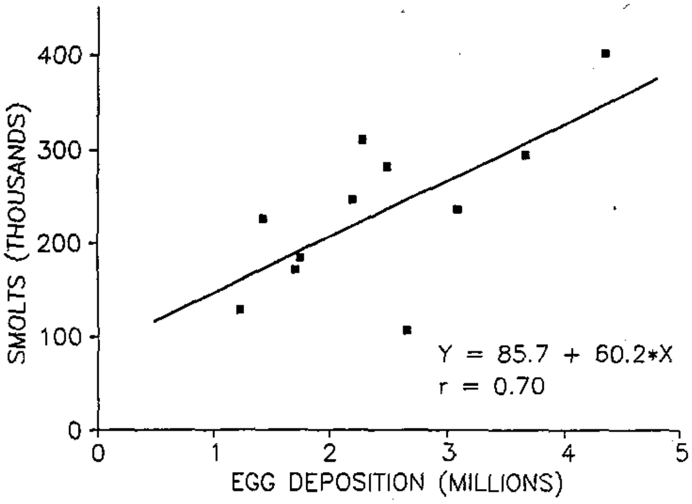

FIGURE 4.18.—Egg deposition *(X)* by adult chinook salmon in the upper Lemhi River, Idaho, and number of smolt-sized fish *(Y)* that later migrated past the Lemhi River weir during fall, winter, and spring, 1963–1973. (From Bjornn 1978.)

one of the relatively unproductive streams, the density of juvenile chinook salmon, monitored irregularly over 12 years, was related to spawner abundance over a nearly 20-fold range (Figure 4.20). Sekulich (1980) presented evidence that the summer carrying capacity for naturally produced salmon in the relatively unproductive streams was 2–3 g/m^2, lower than the carrying capacity of at least 13 g/m^2 in the relatively productive Lemhi River (Bjornn 1978). In Pacific coast streams, the biomass of coho salmon averaged 2–3 g/m^2 in several studies (Cederholm and Reid 1987).

The number of chinook salmon smolts produced in two Lake Michigan tributaries with alternating pool–riffle habitats was independent of the threefold difference in spawner densities that occurred in 2 years of study (Carl 1984). Even at their lower density, spawners apparently seeded the rearing area fully (about 80 spawners per hectare, 0.7–2.9 newly emerged fish per square meter).

For a given level of seeding, what factors in the stream environment regulate abundance or set the carrying capacity for juvenile salmonids? Density-independent environmental factors (amount of suitable habitat, quality of cover, productivity of the stream, and certain types of predation) set an upper limit on the abundance of juveniles, and the population is held to that level by interactions that function in a density-dependent fashion (competition and some types of predation). Carrying capacity, and hence fish production, may vary yearly if controlling habitat components, such as streamflow, vary widely from year to year at critical periods such as late summer (Smoker 1955). The carrying capacity of a stream may also vary with the season, differing, for example, between winter and summer (Bjornn 1978), and it may differ for the various life stages of fish.

Environmental factors can affect the distribution and abundance of juvenile salmonids throughout a stream or drainage or within specific segments of streams.

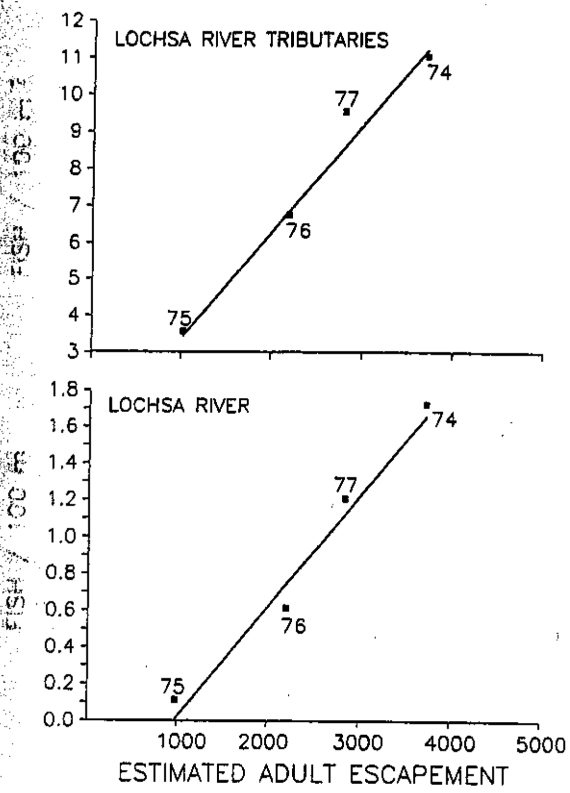

FIGURE 4.19.—Observed density of age-1 steelhead in relation to estimated number of adults returning to the Lochsa River and its tributaries, Idaho, 1974–1977. (Redrawn from Mabbott 1982.)

Temperature, productivity, suitable space, and water quality (turbidity, DO, etc.) are examples of variables that regulate the general distribution and abundance of fish within a stream or drainage. Factors to which fish respond at specific locations in a stream are velocity, depth, substrate, cover, predators, and competitors. Fish often spawn in limited parts of a drainage (sometimes in ephemeral streams), but

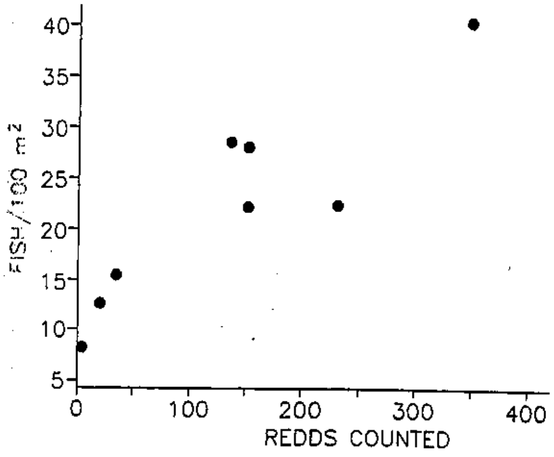

FIGURE 4.20.—Relation between chinook salmon redds counted and density of age-0 juveniles the following summer in an Idaho stream. (Authors' original data.)

the juveniles spread out and occupy most of the areas that are suitable and accessible (Everest 1973; Leider et al. 1986).

All of the general factors must be within suitable ranges for salmonids during the time they use a stream segment; otherwise, no fish will be present and there will be no concern about site-specific factors. Rarely, if ever, are most factors optimum for salmonid production. Often some factors may be near optimum while others are suboptimum but still in a suitable range.

Temperature

Salmonids are coldwater fish with definite temperature requirements during rearing. Water temperature influences the metabolism, behavior, and mortality of fish and the other organisms in their environment (Mihursky and Kennedy 1967). Although fish may survive at temperatures near the extremes of the suitable range, growth is reduced at low temperatures—because all metabolic processes are slowed—and at high temperatures—because most or all food must be used for maintenance. Many salmonids change behavior with increases or decreases in temperature.

Normal water temperatures in salmonid streams vary daily, seasonally, annually, and spatially. Humans have altered temperature patterns by changing riparian zone vegetation, diverting water, building reservoirs, and discharging hot water from power plants. Alterations of natural light and temperature patterns in streams can be beneficial or detrimental, depending on the situation, but the consequences of marked changes in the temperature regime of a stream are not fully understood. Small streams in dense forests of the Pacific Northwest, for example, might be too cold in summer for maximum growth of salmonids (Chapman and Knudsen 1980), but warming the stream by altering the riparian vegetation (Gray and Edington 1969; Narver 1972a; Moring 1975a; Moring and Lantz 1975; Murphy et al. 1981; Johnson et al. 1986; Murphy et al. 1986; Beschta et al. 1987) might not enhance growth unless food abundance can satisfy the increase in fish metabolism and other needs of the fish are met (Brett et al. 1969; Hughes and Davis 1986; Hartman et al. 1987; Holtby 1988a). Care must be taken to avoid unwanted warming of downstream waters and excessive loss of cover (both overhead bank and instream) that may be important in winter as well as in summer (Murphy et al. 1986). In many large streams, temperatures become too warm for salmonids in summer for a variety of reasons, including excessive exposure to the sun.

Temperatures that can be tolerated by fishes have been defined and determined in two ways (Brett 1952; Becker and Genoway 1979): slow heating of fish (to reveal the critical thermal maximum, CTM), and abrupt transfer of fish between waters of different temperature (to show the incipient lethal temperature, ILT). In general, upper lethal temperatures determined by the CTM procedure tend to be higher than those established with the ILT technique. The upper ILT for anadromous Pacific salmon, Atlantic salmon, trout, and char range from about 23 to 29°C, depending on species and acclimation temperature (selected examples are in Table 4.8). Half of the upper lethal values presented in Table 4.8 were taken from Brett (1952), who acclimated fish at 20°C and used 50% mortality at 1,000 min as the end point. Lee and Rinne (1980) reported CTM values of 29–30°C for hatchery stocks of rainbow, brown, and brook trout stocked in Arizona and two

TABLE 4.8.—Lower lethal, upper lethal, and preferred temperatures (°C) for selected species of salmon, trout, and char based on techniques to determine incipient lethal temperatures (ILT) and critical thermal maxima (CTM).

Species	Lethal temperature (°C)		Preferred temperature (°C)	Source	Technique
	Lower lethal[a]	Upper lethal[b]			
Chinook salmon	0.8	26.2 79	12–14 54-57	Brett (1952)	ILT
Coho salmon	1.7	26.0 79 28.8[c] 84	12–14	Brett (1952) Becker and Genoway (1979)	ILT CTM
Sockeye salmon	3.1	25.8	12–14	Brett (1952)	ILT
Chum salmon	0.5	25.4	12–14	Brett (1952)	ILT
Steelhead	0.0	23.9 75	10–13 50-55	Bell (1986)	
Rainbow trout		29.4 25.0		Lee and Rinne (1980) Charlon et al. (1970)	CTM ILT
Brown trout		29.9 26.7		Lee and Rinne (1980) Brett (1952)	CTM ILT
Gila trout		29.6		Lee and Rinne (1980)	CTM
Apache trout		29.4		Lee and Rinne (1980)	CTM
Brook trout		29.8 25.8	 14–16	Lee and Rinne (1980) Brett (1952) Graham (1949)	CTM ILT
Cutthroat trout	0.6	22.8		Bell (1986)	
Atlantic salmon		27.1 27.8		Brett (1952) Garside (1973)	ILT ILT
Lake trout		25.0		Brett (1952)	ILT

[a] Acclimation temperature was 10°C; no mortality occurred in 5.500 min.
[b] Acclimation temperature was 20°C unless noted otherwise; 50% mortality occurred in 1,000 min.
[c] Acclimation temperature was 15°C.

native trouts (Gila trout and Apache trout) when these fish were acclimated at 20°C and subjected to a temperature change rate of 1.2°C/h. Although some salmonids can survive at relatively high temperatures, most are placed in life-threatening conditions when temperatures exceed 23–25°C, and they usually try to avoid such temperatures by moving to other areas.

Lower lethal temperatures for salmonids depend somewhat on previous acclimation (Brett 1952) but they probably are no lower than −0.1°C (Brett and Alderdice 1958). Temperatures in the range of 1 to 4°C can be lethal if fish acclimated in warmer water are transferred abruptly into the cold water. Under natural conditions, fish are not subjected to cold water (<4°C) without prior acclimation in gradually decreasing temperatures, and thus lower lethal temperatures for most species are near 0°C.

Daily summer temperatures can fluctuate more than 15°C in small streams with flows less than 1 m^3/s and little or no shade (Meehan 1970; Bjornn 1978).

Temperatures can increase rapidly in a short distance under direct sunlight: 6°C in 1,000 m within a stream flowing at about 1.4 m^3/s in central Idaho, for example (Bjornn et al. 1968). As stream size and water mass increase, daily temperatures of streams fluctuate less and tend to reflect the local climate near the stream.

Many populations of native salmonids respond to natural temperature patterns in streams by moving upstream or downstream when water temperatures become unsuitable. Fish may use a section of stream during one season of the year, but move to other sections at other seasons because temperatures become unsuitable. Salmonids may not always avoid unsuitable temperatures, however, especially if the temperatures change rapidly and are not part of the normal pattern in which the fish evolved. Munson et al. (1980) found that rainbow trout accustomed to feeding in a certain location continued to enter the area after temperatures had been changed to a lethal level.

In small streams where daily maximum temperatures approach upper incipient lethal values, salmonids can thrive if the temperature is high for only a short time and then declines well into the optimum range. In an Idaho stream with daily maximum temperatures up to 24°C that lasted less than 1 h and minimums of 8–12°C, juvenile chinook salmon and steelhead maintained high densities and grew normally (Bjornn 1978). In larger Idaho streams where summer maximum temperatures were 24–26°C, but the minimums were relatively high (15–16°C), most young salmon and trout moved upstream or into tributaries where temperatures were lower (Mabbott 1982).

As water temperatures in temperate-zone streams decline in autumn, salmonids change behavior from mostly feeding and defending territory to hiding and schooling. The winter behavior patterns appear to us to be motivated by security. Fish that were curious and easily approached by divers in summer become wary and often dart from view in winter. Winter water temperatures in streams can range from freezing to relatively moderate, according to geographic and groundwater influences. Temperatures in coastal streams often are moderated by maritime climates. Inland, streams can become filled with flow ice, anchor ice, and ice jams during extreme cold spells. The temperature at which the change in behavior occurs apparently varies by species. Chapman and Bjornn (1969) reported that most of the steelhead and chinook salmon juveniles they tested in winter were visible above the substrate at 6°C but hid at 4°C (Figure 4.21). In a British Columbia stream, juvenile coho salmon and steelhead began shifting to winter positions at about 7°C (Bustard and Narver 1975a). Gibson (1978) found that Atlantic salmon began entering the interstitial spaces of rubble substrate in autumn when water temperatures dropped to 10°C, and most had disappeared at 9°C.

The response of salmonids to the lower temperatures that occur in autumn and winter in temperate streams can vary by species and size of fish. Small fish (<15–20 cm) tend to hide in interstitial spaces in the substrate of streams, or in other forms of cover if available, and may move to shallower water (Bustard and Narver 1975a; Gibson 1978), whereas larger fish may join together in schools and move long distances to find suitable winter habitat. In the Lemhi River drainage, Idaho, a large fraction of the young chinook salmon and steelhead moved downstream from rearing areas after their first summer (Bjornn 1971). The chinook salmon moved down into the Salmon River and even the Snake River

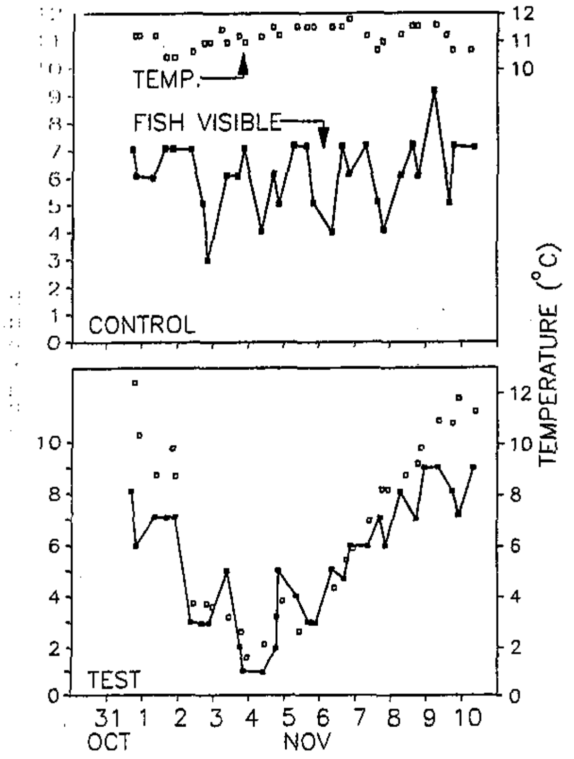

FIGURE 4.21.—Water temperature and number of age-0 steelhead visible above the substrate in test and control vats. (From Chapman and Bjornn 1969.)

(50–200 km) to spend the winter before continuing to the ocean as smolts the following spring. The steelhead moved downstream out of a tributary with a high summer carrying capacity (at least 12 g/m^2) but a lower winter carrying capacity, and spent the winter, the next summer, and the following winter in the larger stream before going to the ocean the following spring. Both the chinook salmon and steelhead moved downstream in response to low winter temperatures and a lack of winter cover. Fish migrating downstream in the fall ceased moving when placed in channels with large rock piles (which contained interstitial spaces used in winter) but continued moving downstream when placed in channels without the rock piles (Bjornn and Morrill 1972). In contrast, few juvenile cutthroat trout moved downstream in autumn in tributaries of other Idaho streams where densities were lower (2.1 g/m^2) and adequate amounts of suitable winter cover were apparently present (Mauser 1972). On sunny autumn days, the cutthroat trout could be seen in the stream in the afternoon when temperatures approached the daily high (8–10°C), but were not visible in the morning when temperatures were low (3–5°C).

Larger fish that may not be able to use voids in the substrate to hide in winter have been observed joining together in large schools (600 fish) and in some cases moving long distances in fall and spring. In the Coeur d'Alene River of Idaho, Lewynsky (1986) counted fish along transects throughout the summer, fall, and winter; in winter, larger (>20 cm) cutthroat trout moved from dispersed summer feeding stations throughout the river to a few large pools, where they became much more wary and difficult to approach. The extent of seasonal movements of fish in response to temperature is illustrated by migrations of cutthroat and bull trout more than 100 km downstream in autumn and back upstream in spring and early summer in the Salmon River, Idaho (Bjornn and Mallet 1964). Winter temperatures and ice conditions apparently were unsuitable in the upper portions of the Middle Fork drainage and most of the fish larger than 15 cm moved. Temperatures in the main-stem rivers became marginal in summer for salmonids.

Temperature is one of the factors that contribute to quality of habitat for fish. If temperature is in a tolerable range for the fish, the question of optimum temperature becomes pertinent. Optimum temperature could be defined in relation to a variety of population or individual variables, including temperature preference, growth, efficiency of converting food to tissue, standing crops, and swimming performance. When Brett (1952) placed five species of Pacific salmon in a vertical temperature gradient, they all tended to congregate in the 12–14°C stratum.

Optimum temperatures, measured in terms of fish growth rate and food conversion efficiency, vary with the amount of food available. Brett et al. (1969) reported that growth of yearling sockeye salmon was highest at about 5°C when the daily ration (percent of body weight) available was 1.5%, but shifted to about 15°C when the ration was 6%. At highest temperatures, the growth rate declined regardless of food abundance. Food conversion efficiency peaked at 8–11°C (Brett et al. 1969)—lower than the 15°C associated with maximum growth, optimum metabolic scope for activity, greatest tolerance of oxygen debt, and maximum sustained swimming speed (Brett 1964). After tests with Atlantic salmon, Dwyer and Piper (1987) reported that maximum growth with unlimited food was attained at 16–19°C, but that growth efficiency was highest at 10–16°C.

Similar relations—with variations in the optimum temperature or temperature range—probably exist for other species. The optimum temperature for brook trout, for example, appears to be 14–16°C. Graham (1949), as reported in Mihursky and Kennedy (1967), listed 14–16°C as the temperature preferendum for brook trout, and Beamish (1964) gave 15°C as the temperature for maximum spontaneous activity. Dwyer et al. (1983) reported that brook trout grew most efficiently at 10 and 13°C. Jensen and Johnsen (1986) presented evidence that stocks of fish may be able to adapt to temperatures that might otherwise make their existence unlikely.

Brett et al. (1958) reported that the optimum temperature for sustained swimming was 15°C for sockeye and 20°C for coho salmon (Figure 4.22), and that maximum sustained swimming speeds at these temperatures were 35 and 30 cm/s, respectively. Sustained swimming performance was reduced to about 12 cm/s for sockeye salmon and to 6 cm/s for coho salmon at temperatures near 0°C. Davis et al. (1963) also found that the maximum sustained swimming speed of underyearling coho salmon was higher at 20°C than at 15 or 10°C. In a study of the critical swimming speeds of yearling rainbow trout as a measure of temperature preference, Schneider and Connors (1982) found no significant differences at 10, 15, or 20°C, but swimming performance was reduced at 25°C. The 25°C test temperature was 2°C less than the ILT measured for rainbow trout by Charlon et al. (1970).

The effect of water temperature on fish behavior and the regulation of densities in streams is not well understood, but there is some evidence that densities or

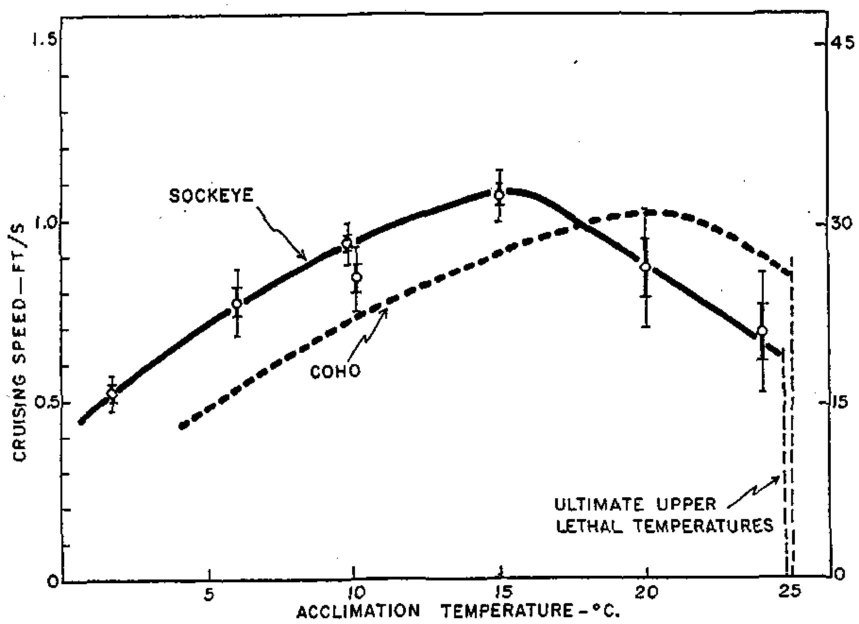

FIGURE 4.22.—Variation in cruising speed among temperature-acclimated underyearling sockeye and coho salmon, adjusted to common mean lengths of 6.9 cm and 5.4 cm, respectively. The fish were cultured under similar conditions and were 4 to 6 months of age. The sockeye salmon data are means (circles), standard errors (heavy vertical bars), and standard deviations. (From Brett et al. 1958.)

even production of fish may be less at high (but suitable) temperatures than at lower ones. In laboratory stream studies, Hahn (1977) found that twice as many steelhead fry remained in channels with daily temperature fluctuations of 8–19°C or a constant temperature of 13.5°C than in a channel held at a constant 18.5°C. At constant 8.5°C, the density of fish was twice that found in channels held at 13.5°C. Hughes and Davis (1986), who studied coho salmon and steelhead in laboratory streams, concluded that a moderate (4°C) increase in temperature could decrease the productivity of streams for those species when food is limiting. Glova (1986) found that habitat use by juvenile coho salmon and cutthroat trout in summer, when temperatures were 13°C, was different from that in winter, when temperatures were colder. When tested separately in summer, most fish of both species took up residence in pools, but, when tested together, most of the coho salmon stayed in pools and cutthroat trout remained in riffles. In winter at temperatures of 3°C, both species, whether together or separate, preferred pools and overhead cover.

Changes in water temperatures resulting from land and water use may affect fish indirectly as well as directly. In a small Vancouver Island stream, coho salmon emerged earlier when winter water temperatures became higher after logging, and detrimental downstream movement of the newly emerged fish occurred when freshets took place soon after emergence (Scrivener and Andersen 1984). Growth rate of coho salmon juveniles was inversely related to density in the stream, and the fish were larger in autumn after logging than before because of the earlier

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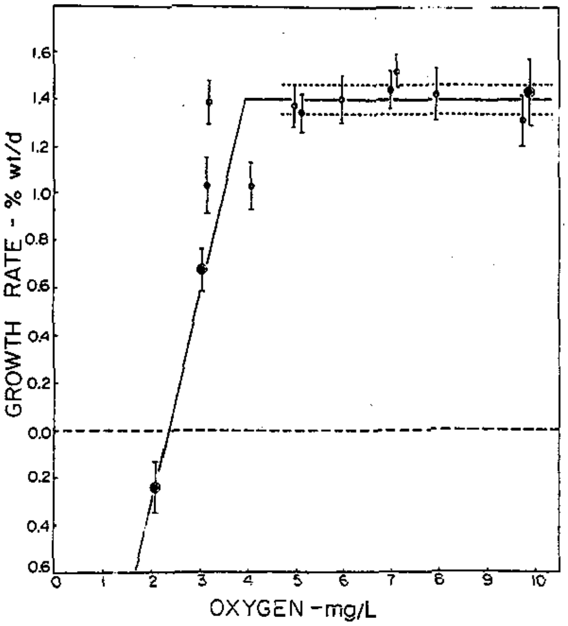

FIGURE 4.23.—Specific growth rate (percent of body weight per day ± SE) of fingerling coho salmon (5–10 g) in relation to oxygen concentration at 15°C. (From Brett and Blackburn 1981.) Dotted lines are 95% confidence limits for values with dissolved oxygen above 6 mg/L. Sloped line (fitted by eye) defines the zone of dependence of growth on dissolved oxygen.

gence and longer period of growth. A dam on the Rogue River, Oregon, d flows and temperatures in both summer and winter, and changed the g of salmon and steelhead fry emergence, adult migration, fish distribution in iver, and adult mortality (Cramer et al. 1985).

Dissolved Oxygen

The waters of most natural salmonid streams have enough DO for juveniles, although concentrations in small streams may be reduced by large amounts of organic debris when temperatures are high and flows low (Hall and Lantz 1969). Streams downstream from deep, productive reservoirs may have marginally low DO concentrations at times if the discharge comes from the hypolimnion. The DO must be above a critical level for salmonids to exist in streams. Rainbow trout have survived laboratory tests at DO concentrations of less than 2 mg/L (Alabaster et al. 1957), and the survival threshold concentration for Atlantic salmon smolts is about 3.3 mg/L (Alabaster et al. 1979), but growth rate (Figure 4.23) and food conversion efficiency (Figure 4.24) are probably limited by concentrations less than 5 mg/L. Davis (1975), who reviewed information on incipient DO response thresholds and developed oxygen criteria related to concentration, water temperature, and percent saturation (Table 4.9), concluded that salmonids would not be impaired at concentrations near 8 mg/L (76–93% saturation), and that initial symptoms of DO deprivation would occur at about 6 mg/L (57–72% saturation). Davis et al. (1963) and Dahlberg et al. (1968) found the maximum sustained swimming performances of coho and chinook salmon decreased when DO concentrations were much below air-saturation levels (about 8–9 mg/L at 20°C).

In summary, salmonids may be able to survive when DO concentrations are relatively low (<5 mg/L), but growth, food conversion efficiency, and swimming

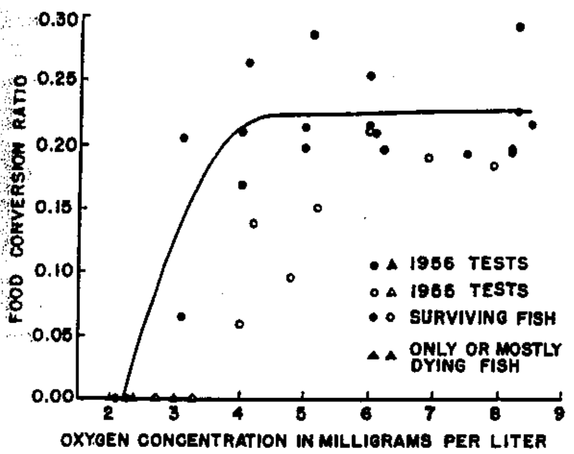

FIGURE 4.24.—Food conversion ratio (weight gained by fish/weight of food consumed) for frequently fed age-0 coho salmon in relation to dissolved oxygen concentration. A food conversion ratio of zero (not a negative ratio) has been assigned to each group of fish that lost weight. The curve has been fitted only to the 1956 data. (From Herrmann et al. 1962.)

performance will be adversely affected. High water temperature, which reduces oxygen solubility, can compound the stress on fish caused by marginal DO concentrations.

Most data on the oxygen requirements of salmonids come from laboratory studies. Brett and Blackburn (1981) appropriately urged caution when such data are extrapolated to fish in natural streams. Water qualities and the biological activities necessary for survival may differ between laboratory and field environments.

Turbidity

In most streams, there are periods when the water is relatively turbid and contains variable amounts of suspended sediments. Larger juvenile and adult salmon and trout appear to be little affected by ephemerally high concentrations of suspended sediments that occur during most storms and episodes of snowmelt (Cordone and Kelley 1961; Sorenson et al. 1977). Bisson and Bilby (1982) reported, however, that juvenile coho salmon avoided water with turbidities that exceeded 70 NTU (nephelometric turbidity units), which may occur in certain types of watersheds and with severe erosion. Berg and Northcote (1985) reported that feeding and territorial behavior of juvenile coho salmon were disrupted by short-term exposures (2.5–4.5 d) to turbid water (up to 60 NTU).

Newly emerged fry appear to be more susceptible to even moderate turbidities than are older fish. Turbidities in the 25–50-NTU range (equivalent to 125–275 mg/L of bentonite clay) reduced growth and caused more young coho salmon and steelhead to emigrate from laboratory streams than did clear water (Sigler et al.

TABLE 4.9.—Response of freshwater salmonid populations to three concentrations of dissolved oxygen. (Modified from Davis 1975.)

Response	Dissolved oxygen (mg/L)	Percent saturation at temperature (°C)					
		0	5	10	15	20	25
Function without impairment	7.75	76	76	76	76	85	93
Initial distress symptoms	6.00	57	57	57	59	65	72
Most fish affected by lack of oxygen	4.25	38	38	38	42	46	51

1984). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities (Lloyd et al. 1987), except when the fish have to traverse them along migration routes.

Productivity of Streams

Streams vary in productivity due largely to the nutrients and energy available. The rates of primary and secondary production largely determine the amount of food available to fish. A detailed discussion of energy sources and processes is presented by Murphy and Meehan (1991, this volume).

The amount of food available to fish is one of the factors that set the salmonid carrying capacity of streams. In many infertile streams, summer fish production appears to be food-limited. A change in fish production, density, or growth when food availability increases or decreases is proof of food limitation. More coho salmon could be produced in a small Vancouver Island stream during summer when Mason (1976) increased the amount of food available. In another Vancouver Island stream, Slaney et al. (1986) added inorganic fertilizers (phosphorus and nitrogen) to a 29-km section and found large increases in primary production, no significant changes in invertebrate abundance and fish density, and significant increases in trout growth. The increased growth allowed steelhead to become smolts at a younger age; because this period of juvenile mortality was reduced, the stream produced more smolts.

Positive correlations between stream productivity and production, standing crops, and growth of brown trout were observed by McFadden and Cooper (1962). In Idaho streams that differed in conductivity by a factor of 10 (40 to 400 μS/cm^3), the production and standing crop of age-0 chinook salmon differed by a similar factor (T. C. Bjornn, unpublished data). Konopacky (1984) found juvenile chinook salmon and steelhead lost weight and eventually left laboratory streams when no food was supplied; he also found proportionate increases in production, but not in density, in response to two levels of daily ration. Wilzbach (1985) reported that most cutthroat trout left laboratory channels when they were given a daily ration of frozen brine shrimp equal to only 5% of their body weight, whether cover was provided or not, but they stayed when given a 15% ration.

Brett et al. (1969) defined the daily rations needed for maximum growth of sockeye salmon at various temperatures. If this relation is similar for other species of salmon and trout, a yearling salmonid in a stream with daily mean temperature of 10°C would need a daily food supply equivalent to 6–7% of its body weight to attain maximum growth. In streams that are food-limited, maximum growth rates may not be achieved by the fish because that may not be the most efficient use of resources. The social interactions that fish use to regulate densities and respond to food abundance may result in more fish growing at less-than-maximum rates, rather than fewer fish growing at maximum rates.

Juvenile salmonids can consume a large fraction of the invertebrates drifting during daylight in the streams they occupy (Allan 1982; Wilzbach et al. 1986), but fish do not appear to regulate the abundance of benthic or drifting invertebrates in streams except in very limited situations of time and space (Allan 1983). Production of aquatic invertebrates that juvenile salmonids eat depends on the amount of organic material available in streams. Bilby and Likens (1980) showed the importance of debris dams in small streams for the accumulation of coarse particulate organic matter. Nearly 75% of the organic matter deposited in first-order streams was associated with the dams, versus 58% in second-order streams and 20% in third-order streams. Fish also eat terrestrial invertebrates that are associated with vegetation surrounding streams.

Space

Space suitable for occupancy by salmonids in streams is a function of streamflow, channel morphometry, gradient, and (in many instances) various forms of instream or riparian cover. Suitable space for each salmonid life stage has water of sufficient depth and quality flowing at appropriate velocities. The addition of cover (extra depth, preferred substrates, woody debris, etc.) increases the complexity of the space and usually the carrying capacity. The addition of certain types of cover (overhead, for example) may make some areas in streams suitable for fish that would not otherwise be used.

The space an individual fish needs and uses—in some instances a territory—is a part of the total suitable space available. Food abundance (Chapman 1966), the competitors (Fausch and White 1981, 1986) and predators present, and the complexity of the habitat determine what part of the available suitable space an individual fish uses.

Fish densities in streams provide a measure of the spatial requirements of juvenile salmonids, but the wide variation in observed densities illustrates the diversity of habitat quantity and quality and other factors that regulate fish abundance. In a productive Idaho stream, end-of-summer densities of age-0 chinook salmon (9.6 g mean weight) have been as high as 1.35 fish/m^2 and 12.9 g/m^2 (Bjornn 1978). With the age-0 steelhead (4.5 g) also produced in the stream, the combined densities were 2.05 fish/m^2 and 16.1 g/m^2. These salmonids were not uniformly distributed throughout the length of the stream and densities in some sections were as high as 3.4 fish/m^2 (21.8 g/m^2). Total salmonid density, including the age-1 and older fish, has been as high as 3.5 fish/m^2 and 27.0 g/m^2. Spring-to-fall production (tissue elaborated) by age-0 chinook salmon and steelhead has been measured at rates as high as 20.3 g/m^2.

In less productive third- and fourth-order streams in Idaho, age-0 chinook salmon were less dense (usually <0.8 fish/m^2), the fish grew slower (end-of-summer weight, about 5 g), biomass standing crops were only 1–3 g/m^2, and few fish of other species were produced. Summer production was 1–2 g/m^2 (T. C. Bjornn, unpublished data). In coastal and inland British Columbia streams, Shepherd et al. (1986b) reported overall maximum densities of 0.14 age-0 chinook salmon/m^2 (five streams) and 0.41 age-0 and age-1 coho salmon/m^2 (nine streams).

Salmonids, especially the juveniles, also use the space available in side channels for rearing. Mundie and Traber (1983) found higher densities of steelhead (0.66 smolts/m^2 and 9.94 g/m^2) and coho salmon (0.85 smolts/m^2 and 12.8 g/m^2) in side-channel pools than are commonly found in the main channels of Pacific coastal streams. Peterson (1982a, 1982b) reported coho salmon moving into side-channel pools for the winter.

The amount of space needed by fish increases with age and size. Allen (1969) assembled data on densities for a variety of salmonids and found a positive relation between area per fish in streams and age (Figure 4.25) or length. For the streams he evaluated, 7–10-cm fish (which had completed the first year of life)

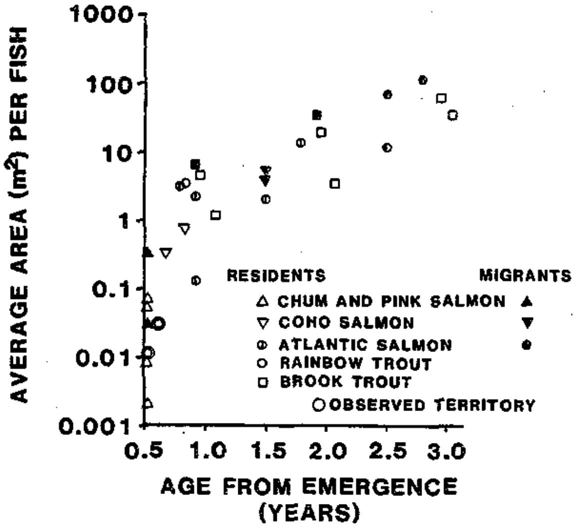

FIGURE 4.25.—Average area per fish (on a logarithmic scale) versus age for several salmonids in streams. (Redrawn from Allen 1969.)

were found at densities of 0.1 to 1.0 fish/m^2 (10-cm fish averaged 0.17 fish/m^2 and 1.7 g/m^2). Densities of larger and older fish were usually less than 0.1 fish/m^2.

Based on the foregoing, the summer space requirements of juvenile salmonids during their first year in streams probably range from 0.25 to 10 m^2 of stream per fish, depending on such things as the species and age composition of fish present, stream productivity, and quality of the space. The space required in winter has not been as well defined.

The presence of abundant space does not necessarily mean there will be large numbers of fish. The space must be in the right context with other needs of the fish. For example, the abundance of age-0 chinook salmon in some infertile Idaho nursery streams appeared to be asymptotically related to the size of pools (Figure 4.26). In pools up to about 200 m^2 in area (volume, 150 m^3), the number (or biomass) of fish observed was directly related to size of the pools. In larger pools, however, much of the space in the downstream portions was unused, despite the presence of suitable depths and velocities. Fish abundance was probably food-limited in these streams and thus the fish were concentrated in the upper portions of each pool, close to the incoming food supply.

The effect of reducing space available to fish in small pools of third-order streams was illustrated by Bjornn et al. (1977) in a stream sedimentation experiment. When sand was added to a natural pool, reducing pool volume by half and surface area of water deeper than 0.3 m by two-thirds, fish numbers declined by two-thirds.

Streamflow.—Streamflow, one of the basic determinants of the amount of space available for fish, varies seasonally in ways that depend on geography and climate. In coastal streams, flows are often high in winter because of heavy rain and snowfall. In inland areas, flows are most often high in spring as a result of snowmelt, but rain-on-snow events occasionally cause high flows in winter. In most unregulated salmonid streams of North America, flows are usually lowest in late summer, fall, or winter (Stalnaker and Arnette 1976a). Diversion of water

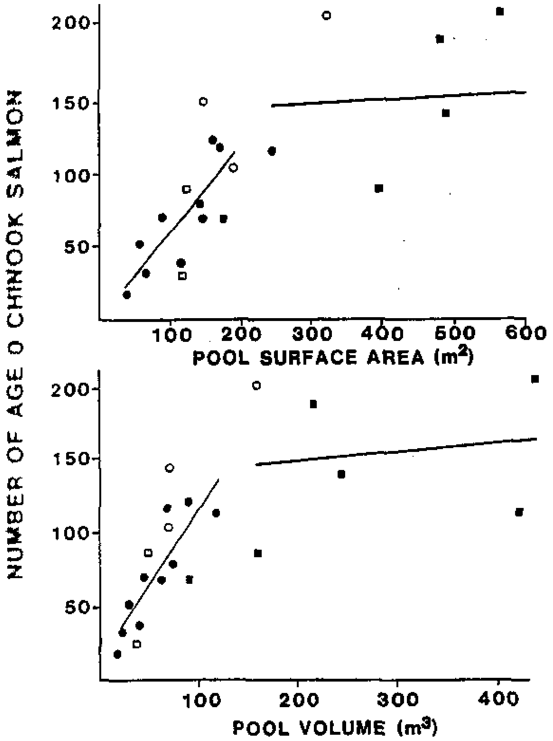

FIGURE 4.26.—Relation between pool surface area or volume in several Idaho streams (denoted by different symbols) and number of juvenile chinook salmon per pool. (Redrawn from Konopacky 1984.)

from streams and storage of water for municipal, agricultural, flood control, and hydropower uses usually lead to altered streamflows and potential changes in the carrying capacity of streams for salmonid fishes. The relation between streamflow and carrying capacity could vary with channel geometry and surrounding land forms; it probably differs, for example, between streams consisting mostly of riffles in a V-shaped canyon and streams with alternating pools and riffles in a broad valley. In general, the relation must start at the origin (no flow, no fish), increase (perhaps not uniformly) with increases in flow up to a point, and then level off or decline if flows become excessive. The relation between flow and carrying capacity is difficult to assess directly in natural streams, however, and there are few studies for reference. The roles of flow magnitude and seasonality in setting the carrying capacity of a stream have not been well defined.

Kraft (1972) diverted water from a 520-m section of natural stream channel in Montana for 3 months in summer and found that both physical stream characteristics and resident brook trout were more affected in runs than in pools. After a 90% reduction from normal summer flows (about 1.0 m³/s), depth in runs decreased 38%, average water velocity decreased 73%, and cover decreased 50%; decreases were smaller in pools. The response of brook trout to the 90% flow reduction was variable, but many fish in the dewatered section moved from runs into pools; the number of fish decreased an average 62% in dewatered runs compared with 20% in runs that were not dewatered (Figure 4.27).

In an Oregon flume studied by White et al. (1981), water velocities, depths, wetted perimeters, and surface areas in runs declined with decreases in flow, as

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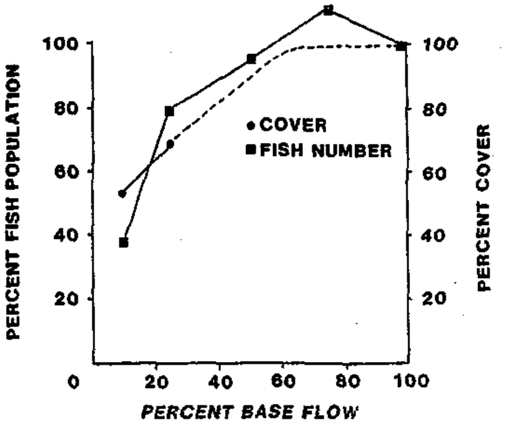

FIGURE 4.27.—Relations of fish number and cover to reductions in summer base flow in three runs in Blacktail Creek, Montana. (Data from Kraft 1968, as plotted by White 1976.)

did the abundance of wild steelhead juveniles, but the researchers were unable to determine the relative influences of the physical features on fish abundance. The authors also calculated an index (weighted usable area, WUA) of the amount of suitable habitat in the flumes for juvenile steelhead, based on IFIM. Their estimates of WUA from suitability curves for velocity and depth did not correspond closely with the number of fish remaining at each flow.

The IFIM, although controversial and incompletely validated, is a modeling procedure designed to help evaluate the importance of differing streamflows to the production of fish. The procedure generates a relation between WUA and flow. Typically, WUA increases asymptotically with flow (Figure 4.28), but the estimates can vary widely depending on the velocity and depth suitability indexes used. In an Idaho stream, WUA estimates for age-0 chinook salmon were highest at flows that occurred near the end of summer, and decreased when flows were higher or lower. The WUA values based on velocity and depth were highest for pools, followed by runs, and then riffles.

For IFIM models to be useful, there must be a definable relation between WUA index values and the standing crop or production of fish in a stream. Such relations can exist only if the physical variables included in the model (velocity, depth, substrate, cover, etc.) are the factors that regulate abundance. Stalnaker (1979) found that standing crop of brown trout was strongly correlated with WUA in 19 sections of 8 Wyoming streams. Orth and Maughan (1982) and Conder and Annear (1987) had less success in relating WUA index values to standing crops of fish or to another habitat quality index. Conder and Annear (1987) discussed the use of the IFIM to estimate changes in fish production in streams as related to streamflow. Nickelson et al. (1979) reported on studies of models that could be used to evaluate streamflow requirements of salmonids in Oregon streams. After several years of study, they recommended use of the IFIM with the addition of variables for pool volume and cover.

Smoker (1955) found a correlation between the commercial catch of coho salmon and annual runoff, summer flow, and lowest monthly flow in 21 western Washington drainages 2 years previously; the data covered the years 1935–1954. In the last two decades, hatchery production of coho salmon smolts has increased markedly and made such comparisons more difficult, but Mathews and Olson (1980) analyzed data

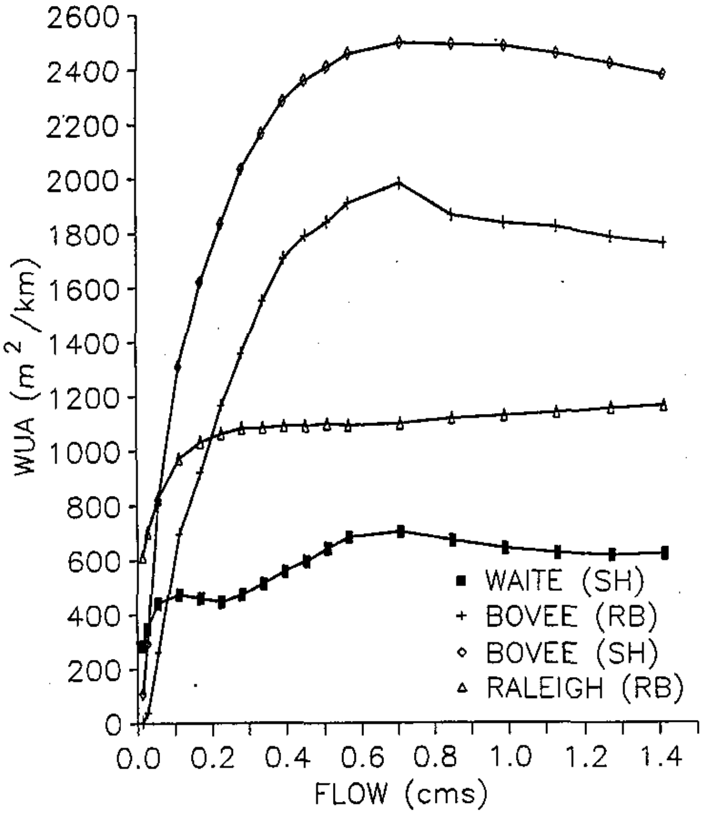

FIGURE 4.28.—Indices of suitable area (weighted usable area, WUA) versus flow (cubic meters per second) for juvenile steelhead (SH) and rainbow trout (RB) in a California stream based on different probability-of-use curves devised by Waite, Bovee, and Raleigh. (Ian Waite, unpublished data.)

from Washington for the years 1952–1977 and found that summer streamflow still had an important influence on total coho salmon production in Puget Sound area streams. Scarnecchia (1981) found that the coho salmon catch off the Oregon coast for the years 1942–1962 was correlated with total flow in five coastal rivers during the salmon's freshwater existence; however, the catch was poorly correlated with the 60-d period of lowest flow in these rivers. Nickelson (1986), in an analysis of coho salmon survival from smolt to adult off the Oregon–California coast, concluded that survival at sea was variable (related to upwelling), but density independent. The implication of the above studies is that the abundance of adult coho salmon is a function of the number of smolts produced, which is in turn related to streamflow and the other factors that regulate the production of smolts.

Velocity.—Given flow in a stream, velocity is probably the next most important factor in determining the amount of suitable space for rearing salmonids (Chapman 1966; deGraaf and Bain 1986); if the velocities are unsuitable, no fish will be present. Natural streams contain a diversity of velocities (Figure 4.29) and depths,

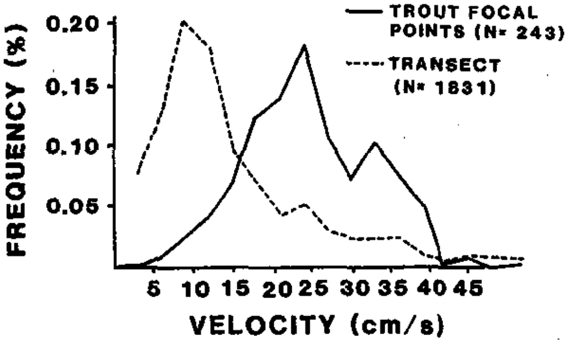

FIGURE 4.29.—Frequency of velocities at sites (focal points) occupied by trout in three sections of Uvas Creek, California, and frequency of velocities measured along transects in the stream. (From Smith and Li 1983.)

some of which are suitable for most salmonids. The velocities required and used by juvenile salmonids vary with size of fish, and sometimes with species. Some juvenile salmonids, as they grow, select sites in streams with increasingly faster velocities (Chapman and Bjornn 1969; Everest and Chapman 1972; Rimmer et al. 1984; Moyle and Baltz 1985), presumably to gain access to more abundant food (Chapman and Bjornn 1969; Fausch 1984). Sites used for feeding over long periods and the size of food items eaten may be selected largely to maximize net energy gain (Bachman 1984).

Water velocities required by fish of various sizes have been estimated from studies of the sites fish occupy in streams and of the swimming performance of fish in laboratories. Use of data from so-called field microhabitat studies to establish velocity and depth requirements has limitations because the sites selected by fish in natural streams are influenced by factors other than their velocity and depth preferences. Interactions with other fishes and the presence and location of cover alter sites selected by fish (Fausch and White 1981, 1986). Wild brown trout placed in a flume shifted position to stay within a suitable velocity range when flows were increased (Baldes and Vincent 1969). In a study by Shirvell and Dungey (1983), velocity was the most important factor determining the preferred sites of large brown trout (42 cm), but the fish often chose compromise positions to be close to food or cover.

Velocity and depth preferences may change seasonally. Chisholm et al. (1987) noted that brook trout selected areas of lower velocity (<15 cm/s) and deeper water (>30 cm) in winter than in summer, but showed no preference for substrate. Tschaplinski and Hartman (1983) noted similar shifts by coho salmon in winter to

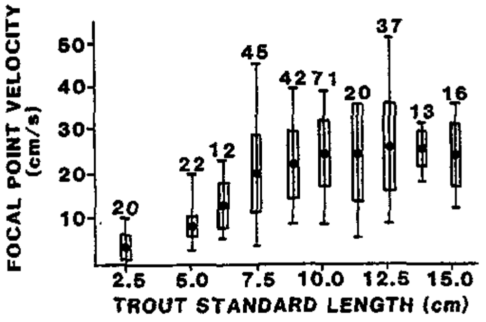

FIGURE 4.30.—Water velocities at focal points (means, ranges, and 95% confidence intervals) for trout of different standard lengths in a California stream. Numbers above data points are sample sizes. (From Smith and Li 1983.)

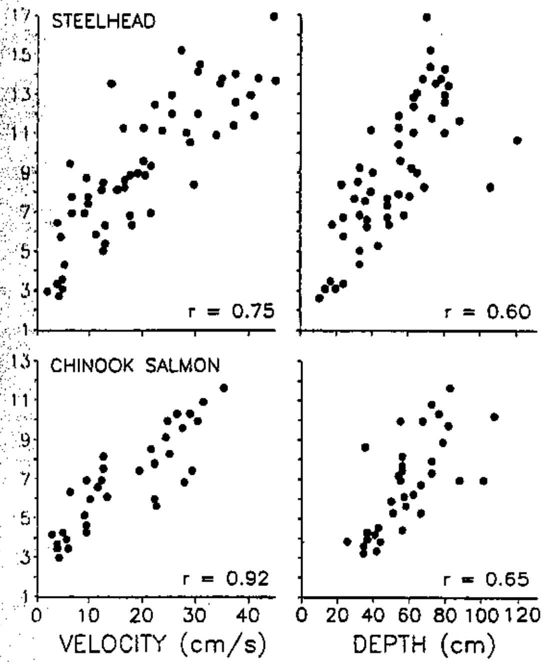

FIGURE 4.31.—Correlations between length of juvenile steelhead and chinook salmon and velocity and depth of water at sites (focal points) used by the fish in two Idaho streams. (Redrawn from Everest and Chapman 1972.)

sites (deep pools, undercuts, debris jams, side sloughs) with low velocity (<30 cm/s) but good cover.

Newly emerged fry (20–35 mm long) of salmon, trout, and char require velocities of less than 10 cm/s, based on studies of sites selected by the fish in streams (Chapman and Bjornn 1969; Everest and Chapman 1972; Griffith 1972; Hanson 1977; Smith and Li 1983; Konopacky 1984; Pratt 1984; Bugert 1985; Moyle and Baltz 1985; Sheppard and Johnson 1985). Larger fish (4–18 cm long) usually occupy sites with velocities up to about 40 cm/s (Figures 4.30, 4.31, 4.32; Table 4.10). Velocities at the sites occupied (focal points) by juvenile steelhead in a California stream were higher than the modal velocities in the stream (Figure 4.29), increased asymptotically with fish length (Figure 4.30), increased with temperature, and were less than the velocities at their usual feeding sites (Smith and Li 1983). Because invertebrate drift abundance increased with velocity across a stream section, there was a potential energetic benefit from feeding in the fastest water possible. In Idaho streams, young chinook salmon and steelhead occupied deeper and faster water as they increased in size (Figure 4.31), presumably to gain better access to food. By the end of summer, young chinook salmon (4–10 cm long) were found in the full range of available depths, but in velocities that were on the low end of those available (Figure 4.32).

Swimming performance as measured in the laboratory provides a measure of the ability of a fish to swim under specified conditions, but may not reveal velocities preferred by the fish. Brett et al. (1958) reported cruising speeds (speeds a fish could maintain for at least 1 h under stimulation) of juvenile coho salmon increased with fish size and temperature (Figure 4.33). At 10°C, cruising speeds

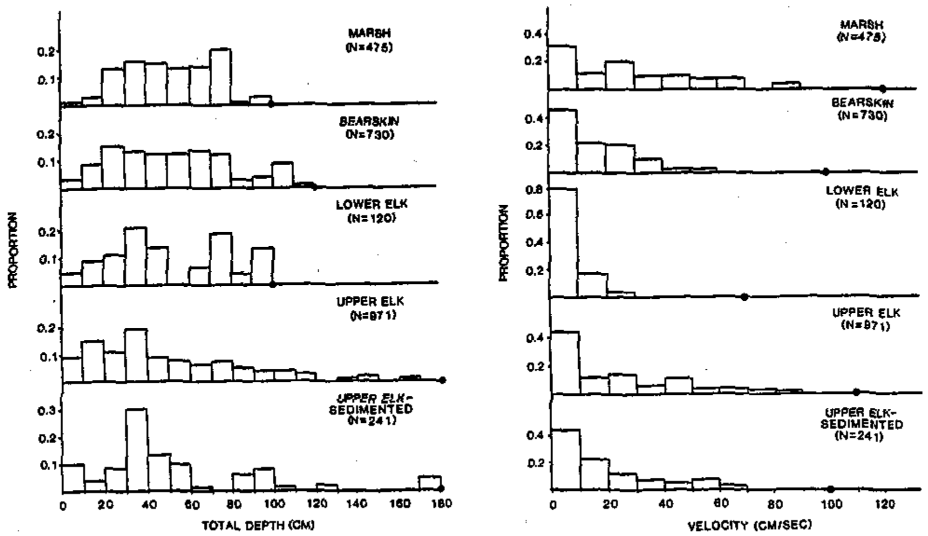

FIGURE 4.32.—Distribution of age-0 chinook salmon (77–89 mm mean total length) relative to water depth and velocity in pools of Idaho streams in August 1979. Dots indicate maximum water depth or velocity observed in the pools surveyed. (From Konopacky 1984.)

were 20–25 cm/s for 5-cm coho salmon and 35–40 cm/s for 9-cm fish; at 20°C, the speeds were 5–6 cm/s faster. Cruising speeds of fish are lower than speeds at which fish can swim for short bursts, but may be higher than water velocities observed at focal points selected by fish in streams. In a southeast Alaska stream, the mean velocity at focal points selected by age-0 (<7 cm long) and yearling (up to 12 cm long) coho salmon averaged 13–14 cm/s (T. C. Bjornn, unpublished data). Brett (1967) reported that juvenile sockeye salmon (136 mm mean length) could swim for 300 min in velocities up to about 37 cm/s (at 15°C) without becoming fatigued; at increasingly higher velocities, all fish eventually became fatigued (Figure 4.34). Velocities that did not produce fatigue in 300 min (<37 cm/s) were about half the cruising speed for fish of a given size.

Depth.—The depth of water juvenile salmonids use depends on what is available, the amounts and type of cover present, and the perceived threat from predators and competitors. Young trout and salmon have been seen in water barely deep enough to cover them and in water more than a meter deep. Densities (fish/m^2) of some salmonids are often higher in pools than in other habitat types (runs, riffles, pocket waters; Figure 4.35), but that may reflect the space available (there is more volume in pools per unit of surface) rather than a preference for deep water, especially for smaller fish (<15 cm long).

Fish usually are not uniformly distributed at all depths in a stream. Raleigh et al. (1986) presented index curves for chinook salmon in which suitabilities for newly emerged fry and juveniles were highest at depths of 25–60 cm. The curves were constructed from observations of fish distributions in streams. Everest and Chapman (1972) found significant correlations between size of fish and total water

TABLE 4.10.—*Depths and velocities at sites used by salmonids in streams.*

Species and source	Age[a] or size	Depth (cm)	Velocity (cm/s)
Steelhead			
Bugert (1985)	31–44 mm	24	40
Everest and Chapman (1972)	0	<15	<15
	1	60–75	15–30
Hanson (1977)	1	51 mean	10 mean
	2	58 mean	15 mean
	3	60 mean	15 mean
Moyle and Baltz (1985)	0	35	7.3
	Juvenile	63	19.4
	Adult	82	28.6
Sheppard and Johnson (1985)	37 mm	<30	<25
Smith and Li (1983)	25 mm		4
	50 mm		8
	75 mm		18
	100 mm		24
	150 mm		24
Stuehrenberg (1975)	0	<30	14 (range, 3–26)
	1	>15	16 (range, 5–37)
Thompson (1972)	0	18–67	6–49
Chinook salmon			
Everest and Chapman (1972)	0	15–30	<15
Konopacky (1984)	77–89 mm	55–60	12–30 18 (dawn) 12 (midday) 25 (dusk)
Stuehrenberg (1975)	0	<61	9 (range, 0–21)
	1	<61	17 (range, 5–38)
Thompson (1972)	0	30–122	6–24
Steward and Bjornn (1987)	78–81 mm	40–58	8–10
Coho salmon			
Bugert (1985)	40–50 mm	24	39 (flume)
	0		15
	1		18
Nickelson and Reisenbichler (1977)	0	>30	<30
Pearson et al. (1970)	0		9–21
Sheppard and Johnson (1985)	62 mm	30–70	<30
Thompson (1972)	0	30–122	5–24
Cutthroat trout			
Hanson (1977)	1	51 mean	10 mean
	2	56 mean	14 mean
	3	57 mean	20 mean
	4	54 mean	14 mean
Pratt (1984)	<100 mm	32	10
	>100 mm	62	22
Thompson (1972)	0, 1	40–122	6–49
Atlantic salmon			
Rimmer et al. (1984)	40–100 mm		30
	100–150 mm		38
Bull trout			
Pratt (1984)	<100 mm	33	9
	>100 mm	45	12

[a] Ages are in years or life stages, without units.

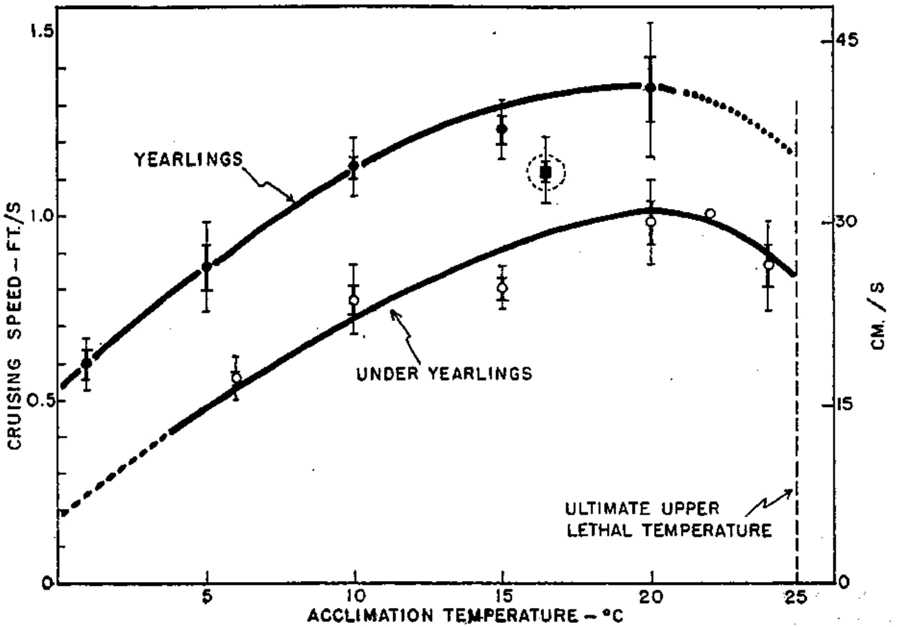

FIGURE 4.33.—Variation in cruising speed for temperature-acclimated underyearling and yearling coho salmon, adjusted in each age group to common mean lengths of 5.4 cm and 8.9 cm, respectively. The circled point between two curves is for exercised underyearling coho salmon acclimated to 16.5°C. Standard deviation (thin vertical bar) and standard error (heavy bar) are indicated for each sample. (From Brett et al. 1958.)

depth at sites (focal points) occupied by juvenile chinook salmon and steelhead (Figure 4.31). Correlations were poor between fish size and distance of focal point from the bottom; most fish, regardless of size, were near the bottom. In two Newfoundland Rivers, water depth was an unimportant factor in site selection by juvenile Atlantic salmon (deGraaf and Bain 1986).

If fish have a preferred depth of water, we believe it is readily subjugated to the needs for suitable velocities, access to food, and security from predators. Sites that fish select in streams must satisfy all the basic needs to enable the fish to survive. In laboratory streams, chinook salmon fry 30–40 mm long occupied a wide variety of

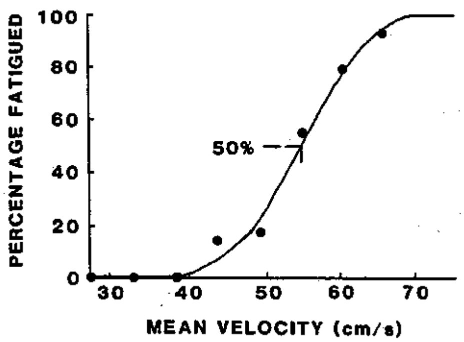

FIGURE 4.34.—Percentage of young sockeye salmon that became fatigued within 300 min at 15°C when forced to swim at the velocity indicated. The mean total length of the 104 fish in the sample was 13.6 cm. (Redrawn from Brett 1967.)

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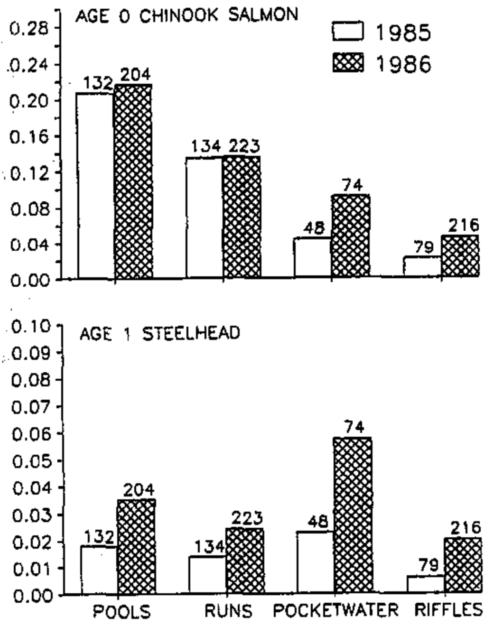

FIGURE 4.35.—Densities of age-0 chinook salmon and age-1 steelhead in various types of habitat in 22 Idaho streams. Numbers above bars represent the number of units of each type of habitat surveyed. (Authors' original data.)

sites (including the deepest water) when they were the only fish present, but only restricted areas when they shared the streams with yearling steelhead 70–120 mm long (T. C. Bjornn, unpublished data). The newly emerged fry were distributed throughout the water in both small pools (0.6 m wide, 1.2 m long, 0.32 m deep) and larger pools (1.5 m wide, 2.5 m long, 1.1 m deep) when no other fish were present and there was no threat of bird predation. The presence of only two yearling steelhead in a 4.8-m section of the smaller stream (two pools, two riffles, one run) changed the behavior of and site selection by the chinook salmon fry: some left the stream and those that remained stayed close to the bottom in the pools or moved into the interstitial spaces of the gravel substrate. When larger numbers of yearling steelhead were present, all chinook salmon fry left the stream or were eaten. In the larger stream, the fry moved to shallow water (<6 cm deep) above a sand bar, left the stream, moved into the substrate, or were eaten when yearling steelhead were present. A simulated kingfisher flight over the sand bar frightened the fry into the pool where they were vulnerable to predation by steelhead.

The relation between water depth in streams and fish numbers has not been empirically defined, but depends on the mixture of fish species and sizes, types and amounts of other cover present, and size of stream. In second- to fourth-order salmon streams, we suspect the relation is asymptotic, fish abundance increasing with increases in depth (more space) up to a point. We see no reason why fish that form schools in pools should become less abundant in extra deep water, but territorial fishes and those that select sites close to the substrate may not be as abundant in deep pools as in shallower types of habitat (runs and pocket water; Figure 4.35).

Substrate.—The substrates of salmonid streams are important habitats for incubating embryos and aquatic invertebrates that provide much of the food of

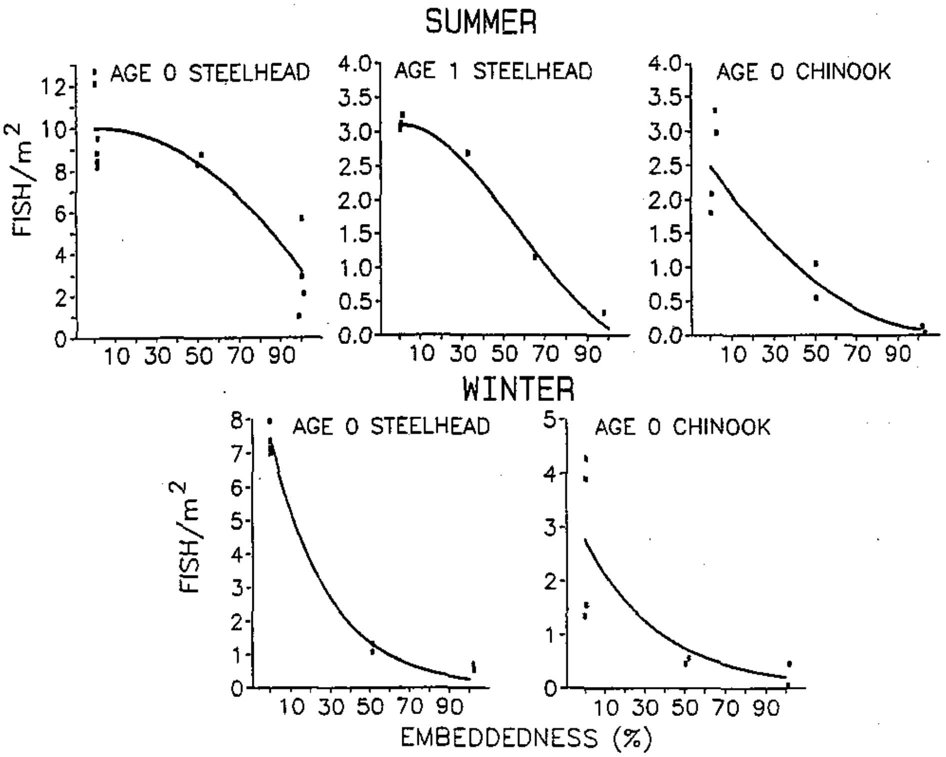

FIGURE 4.36.—Densities of chinook salmon and steelhead juveniles remaining in laboratory stream channels after 5 d during winter and summer tests to evaluate the effects of sedimentation. The channels had alternating pool–riffle configurations; fine sediments (<6 mm) were added to pools and riffles to embed the cobbles and boulders from 0 to 100%. (From Bjornn et al. 1977.)

salmonids, and they provide cover for fish in summer and winter. Silt and sand substrates have little or no value as cover for fish. Larger substrate materials (up to 40 cm in diameter) provide visual isolation and their interstitial spaces are often the primary cover, along with depth and water turbulence, in some streams.

Salmonids will hide in the interstitial spaces in stream substrates, particularly in winter, when the voids are accessible (Chapman and Bjornn 1969; Bjornn and Morrill 1972; Gibson 1978; Rimmer et al. 1984; Hillman et al. 1987). Newly emerged fry can occupy the voids of substrate made up of 2–5-cm diameter rocks, but larger fish need cobble and boulder-size (>7.5-cm diameter) substrates. The summer or winter carrying capacity of the stream for fish declines when fine sediments fill the interstitial spaces of the substrate (Figure 4.36). In a laboratory stream experiment, Crouse et al. (1981) found that production (tissue elaboration) of juvenile coho salmon was related to the amount of fine sediments in the substrate. When large substrate particles (>12 mm in diameter) were covered (embedded) with various amounts of fine sediments (<2 mm in diameter), fish production was reduced in direct proportion to the degree of embeddedness (expressed as a substrate score or geometric mean size of particles). In another laboratory stream study, Bjornn et al. (1977) found that the density of juvenile steelhead and chinook salmon in summer and winter was reduced by more than half when enough sand was added to fully embed the large cobble substrate (Figure 4.36).

Much of the food eaten by salmonid fishes in streams is produced in the substrate. Particles that make up stream substrates, and thus the habitat of aquatic invertebrates, vary widely from silts and sands to boulders and barely fractured bedrock. Invertebrates differ in their ability to thrive in various types of substrates. Chironomids of various species do well in silts and sands, but the larger ephemeropterans, trichopterans, and plecopterans prefer a mixture of coarse sands and gravels. The addition of fine sediments to stream substrates as a result of watershed disturbances and erosion is worrisome because sedimentation may reduce the abundance of invertebrates. In streams where food is limiting for fish, a reduction in aquatic invertebrate abundance would lead to reduced fish production.

The influence of fine sediments on aquatic invertebrates and ultimately on fish has been investigated, but has not been clearly defined. Cordone and Kelley (1961) reported that fine sediments were detrimental to aquatic organisms. Brusven and Prather (1974) found that invertebrate abundance was reduced when larger streambed particles were fully embedded in fine sediments. Bjornn et al. (1977) found that many ephemeropterans, trichopterans, and simuliids were less abundant in riffles fully embedded with fine granitic sediments than in less-embedded riffle substrates. Hawkins et al. (1983) found decreasing numbers of invertebrates in shaded riffles as the percentage of fine sediments increased, but no such correlation existed in unshaded riffles. In seminatural laboratory streams, benthic and drifting invertebrates (mostly chironomids and ephemeropterans) were more abundant in sections with sand–pebble substrate than in sections with large gravel (Konopacky 1984).

Summer and winter carrying capacities of streams for salmonids may differ markedly because of the substrate present. For example, more than half the steelhead and chinook salmon that reared in two Idaho streams in summer left during fall and winter, but ceased migrating downstream when they encountered areas with larger substrate (Bjornn 1978). In laboratory experiments, fall and winter migrants stopped migrating downstream when placed in channels with large rocks, but continued migrating when put in channels with small gravel (Bjornn and Morrill 1972). After piles of large rock were added to provide cover in sections of a stream with small gravel, more juvenile steelhead stayed there in winter than previously (Chapman and Bjornn 1969). In summer, substrates contribute to a stream's carrying capacity by providing habitat for invertebrates that fish eat and, perhaps less importantly, by providing cover. In winter, the substrate is more important as a source of cover than as a source of food.

Cover

Cover is an important, but difficult to define, aspect of salmonid habitats in streams. Some of the features that may provide cover and increase the carrying capacity of streams for fish are water depth, water turbulence, large-particle substrates, overhanging or undercut banks, overhanging riparian vegetation, woody debris (brush, logs), and aquatic vegetation. Cover provides security from predation for fish and allows them to occupy portions of streams that they might not use otherwise. The needs of fish for cover may vary diurnally, seasonally, by species, and by size of fish (Kalleberg 1958; Hartman 1963, 1965; Chapman 1966; Ruggles 1966; Butler and Hawthorne 1968; Edmundson et al. 1968; Allen 1969; Chapman and Bjornn 1969; Everest 1969; Lewis 1969; Wesche 1973; Hanson 1977; Cunjak and Power 1986). Cover is usually an important variable in models developed to estimate the standing crop of salmonids that could be expected in streams (Binns and Eiserman 1979; Conder and Annear 1987).

Fish abundance in streams has been correlated with the abundance and quality of cover. Standing crops of cutthroat trout in summer were correlated with the indices of cover (Figure 4.37) and surface area used by Wesche (1974). Juvenile steelhead and chinook salmon responded to various types (Figure 4.38) and amounts (Figure 4.39) of cover in winter by either staying in or leaving outdoor laboratory streams (T. C. Bjornn and C. R. Steward, unpublished data). More fish remained in channel pools with a combination of deep water, undercut bank, large rocks, and a bundle of brush than in pools with less cover. The number of chinook salmon remaining in pools increased with increasing amounts of cover (Figure 4.39).

The addition of structures or large boulders to streams to create pools and cover can increase the abundance of salmonids if the amount of suitable habitat is limiting the fish population. When gabions were added to an Oregon stream after logging, debris removal, and floods, the number, depth, and total volume of pools increased, as did the biomass of salmonids (House and Boehne 1985).

Large woody debris originating from riparian timber is a form of cover in many streams and its importance has become more widely known in recent years (Bisson et al. 1987; Holtby 1988a). For example, coho salmon production declined when woody debris was removed from second-order streams in southeast Alaska (Dolloff 1983). More large woody debris and juvenile coho salmon were found in

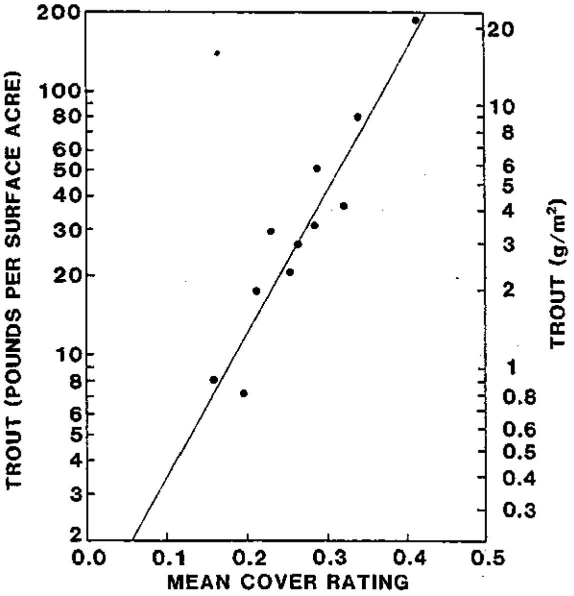

FIGURE 4.37.—Relation between mean trout cover rating and standing crop estimate of trout for 11 study areas. (From Wesche 1974.)

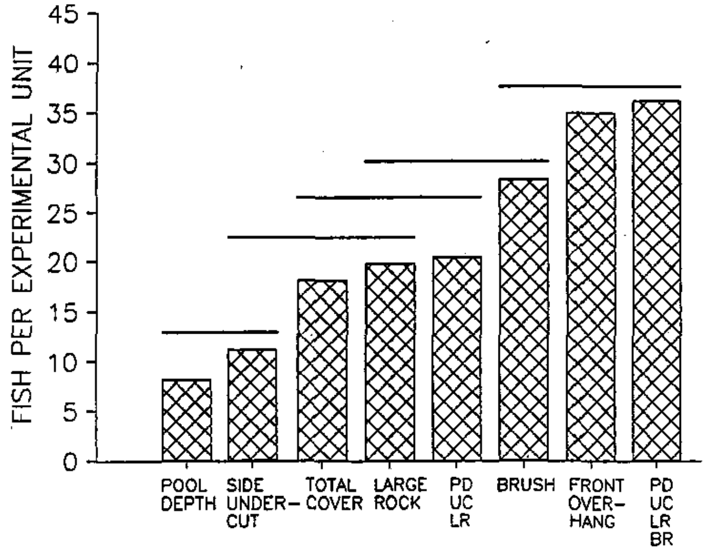

FIGURE 4.38.—Number of yearling steelhead that remained in sections of an outdoor laboratory stream in winter in pools that contained various types of cover. (T. C. Bjornn and C. R. Steward, unpublished data.) Bars not covered by the same horizontal lines were statistically different ($P < 0.05$).

streams surrounded by mature, mixed-conifer forest than in streams lined by red alder that had grown in a 20-year-old clear-cut (House and Boehne 1986). When wood debris was removed from a stream, the surface area, number, and size of pools decreased, water velocity increased, and the biomass of Dolly Varden decreased from 12.5 to 3.9 g/m^2 (Elliott 1986). In another stream, young steelhead were more abundant in clear-cut than in wooded areas in summer but moved to areas with pools and forest canopy in winter (Johnson et al. 1986). Bryant (1983, 1985)

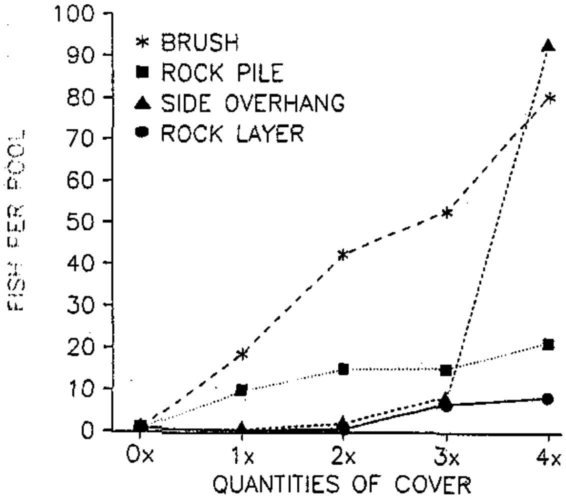

FIGURE 4.39.—Response (number remaining in pools) of yearling chinook salmon to various amounts of different types of cover in an outdoor laboratory stream during winter. (C. R. Steward and T. C. Bjornn, unpublished data.)

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proposed guidelines for woody debris management in streams after he found a gradual loss of large debris from streams where riparian timber had been removed.

Overhead cover (including undercut banks, overhanging vegetation, logs, and debris jams) is often an important component of fish habitat in streams. Boussu (1954) reported increases in trout standing crop after the addition of overhanging brush as cover, and decreases when brush and overhanging banks were removed. Overhead bank cover, in association with water depths of at least 15 cm, was the single most important type of cover for brown trout in Wyoming streams (Wesche et al. 1985, 1987). In a small Lake Erie tributary, the distribution of subyearling rainbow trout, brown trout, and coho salmon was related to bank and instream cover (Gordon and MacCrimmon 1982). Brusven et al. (1986) found that 82% of age-0 chinook salmon preferred sections of a small stream channel with one-third overhead cover to sections without such cover. With the same stream channel, Meehan et al. (1987) showed that the fish preferred shade from artificial canopies to open areas, especially in the shallow reaches. Juvenile Atlantic salmon and brook trout were attracted to shaded areas of a shallow flume, but moved to deeper water when given the opportunity (Gibson 1978). Wilzbach et al. (1986), however, found that cutthroat trout foraged more effective on experimentally introduced invertebrate prey in pools within a recently logged area than in forested pools, presumably because light levels were higher in the logged area. Growth of trout was higher in pools of the logged section, but the investigators thought differences in foraging efficiency alone did not fully account for the slower growth in the forested pools.

Use of stream habitat and cover by juvenile salmonids may depend on the presence of other fish. Glova (1986) reported evidence of interactive segregation between juvenile coho salmon and cutthroat trout in summer. When tested separately, most fish of both species were found in pools, but when tested together, most coho salmon were in pools and cutthroat trout were in riffles. In winter, Glova (1986) found that both species, whether together or separate, preferred pools and overhead cover. Similar interactive segregation in summer has been demonstrated for coho salmon and steelhead: salmon used the pools and steelhead the riffles when the species were together in the same streams (Hartman 1965). In southeast Alaska streams, cover affected habitat use by coho salmon, steelhead, and Dolly Varden with respect to depth, position in the water column, and water velocity. Coho salmon and steelhead selected lower positions in the water column in pools without cover than in pools with overhead bank cover or instream cover (Bugert 1985). The presence or absence of Dolly Varden 10–20 cm long in pools caused shifts in habitat use by age-0 steelhead and coho salmon, even when some forms of cover were provided.

Seaward or Lakeward Migration

In some populations of salmonids, the fish spend their entire lives in a limited reach of stream (Miller 1954, 1957; Hunt 1974; Bachman 1984). In many other populations, however, juveniles may live in their natal streams for a few days to more than 3 years and then move to other areas to complete their maturation. Nonanadromous salmon, trout, and char may move downstream into lakes (upstream in some cases) or larger rivers. The anadromous salmonids eventually migrate to the sea, but in some cases spend extended periods rearing or overwintering in streams (or lakes) other than their natal sites (Bjornn 1978; Leider et al. 1986). Regardless of the destination of the juvenile migrants, flows and water quality must be suitable for the migration to be successful.

The timing of most lakeward or seaward migrations of salmonids that rear for an extended period in steams appears to be regulated primarily by photoperiod, but streamflow, water temperatures, and growth may play a role in some areas. Chinook salmon and steelhead smolts migrated seaward from an Idaho stream at slightly different times, but the timing for each species was similar each year, and was modified only slightly by flow and moon phase (Bjornn 1971); water temperatures were similar each year. In a Norwegian river, water temperature (increase and general temperature in spring) accounted for most of the variation in timing of the seaward migrations of Atlantic salmon (Jonsson and Ruud-Hansen 1985); streamflow, cloudiness, and lunar cycle were not correlated with the migration.

Streamflows are usually adequate in unaltered streams because seaward migration commonly occurs in the spring. Seaward migration has been altered in streams and rivers from which large amounts of water are diverted or along which large reservoirs have been created. Streamflows that were sufficient before construction of dams become inadequate in large reservoirs. There is evidence that smolts depend on river currents during their downstream migration (Fried et al. 1978), and they have difficulty finding their way through large reservoirs with barely perceptible currents. The time required for a smolt to travel the 517 km from the Salmon River in Idaho to The Dalles Dam in the lower Columbia River increased by about 30 d during years with low flows after completion of six intervening dams. The poor success of smolts moving down through large reservoirs with low flows may be due in part to the suppression of some parr-to-smolt physiological processes; Adams et al. (1973) observed this condition when fish were held in relatively high water temperatures (15–20°C). The parr-to-smolt transition is often incomplete when fish begin to migrate and may fail to develop fully if the fish encounter high temperatures and reservoirs without perceptible currents.

Another hazard created at some dams is supersaturation of dissolved gases, particularly nitrogen, which can cause gas bubble disease in both upstream- and downstream-migrating salmonids (Ebel 1970; Ebel and Raymond 1976). Salmon may be more successful than steelhead in sensing and avoiding highly supersaturated waters (Stevens et al. 1980), but most salmonids migrating in the rivers are susceptible to gas bubble disease.

The magnitude of the effect dams and associated reservoirs can have on anadromous fishes is evident in data from the Columbia River drainage. Salmon and steelhead must pass up to nine dams in the Columbia and Snake rivers during their migrations to and from the sea. Smolt-to-adult survival rates declined from more than 4% before 1968 to less than 1.5% in the mid-1970s when all the dams were completed (Raymond 1988). In years with low flows (such as 1973 and 1977), smolt mortality averaged 45% at each dam and reservoir, compared to 15% in years with higher flows. In recent years, smolt-to-adult survival rates of steelhead and chinook salmon from the Snake River have increased to 2–5% with the help of spillway deflectors to reduce gas supersaturation, fish bypasses around turbines, transportation around dams, and supplemental spills at dams without bypasses (Raymond 1988).

Summary

In the foregoing discussion of habitat variables, each factor was addressed separately, but the reader should keep in mind that fish usually respond to the combined effect of two or more of the physical, chemical, and biological variables in their environment. The fish may respond physiologically (altered growth and health) and behaviorally (site selection and interactions) to the array of environmental features they encounter. In streams where fish live and reproduce, all the important factors are in a suitable (but usually not optimum) range throughout the life of the fish. The mix of environmental factors in any stream sets the carrying capacity of that stream for fish, and the capacity can be changed if one or more of the factors are altered. The importance of specific factors in setting carrying capacity may change with life stage of the fish and season of the year.

Low streamflows, high water temperatures, and excessive turbidities impede adult salmon, trout, and char on their migration to spawning areas. These impediments occur even in pristine environments on occasion, but more often in drainages with irrigation, extensive agriculture, hydropower, surface mining, forest harvesting, and flood control projects. Once in the spawning areas, the amount and suitability of stream substrate and flows in the spawning areas are key factors. During incubation of the embryos and alevins, conditions within the redd dictate the number of young fish that will emerge into the stream. Adequate flows of well-oxygenated water and relatively small amounts of fine sediments (organic and inorganic) will allow a high percentage of the young fish to survive and emerge from the redd.

As soon as the young fish begin rearing in the stream, they become subject to predation by other fish, birds, and mammals, and they interact with the other fish present for choice feeding sites and cover. Given adequate numbers of young fish to use all the available habitat, the number and size of fish that can be produced in a stream is governed by the quantity and quality of space available, productivity of the stream, and the presence of competitors and predators. In summer, juvenile fish are primarily concerned with feeding and they select sites in streams that optimize the opportunity to obtain food, yet provide acceptable security from predation. In winter where water temperatures are low, the fish appear to be primarily concerned with security; they hide in cover or adopt behavior patterns that may have security benefits (such as gathering in large schools) and they are less interested in feeding. Because the requirements of salmonids and their use of habitat in winter are different from those in summer, the carrying capacity of streams or stream reaches may not be the same during both seasons. The changes in carrying capacity that result from alteration of stream features depend on the roles those features play in establishing the carrying capacity—roles that can change with time.

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Does light have an influence on fish growth?

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Abstract

Light compares a complex of external and ecological factors, including colour spectrum, intensity and photoperiod. Light characteristics are very specific in an aquatic environment and light is extremely variable in nature. 'Receptivity' of fish to light profoundly changes according to the species and the developmental status. Specific photoreceptor cells are present in both eye and pineal. If it is easy to change the light in experimentation and to observe the effects on fish growth, it is much more difficult in nature to make such determinations. In larvae, many studies have been dedicated to the influence of intensity and photoperiod on growth: generally, species need a minimal threshold intensity to be able to develop normally and grow. This is probably related to the aptitude to localize, catch and ingest prey. Light is also indispensable for body pigmentation, an important phenomenon involved in early development and growth. Too intense light can be stressful or even lethal. A few species are able to develop and grow at very low intensities or, sometimes, in the absence of light. Generally, long daylength improves larval rearing quality. The synergistic effect of 'food availability-daylength' appears to be determining at this stage. In older fish, there is very little information about the influence of light 'quality' but more about intensity and much more about photoperiod. Light intensity effects are not so clear and depend on the species and the experimental procedures: it is probably not an important factor for growth stimulation. Daylength appears much more important. Many species, including both marine species and salmonids, react to photoperiod treatments and long daylength stimulates growth. The most studied species is the Atlantic salmon, which is very sensitive, both during the freshwater stage, with the parr–smolt transformation very dependent on the photoperiod, and also in sea water. In this last condition, lighting also influences early maturation. An important point is to be certain that light affects fish growth through a better food conversion efficiency and not just through stimulated food intake. Also included in this review is a discussion about the endolymph–otolith system, which is very sensitive to daylight and seasonal cycles and a review of the present knowledge on the involvement of light influence on hormone levels (melatonin,

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somatotropin, thyroid hormones and other hormones).

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1. Introduction

For a long time, the influence of environmental factors on fish has been studied in respect to their effects on growth and reproduction. Fish, as ectotherms, are highly dependant on temperature. But other factors are also involved in the control of physiological functions. Salinity and pH, oxygen availability, the presence of 'natural toxicants', such as ammonia, are also known to play a major role on the capacity to develop and grow. Available information on light influence will be reviewed to clarify a situation, still controversial in the scientific community.

Sunlight is the main natural light source, although other secondary sources must be taken into account in certain cases, such as moonlight, starlight and the light from luminescent organisms. Light is essential to life, for most plants and animals, even if a few species are able to do without it, as is the case in the deep sea (aphotic zone) or in caverns.

Light (in intensity, quality and photoperiod) is extremely variable and can change over a tremendous range, often very rapidly. Fish move within their environment and often their environment moves around them, affecting the light that the fish receives (Sumpter, 1992). Moreover, light shows interesting characteristics in the aquatic environment. In fact, 'quality' (meaning the different wavelengths which are absorbed by water to various extents), 'quantity' (different intensities) and 'periodicity' (it undergoes daily cycles, which vary seasonally according to latitude) should also be considered. One important point has to be underlined: apparent secondary effects of light on development and growth can be 'muddled' by other impacting factors such as temperature and feeding activity. A consequence of these moving conditions is that it is not known whether fish growth rate (or any other characteristic) is influenced by light in the natural environment (Sumpter, 1992). It is much easier to control lighting regimes in the laboratory, or in intensive indoor rearing, as it is possible to investigate the fish's response under fixed conditions. Numerous and extensive experiments have been carried out in this way.

Firstly, the main methodological difficulties induced by light specificity will be discussed. Then, the effects of light quality, quantity and periodicity (photoperiod) on both larval and juvenile growth and the relationship with the endolymph–otolith system and endocrinological control will be presented.

2. Methodological aspects

2.1. Light quality

The light intensity-irradiance-distribution above the sea surface first depends upon the altitude of the sun. However, the scattering–absorbing properties of atmospheric molecules and particles, the meteorological local conditions and the radiant energy which has been reflected back from the water surface (10% is lost by reflection; Clarke, 1965) are also decisive factors.

The sun’s radiant energy is selectively absorbed and is scattered on penetration of the upper layers of the aquatic environment. These basic processes alter the structure of the radiant energy field. In order to describe the time and flow rate of the radiant energy, one must specify its magnitude (the square of the electric field vector), its polarisation (direction of oscillation of the electric field vector), its wavelength (frequency of oscillation) and its direction and propagation (Smith, 1974).

Light’s blue component is the most penetrating in the clearest ocean or lake waters. On reaching a depth of 100 m or more, blue light becomes completely predominant. Even pure water absorbs light very rapidly, compared to air. This causes a profound change in spectral composition (Clarke, 1965). Other natural waters contain suspended particles and dissolved material and, in sufficient quantities, they cause a further reduction (extremely strong in rivers after rains for example) in transparency and a further alteration in spectral distribution. Whilst optical contributions from the detrital component are relatively constant with depth, seasonal variations in the optical contributions of phytoplankton may appear (interpreted in terms of photoadaptation by cells to changes in the light and vertical mixing fields; Morrow et al., 1989).

The fish ‘receptivity status’ must also be taken into account but very little information is available on this subject. Fish are sensitive to light and the eyes are the major light receptor organs, but, as in many other vertebrate species, the pineal gland is also of importance. Flatfish larvae have a pure-cone retina and no retinomotor responses. Their visual threshold decreases with age (sensitivity increases): the spectral sensitivity curves are plateau-like (400–600 nm of wavelengths) and photopic in nature. Thus, the larval cones have spectral properties similar to those of adult teleosts (Blaxter, 1969). The herring *Clupea harengus pallasi* has twin cones arranged in rows with the same orientation and tangentially arranged *lamellae*, while the northern anchovy *Engraulis mordax* has bifid cones with cone lamellae parallel to the cones length: they do not exhibit the same light polarization sensitivity (Novales Flamarique and Hawryshyn, 1998).

These physical and biological data are of importance to our understanding of light influence on fish. Very little information is available concerning light quality in relation to fish growth because measurement and control are very difficult. Due to this lack of information, farmers in indoor rearing empirically decide to use ‘true-light’ tubes, which are the nearest to spectral natural light composition.

2.2. Light quantity

Comments must also be included concerning the units used in the past to characterise light intensity. Photometric units of illuminance, such as lux ($\text{lumen} \cdot \text{m}^{-2}$) attempt to make quantitative measurements of the relative illuminance by white light and should therefore only be used for white or near-white light when the receptor of the organism has a similar sensitivity to that of the human eye. Photometric units have little value for coloured light as the relationship between lux and visible incident energy changes with wavelength (Murray, 1993). The irradiance unit, $\text{W} \cdot \text{m}^{-2}$, is of better use.

Fish light receptivity also changes with the developmental stage. The number of cones in the retina increases during ontogenesis and early development (Blaxter, 1969, 1975). These cells appear to be very important to further development and growth. At the beginning, they play the role of primary photoreceptors. A Californian marine species, *Sebastes diploproa*, migrates when it reaches 1 year, from the surface to depths of 250 to 500 m, and so undergoes a considerable change in photic environment: retina changes occur during 'vertical' migration. A loss of single cones shows a change from high visual acuity in small surface prejuveniles to high visual sensitivity in benthic juveniles. The few remaining cones would then be involved in the detection of the bioluminescent light of prey organisms (Boehlert, 1979). While hatching, fish eyes are often transparent and the retina is undifferentiated. During yolk resorption, the retina differentiates slowly in sectors and is functional in Atlantic halibut *Hippoglossus hippoglossus* around 150 degree-day (d°) post-hatching (Kvenseth et al., 1996). This timing coincides with the development of functionality in other organs and in the ability to feed. Fully pigmented eyes appear later and in the halibut while metamorphosis is being achieved, the retina contains groups of rods and can be considered as mature (formation of a cones mosaic, recruitment of rods and increasing size of the eye).

At this stage, light has a great influence on pigmentation and serious developmental abnormalities appear when light is insufficient (Bolla and Holmefjord, 1988). In halibut larvae, a recent experiment shows that submerged light, compared to external sources, clearly offers the most favourable light regime, with respect to larval survival (Gulbrandsen et al., 1996). Total darkness resulted in a 100% mortality for the larvae of another flatfish species, the Australian greenback flounder *Rhombosolea tapirina* (Hart et al., 1996). On the other hand, in European sea bass *Dicentrarchus labrax*, survivals of newly hatched larvae, without pigmentation, are poorer in high light intensities (Barahona-Fernandes, 1979).

It appears that during very young stages, light direction and intensity play a major role in most species, depending on the visual ontogeny, related to pigmentation. This allows the fish to develop normally. Feeding response of fish marine larvae could be elicited by the presence of visual and chemical stimuli (Kolkovski et al., 1997). In detail, as a result of the great biodiversity of fish, different 'light-responses' exist. However, most of them need a minimal light threshold to develop. A few species, particularly pelagic, benthic or those living in very turbid waters, are able to feed, develop and grow at very low (< 1 lx) intensities, or without light. Also, light that is too intense may be stressful or even lethal. The effects of light quantity (intensity, irradiance) on growth have been studied, although not always with the strictness that is required, and with again the problem of using lux as the intensity unit. Future experiments must be better controlled. All these facts, which explain in part the conflicting information, have to be kept in mind when analysing the following effects of light on fish growth.

2.3. Photoperiod

It is clear that a minimal difference is needed so that the fish can distinguish light from darkness. Intensity thresholds have to be reached, and experimental designs must avoid 'parasitic' illuminance.

Most of the fundamental rhythms in nature (diurnal or seasonal) are related to the periodicity of light. Many animals, including fish, exhibit a 24-h cycle in their activities (diel rhythm) which may often be a matter of simple photokinesis (Clarke, 1965). Fish are either more active in light, less active in darkness, or vice versa, but behaviour may also be modified by concomitant diurnal changes in other factors, such as temperature or oxygen availability. For example, Richardson and McCleave (1974), in using different photoperiods in Atlantic salmon *Salmo salar*, concluded that light–dark transitions were important in synchronizing locomotor activity rhythms. For the same species, Thorpe et al. (1988) specified that fish fed actively during the day, but not at night and that downstream nocturnal migration represented relative inactivity (passive displacement). Concerning the rainbow trout *Oncorhynchus mykiss*, diel rhythms of locomotor activity are strongly influenced by a circadian clock entrained to LD cycles (Iigo and Tabata, 1997). Hence daylength may indirectly modify growth by increasing food intake or muscle mass by exercise.

In the wild, one must note the importance of the synergistic effects of temperature and photoperiod: generally these two factors change concomitantly. So even if it is simple in experimentation to only study the effects of photoperiod, it is not so easy to later extrapolate the results to natural situations.

3. Light and somatic growth

3.1. Light spectrum and growth

Stefansson and Hansen (1989) have investigated the possible role of the spectral composition of light (within the visible spectrum) on Atlantic salmon growth in fresh water, without detecting any influence. They reared young salmon (initial size 9.4 cm, under the same changing temperature and photoperiod conditions) for 8 months from October to May under five light sources, from 2 to 10 000 K colour temperatures (including an outdoor tank in natural sunlight). All the fish grew normally, developed into smolts and there was no effect after a subsequent period in sea cages. This well-designed experiment is one of the few studies concerning the possible relationship between light quality and growth. Similar approaches are required for other fish species, including those at younger stages.

3.2. Light intensity and growth

3.2.1. Larvae

It appears that a minimal light intensity threshold is needed to allow the fish larvae to have normal development and growth (see Table 1). Intensity can be variable, for example between 50 and 150 lx in *Sparus auratus* (Ounais-Guschemann, 1989). However, some species may develop and grow even at very low light intensities as is the case for a few pelagic marine species larvae (Blaxter, 1980) and for striped bass *Morone saxatilis* (Chesney, 1989), a fish commonly living in estuaries with turbid water. Herring

Table 1
Light intensity threshold for different fish larvae

Intensity	Species	Source
<1 lx	herring	Blaxter, 1975
1	striped bass	Chesney, 1989
1–10	halibut	Hole and Pittman, 1995
50	arctic charr	Wallace et al., 1988
50–150	gilthead seabream	Ounais-Guschemann, 1989
200–600	Atlantic salmon	Mortensen and Damsgård, 1993
350	southern flounder	Daniels et al., 1996
1000	rabbitfish	Duray and Kohno, 1988

juveniles, *Clupea harengus*, swim faster and still grow when they are forced to live in total darkness (Batty et al., 1986).

Generally, upper intensity light levels are required for growth optimisation. For seabream, intensities of 600–1300 lx promote optimal growth (Tandler and Mason, 1983) and European sea bass larvae develop optimal growth at 600 lx (Barahona-Fernandes, 1979). For other species, the optimum levels are much lower, for example in the Atlantic halibut, Hole and Pittman (1995) observed the best growth at 1–10 lx, compared to 500 lx (12 h of lighting at 11 and 14°C). On the other hand, a few fish are also known to be less sensitive to light intensity level. This is the case for southern flounder *Paralichthys lethostigma* in which light intensity was tested in a range of 340–1600 lx (Daniels et al., 1996), with no effects on growth or metamorphosis. In another study (457 and 1362 lx) with the same species, Denson and Smith (1997) concluded in the same way but found differences in pigmentation, between the two conditions on post-metamorphosis larvae.

These growth variations can be explained by the hunting of prey and feeding activities, which are very dependant on the larval vision development: this is essential in prey-selection, predator avoidance and shoaling behaviour. A minimal intensity light threshold is required to permit the fish to develop normal hunting activity (Ounais-Guschemann, 1989). Below this threshold, the young larvae are unable to detect and to catch food, and die after vitellus resorption. Feeding behaviour is also affected by light intensity. Sea bream larvae prefer tanks with moderate shading: 98% shading led to slower growth while 40 and 55% resulted in the highest survival and feeding rates (Buchet et al., 1995). In an experiment concerning the effects of light intensity during first feeding of Atlantic salmon, no consistent differences in growth rates were found between the groups subjected to different light intensities ranging from 27 to 1400 lx (Stefansson et al., 1990).

3.2.2. *Juveniles*

Only a few studies concern light effects in juvenile fish. Stefansson et al. (1993), experimenting on older stages of salmon (up to smolts and after seawater transfer) concluded that light intensity had no significant effect on growth and parr–smolt transformation, within the range tested (27–715 lx). However in another experiment on the same species, Wallace et al. (1988) observed better growth in 0.7 g fry maintained for 35 days at 700 lx (compared to 200, 50 and 10) and under the same conditions, Arctic charr *Salvelinus alpinus* fingerlings (1.4 g) grew better at 50 lx. In Norway, (22.2 $W \cdot m^{-2}$) Atlantic salmon post-smolts exposed to high light intensity in net pens in sea water showed significantly better growth (Oppedal et al., 1997). A full scale salmon pen rearing experiment with light-reducing black polyethylene netting covers has been carried out by Huse et al. (1990) over 1 year in order to elucidate effects of reduced illumination on growth and survival They concluded that growth was marginally reduced by covers in winter and spring, and was slightly enhanced in summer and early autumn.

It is therefore difficult to draw conclusions from these experiments. It is likely that several authors, in addition to ourselves, have experimented on the possible influence of light intensities on fish growth without being able to observe differences. Even if they represent interesting data, it is often difficult to publish negative results. In certain cases, as in shading experiments, one might imagine that the observed effects could be related to less stressful conditions for fish and thus the influence of light might be strongly dependant on the rearing conditions. When positive, these effects are very slight. Above a specific threshold, it seems that light intensity is not an important factor on growth regulation in juveniles and adults. Its manipulation does not seem to show a great economical interest.

3.3. Photoperiod and growth

3.3.1. Larvae

Many studies have been carried out on cultured marine fish larvae, supplying light either continually or over very long periods, compared to natural conditions. For example, this has been specified for rabbitfish *Siganus guttatus* (Duray and Kohno, 1988), halibut (Hallaråker et al., 1995a), sole *Solea solea* (Fuchs, 1978), sea bass (Barahona-Fernandes, 1979; Ronzani Cerqueira et al., 1991), green back flounder (Hart et al., 1996), gilthead sea bream (Tandler and Helps, 1985; Ounais-Guschemann, 1989) and turbot (Person-Le Ruyet et al., 1991).

Except for larvae reared in darkness, Solberg and Tilseth (1987) demonstrated in cod *Gadus morhua*, that yolk absorption was independent of light regime. Dowd and Houde (1980) showed that for sea bream *Archosargus rhomboidalis* (Sparidae) high levels of prey promoted good larvae growth in lighting of ambient duration, but at low levels of prey, growth increased with longer photoperiods. The better exploitation of ‘daylength-prey abundance’ association is usable for production cycle optimisation. For example, Naess et al. (1996) have shown that it was possible to produce juveniles halibut from larvae, using a 6-month delayed photoperiod and ensure year-round production of juveniles.

Hence, for larvae, as demonstrated for light intensity, the most important factor acting on growth is the ‘synergistic effect of food availability and light’, which allows the optimal exploitation of the trophic level. However, a possible dissociation between best growth and optimal development may occur. In sea bass, it is possible that continuous illumination, although good for growth, is not suitable for normal fish development (Ronzani Cerqueira et al., 1991).

3.3.2. Juveniles

In this review, non-salmonids have been deliberately separated from salmonids due to the large number of experiments that have been dedicated to smoltifying species. Several studies have concluded that there is a lack of effect of different photoperiods on fish growth. In halibut, Hallaråker et al. (1995b) reared fish from 5 to 20 g exposed to changing light regimes (7–12L and 12–18L), with no effect on growth rates. In turbot (maintained at natural, constant 16L:8D and 24L:0D), continuous light slightly enhanced the growth rate above that of other regimes, after at least 3 months of exposure at 10 and 16°C, but not throughout the 6-month experiment (Imsland et al., 1995). The authors concluded that the overall effects of photoperiods were not as conclusive as for other species. A recent experiment carried out in Brest, did not show an effect of six different photoperiods (constant 8L:16D, 16L:8D, 12L:12D, 24L:0D; increasing 12–16L and decreasing 12–8L) on turbot growth and feeding parameters over a 60-day period (Pichavant et al., 1998). However, in a recent paper (Imsland et al., 1997), better long-term growth (18 months) was observed in turbot exposed to extended daylength during the first winter.

Positive effects of photoperiod on growth have been recorded in other species. Constant 16L:8D, compared to 12L:12D, enhanced growth in *S. diploproa* and can be probably related to a greater scope for growth due to their lower standard metabolic rate (Boehlert, 1981). Reared gilthead seabream, under five photoperiod regimes (8L:16D, 16L:8D, 12L:12D, 24L:0D and natural) exhibited better growth related to long daylengths but the differences appeared only after a long exposure time (45–145 days according to the light regime) and were maintained up to 220 days (Silva-Garcia, 1996). However, in these last experiments, it was not possible to determine if the light effect on growth depended on food consumption or better food utilisation.

In green sunfish, *Lepomis cyanellus*, maintained for 6 weeks at four photoperiods (constant 8L:16D, 16L:8D, increasing 8–16L and decreasing 16–8L), Gross et al. (1965) demonstrated that food intake directly correlated to the amount of light to which the fish were exposed. Fish growth and food conversion efficiency were closely correlated and were generally highest in the increasing photoperiod, even when temperature was the same in spring and autumn. This result was the first one to specify that growth might be influenced by light through a better food conversion efficiency and not just stimulated food intake.

In salmonids, for which there is not a true larval stage, Brännäs (1987) failed to demonstrate an influence of photoperiod during the yolk sac phase or on behaviour at emergence in Atlantic salmon. With the same species, Berg et al. (1992) obtained a good relationship between the duration of lighting and growth after first feeding: growth decreased on reduced daylength. This species is particularly receptive to extended daylength and grows very well, even in continuous light, eating continuously during the photophase. In an experiment lasting 192 days after the first feeding, where both temperature and photoperiod were changed, Thorpe et al. (1989) found that the greater growth opportunity (°C × daylength hours) in late summer, the greater the proportion of young salmon maintaining good growth and within the upper mode.

In non-smoltifying salmonid species, Mäkinen and Ruhonen (1992) have shown for rainbow trout *O. mykiss*, that during the natural photoperiodic cycle a reduced rate of decreased daylength was favourable for growth and food conversion efficiency. A longer light phase appears favourable for an increase of food intake and also possibly for a better food conversion (Mason et al., 1992). In a very recent experiment, better growth and food conversion efficiency rate have been observed under continuous illumination during the first living year (Maisse and Le Bail, unpublished results). In Arctic charr, Mortensen and Damsgård (1993) found that a long photoperiod increased the compensatory growth observed after a previous 'warm' (11°C) temperature and short days pre-treatment. Hence, it appears from these data that non-migrating salmonid species growth are sensitive to increasing daylength under artificial conditions. However, these results do not take into account any of the endogenous growth cycles in these species (Jobling, 1987; Saether et al., 1996; Noël and Le Bail, 1997), which could also be influenced by light.

A considerable amount of literature dedicated to the effects of photoperiod on Atlantic salmon juveniles exists: at least 70 papers, since 1980 (and an additional 25 on Pacific salmon species) have been registered. In the only issue of the Third International Salmonid Smoltification Workshop held in Trondheim, published in 1989, 11 papers gave data about light influence on growth and smolting. Obviously, not all of these studies can be referred here, but the effects of photoperiod are so clear for this species that they merit mention.

The major difficulty in extrapolating results is the existence of the major developmental transformation from parr to smolt (see reviews in Fontaine, 1975; Hoar, 1988; Boeuf, 1993). Growth cannot be dissociated from smoltification: the fish at the end of freshwater residence, just before migration, are euryhaline and they grow very fast. Photoperiod exerts an important role in salmon smoltification (Hoar, 1988; Boeuf, 1993; Saunders et al., 1994; Solbakken et al., 1994; Sigholt et al., 1995).

During the first year, before completion of parr–smolt transformation, light stimulates growth. For Baltic salmon, Lundqvist (1980) showed that a longer photoperiod (20L:4D opposed to natural light or 6L:18D) stimulated growth during the autumn. However, this author did not take into account the 'size-structure' of the experimental population. Atlantic salmon has a specific developmental strategy with two modes in weight and size appearing in the population during the first year, 7 to 9 months before the completion of smolting. Thorpe (1987) proposed that photoperiod synchronises an endogenous rhythm, genetically determined, and regulates the moment when the 'switch' of the differentiation is made into two growths modes. Decreasing daylength may cause the appearance of bimodality: transfers of fish from continuous light to natural photoperiod (range 12–15 h) are followed by a segregation in growth rates into lower and upper modes fish (Skilbrei, 1991; Skilbrei et al., 1997). Under continuous light, bimodality is low or absent and the individual decision to enter the upper mode with fast growth is strongly dependent on the fish size at the time of winter light stimulus. Seven weeks of short-day treatment reduced growth in comparison with the continuous light exposed salmon (Sigholt et al., 1997). It is essential for completion of smolting to expose fish to an increasing photoperiod after short-day conditions (Kristinsson et al., 1985; Gaignon and Quemener, 1992; Björnsson et al., 1995). In some cases, authors were able to dissociate a pure growth effect of light from those linked to smolting: long term (a few months) constant long daylength stimulates growth, but is increasing daylength necessary for parr–smolt transformation? (Saunders et al., 1985; Saunders et al., 1989; Duston and Saunders, 1992).

Feeding activity is fundamental, as salmon do not eat at all or at least very little during night time (Thorpe et al., 1988), even if they can do during very short photoperiods. Maybe, they can be looking for food at the bottom of the tank (olfactory sense?) during the night (Jorgensen and Jobling, 1992). Villarreal et al. (1988) suggested that the delays observed in growth, after daylength reduction, reflected a synchronizing effect of photoperiod on an endogenous rhythm of appetite and growth. At present, it seems that growth, linked to daylength, is related to food intake.

All these data lead to the possibility of producing 0^+-age smolts, and at present, an important part of smolt production makes use of light manipulations. One can produce 7–8 month old smolts, with a good growth, and ability to adapt to seawater (Saunders and Duston, 1992; Trush et al., 1994). In the Ifremer laboratory, using three photoperiodic regimes (16L:8D; 12L:12D and 8L:16D) for 5 months (following 3 months at 12L:12D), 0^+-age smolts of different sizes have been produced (data of Medina, Gaignon, Quemener and Boeuf, unpublished observations, see Fig. 1). The effects on growth, depending on temperature, are presented in Fig. 1. Fish were reared in indoor 1 m^2 Swedish type tanks in constant light and temperature conditions at densities of 15 $kg \cdot m^{-2}$. They were fed dry commercial pellet (Aqualim) daily by an automatic feeder. If growth appeared related to temperature, then lighting also affects growth (fork length).

After seawater transfer, Atlantic salmon growth may also be influenced by daylength. Presently, many farmers in Norway and Scotland use continuous lighting during the autumn or winter (October–April in the North hemisphere) to improve growth: growth in fish subjected to natural daylight is depressed during the autumn and winter, while, conversely, no such growth depression in winter is observed under a continuous light regime (Forsberg, 1995). Several authors, using photoperiod treatments, have experimentally demonstrated a substantial improvement of postsmolt growth in sea water (Saunders and Harmon, 1988; Kråkenes et al., 1991; Hansen et al., 1992). However, in these experiments, such treatments not only stimulated growth, but also triggered earlier sexual maturation. Otherwise, it is known that somatic growth is accelerated during the first steps of the gametogenesis through steroidal action (Le Bail, 1988). Hence, it is possible that a great part of the light stimulation of growth under these conditions is due to reproduction. However, in a recent study (Oppedal et al., 1997), it has been demonstrated that, if light intensity was sufficient, abrupt changes from natural short photoperiod to continuous additional light (January–June) promoted growth without triggering maturation.

Other studies have been carried out in Pacific salmon species, mainly coho *O. kisutch* and chinook *O. tshawytscha*. Clarke et al. (1978) showed that the sensitivity of young fry to photoperiod varied seasonally. Clarke and Shelbourn (1986) concluded that bimodal growth in juvenile salmon was a function of a photoperiod phase at the time of

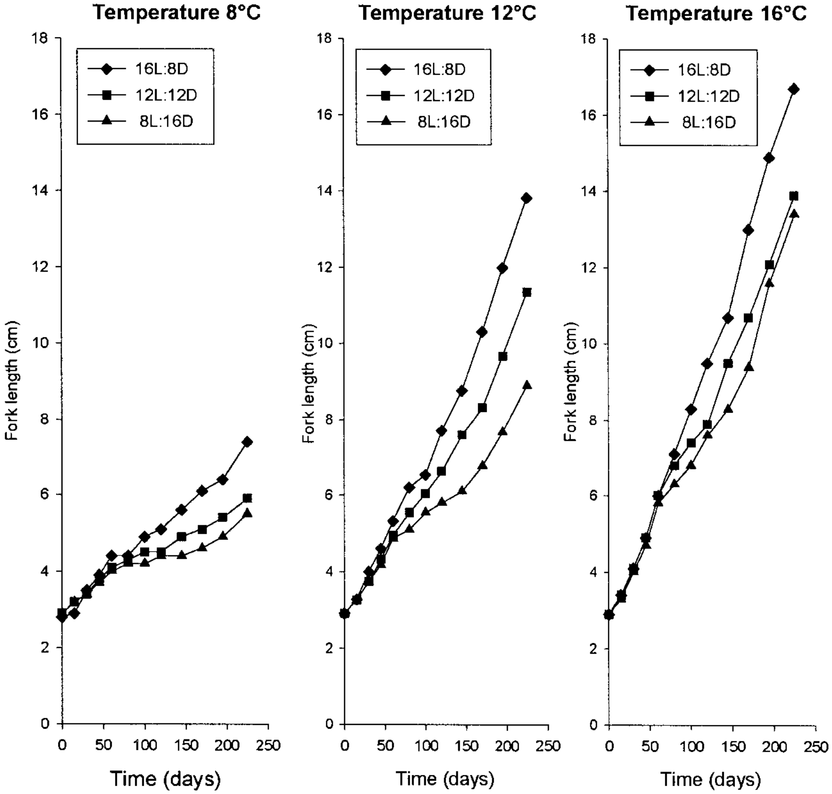

Fig. 1. Influence of constant daylengths on Atlantic salmon (*S. salar*, Norwegian strain) juvenile fork-length. The fish were reared in fresh water (hatching–8 month old) in 1 m^2 Swedish tanks in Ifremer Brest at three constant temperatures (8, 12 and 16°C), at density of 15 $kg \cdot m^{-2}$. They were fed commercial dry pellet (Aqualim) by an automatic feeder. (Medina, A., Gaignon, J.L., Quemener, L. and Boeuf, G., unpublished results). After 100 days, fish reared under the longest daylength (16L:8D) were always larger.

first feeding and it was possible to produce underyearling coho smolts. Extended daylength also stimulates growth for Pacific species (Thorarensen and Clarke, 1989), as it does for Atlantic salmon. In fact, it is not the accumulation of light exposure that initiates smolting, but rather the time during the day when light is experienced. Moreover, responsiveness to inductive photoperiods depends on the initial photoperiod treatment (Thorarensen and Clarke, 1989). Thorarensen et al. (1989) exposed young coho salmon to different levels of night illumination ranging from 0.0001 to 0.05 lx, after a first period at short-day (10L:14D, during 12 weeks) and a second period under inductive lighting (9L:9D:1L:5D or 24L:0D): they observed slower growth rates for the fish exposed to nocturnal illumination. It seems that a period of total darkness is needed to obtain maximum growth.

In conclusion, increasing daylength exerts a greater influence on salmon smoltification than constant daylength. It seems important for freshwater fish to experience a period of a few weeks of short-days prior to subjecting them to increasing daylength.

Even if in nature this smolting phenomenon cannot be dissociated from somatic growth, the preceding data show us that a long daylength (changing or constant) specifically stimulates growth. It is possible that this great dependence of Atlantic salmon on photoperiod could be due to the strains used in the preceding experiments, localised in high latitude Nordic areas. The photoperiod responsiveness of northern or southern strains should be interesting to be compared. Is this fish so sensitive to daylength as it is naturally used to experiencing such extreme lighting conditions?

4. Endolymph / otolith system

Why, then, will the possible role of inner ear of teleosts be discussed in this paper? Simply because fish otoliths exhibit annual and daily rhythmic depositions in relation to photoperiod and light sensitivity. Furthermore, otolith increments have been used as life indicators of history, ageing and somatic growth for a long time. They are composed of calcium carbonate crystals in the aragonite form, enmeshed in an organic matrix composed largely of a keratin-like protein (Wright et al., 1992). Accretion occurs through the successive deposition of a mineral-rich and a matrix-rich, mineral deficient layer: in many species, the deposition of these two layers occurs over a day, so producing a recognisable daily increment (Pannella, 1980).

A few scientists have wondered about the role of photoperiods on otolith growth. In Atlantic salmon, deposition is regulated by an endogenous rhythm synchronized with light/dark cycles over 24 h-periods (Wright et al., 1991). Otolith calcification declines at night and resumes at dawn: a diel fluctuation in net calcium accretion, linked to plasma calcium concentration, appears (Wright et al., 1992). A similar phenomenon is recorded in rainbow trout (Mugiya, 1987), Arctic charr (Adams et al., 1992) and pike *Esox lucius* (Wang and Eckmann, 1992).

Using five photoperiod treatments (6L:6D; 12L:12D; 24L:24D; 24L:0D and 0L:24D), Mugiya (1987) demonstrated that photoperiods worked as a potent entrainer for the rhythmic formation of otolith increments in embryonic and larval rainbow trout. It is not so easy to correlate somatic growth and otolith growth, probably as numerous factors are involved. Incremental increases in otolith width appear linked to photoperiod, whereas increases in the number of rings appear related to feeding activity (Neilson and Geen, 1982). Other external factors, such as temperature, modify the ratio between somatic and otholith growth in young turbot (data of Kossmann, Leroux and Boeuf, unpublished observations).

There is very little information concerning the physiology of the endolymph–otolith complex. The saccule has specialised small and big cells which have all the characteristics of gill ionocytes (Mayer-Gostan et al., 1997). The presence of a pH gradient in the inner ear of teleosts is a unique base among the vertebrates. This is probably related to biocalcification of otoliths. pH variation has been pointed out as the major factor affecting the rate of calcium deposition depending on the daily photoperiodic cycle (Payan et al., 1997). In the future, it will therefore be interesting to try to elucidate the fine control of photoperiod on otolith growth, via nervous and endocrine signals. In hypophysectomised goldfish *Carassius auratus*, Mugiya (1990) demonstrated that somatic and scale growths were totally inhibited, whilst otolith growth was slighty reduced: injections of pituitary extracts (GH) restored normal conditions. On the other hand, starvation resulted in both somatic and otolith growth depression, as it was observed in rainbow trout (Mugiya and Oka, 1991).

5. Hormonal control

As noted before, fish receive ‘light information’ through photoreceptors in the retina and pineal. Holmqvist et al. (1994) have characterized the neural components which receive and relay photoperiodic cues in Atlantic salmon. The data show that (1) different putative dopaminergic diencephalic optic *nuclei* receive both pineal and retinal innervation and possess projections to the optic *tectum*; (2) a dopaminergic neuronal population in the lateral habenular *nucleus* seems to receive retinal, pineal and tectal inputs; (3) an extensive retino-hypothalamic innervation coincides with putative dopaminergic and peptidergic neurons; (4) several of the peptidergic neurosecretory neurons innervate the pituitary but also possess projections to central optic *nuclei* and the optic *tectum* and (5) a distinct group of putative dopaminergic neurons in the ventral pre-optic area receives extensive retinal innervation and possesses major projections to the pituitary. The discovery of additional pineal projections to the hypophysiotrophic portion of the retinorecipient hypothalamic optic nucleus in smolts further emphasizes that the hypothalamic optic nucleus constitutes a photo-neuroendocrine control center, activated by light, which may play an important role during growth and parr–smolt transformation, via pituitary hormones.

5.1. Melatonin

Melatonin, synthetised by the pineal and the retinal cells, is known as the hormone associated with the daily light–dark cycle. As the duration of this neurohormonal message matches with duration of darkness, it is considered an internal ‘zeitgeber’ of the organism (Falcón et al., 1992; Zachmann et al., 1992; Meissl, 1997). The pineal organ of vertebrates has undergone remarkable transformations during phylogeny: it has changed during evolution from a peripheral photosensory organ into a profound intra-cranial endocrine gland, with the substitution of a direct for an indirect light sensitivity (Collin et al., 1989). In fish, hormone biosynthesis is primarily controlled of light perception by the intrapineal photoreceptors. In teleosts, there are functional analogies between pineal and retinal photoreceptors, but only the pineal contributes to the release of melatonin in blood (Molina-Borja et al., 1996). In salmonids, some of which appear to have not an intrapineal endogenous circadian oscillator, the pineal endocrine melatonin message mainly depends on the irradiance of the incident light. More generally, in teleosts (including zebrafish *Brachydanio rerio*, goldfish, gilthead seabream and pike), pineal photoreceptors, which contain a ‘photopigment-based light transducer’, embody a clock or endogenous circadian oscillator (Bolliet et al., 1996). The clock is synchronized to 24 h daily cycles and makes the rhythm of melatonin secretion.

In all teleosts, the rise of melatonin production at night is caused by a large increase in activity of serotonin N-acetyl transferase (AA-NAT), depending on the clock. However, in trout the regulation of AA-NAT activity is controlled by a clock-independent pathway. New studies led by Falcón et al. (1997) specified that: (1) the dark-induced rise in AA-NAT activity and melatonin secretion require a specific protein synthesis in both species (trout and pike); (2) AA-NAT regulation takes place at the translational and post-translational levels in both species; and (3) AA-NAT regulation occurs also at the transcriptional level in pike. Differences between these two regulatory pathways could be explained by the existence of cellular circadian clocks in pike pineal.

It is more difficult to make a link between melatonin and growth in fish. Experiments on Atlantic salmon by Randall et al. (1994) demonstrated that circulating melatonin profiles always reflect the prevailing daylength. Hence they have the potential to provide the fish with accurate information on both daily and calendar time. Increasing or decreasing daylength would be the feature of a photoperiodic signal, responsible for the entrainment of the circannual ‘clock’, which would ultimately control growth, smoltification and reproduction (Randall et al., 1995). However, in mammals, melatonin does not seem to be involved in GH regulation (Harvey, 1995). Further investigations will be needed to link melatonin to photoperiodic control of fish growth.

5.2. Somatotropin (GH)

Somatotropin (growth hormone) originates from the anterior pituitary gland and plays a major role in fish growth and adaptation (Le Bail et al., 1993; Sakamoto et al., 1993). As early as 1976, Komourdjian et al. (1976) suggested that somatotropin could play a role as a part of a ‘light-pituitary axis’ in the growth of Atlantic salmon during smoltification. In fact, during this process, plasma GH levels ‘naturally’ increase after the spring equinox, when photoperiod rapidly increases (Boeuf et al., 1989; Prunet et al., 1989). Generally, increased daylength accelerates the parr–smolt transformation and associated growth, and increases the blood GH levels (Björnsson et al., 1989, 1995; Stefansson et al., 1991; McCormick et al., 1995). Exposure to continuous light into autumn and winter causes a ‘free-running’ of an endogenous rhythm governing smolting and a subsequent phase-delay of the smoltification-related increase in circulating GH levels (Björnsson et al., 1995; Björnsson, 1997). Similar results of somatotropin increase during smoltification completion have been obtained for masu salmon *O. masou* by Okumoto et al. (1989). However, outside of the period during which smolting occurs, light manipulation does not necessarily increase GH levels, even if somatic growth is increased. Clarke et al. (1989) did not find any difference in GH levels in June or August between fish reared under photoperiod treatments in three Pacific salmon species, even though differences in growth were observed. It is interesting to note that in a non-salmonid species, seabream, the seasonal increase of plasma growth hormone seems more related to daylength than temperature (Perez-Sanchez et al., 1994).

In mammals, circulating somatotropin is higher at night than during the day (Harvey and Daughaday, 1995). In some studies in fish, results suggest that diel GH rhythms are related to feeding activity (Holloway et al., 1994; Reddy and Leatherland, 1994), as well as day–night cycles (Bates et al., 1989; Boujard and Leatherland, 1992). In a recent study of cannulated rainbow trout, Gomez et al. (1996) noted peaks in GH values, but they were irregular and asynchronous in individual fish, with no rhythmicity, but with a trend to higher values during the night. However, none of these studies provide a link between diel rhythmicity and somatic growth capabilities.

It should also be mentioned that generally, in fish, plasma GH levels are inversely correlated to growth performance (Le Bail et al., 1993). GH receptivity studies should be useful for a better understanding of daylength influence on growth. Adelman (1977) did not observe growth differences between carp *Cyprinus carpio* reared at 9L:15D and 16L:8D, after treatment with mammalian GH. IGFs are probably very important in the mediation of light influences on growth. Studies of IGFs and insulin have only been possible in fish for the last few years and further experiments will be needed to evaluate a possible direct action of GH and the role of IGFs in these pathways. Recently, Elies et al. (1996) cloned and sequenced an IGF1 receptor in two teleosts species, turbot and trout.

5.3. Thyroid hormones (TH)

The thyroid gland in fish acts in a similar manner to that in mammals, with high thyroxine (T_4) secretion and peripheral transformation into tri-iodothyronine (T_3). The same receptor binds the two molecules, but with much higher affinity to T_3 than to T_4 (Eales, 1985).

By working on wild plaice from the North Sea (samplings on boats), Osborn and Simpson (1978) obtained seasonal variations in both plasma circulating T_3 and T_4, with *maxima* reached in winter and summer. In a closely related species *Pseudopleuronectes americanus*, in Canada, Eales and Fletcher (1982) also observed seasonal changes in plasma TH levels in both laboratory fish and 'wild' animals. Obviously, these changes, even if they are related to lighting, can also be linked to temperature changes.

In laboratory goldfish, Noeske and Spieler (1983) found diel variation of T_4 in two of the four photoperiods (12L:12D and 16L:8D) tested. In rainbow trout, Cook and Eales (1987) and Boujard and Leatherland (1992) found a diel profile in T_4 which resulted from an interaction of feeding and the photoperiod regimes, whilst T_3 changes were more modest. Recently, Gomez et al. (1997) on the same species, using catheterized fish, did not find a rhythm in T_3, but there were marked diel fluctuations in T_4; growth rate was significantly correlated with daily average T_3. Similar results have been reported in other salmonids (Eales and Shostak, 1985; Boeuf and Gaignon, 1989; McCormick and Saunders, 1990). Hence, T_3 levels appear to provide a good estimation of growth responsiveness to light. However, it cannot explain all light effects on growth: Okumoto et al. (1989) found that plasma TH were not affected by changing daylength in masu salmon, although growth was stimulated. In killifish *Fundulus heteroclitus*, Brown and Stetson (1985) showed that long days (14L:10D) increased, and short days (8L:16D) diminished, the negative feedback sensitivity of the hypothalamus–pituitary axis to TH. They proposed that such a photoperiodically-induced change could aid in the year-round maintenance of thyroxine levels necessary for seasonal adaptation and survival.

Roles of TH during parr–smolt transformation have been reviewed by Boeuf (1993). In Atlantic salmon, an increase in daylength stimulated growth and plasma thyroxine levels, without affecting T_3 (McCormick et al., 1987). T_4 levels remained low under continuous light conditions: after transfer to sea water, only true smolts 'normally' grew. At the end of the fresh water stage, the high T_4 levels could act as a growth stimulator, in spite of a lower affinity than T_3 for the nuclear receptor. However, it should be noted that T_4 plays many other roles during this period. For example, Iwata et al. (1989) discovered that coho and chum salmon *O. keta*, treated with thyroxine changed their phototaxis.

A few studies (Grau et al., 1981; Farbridge and Leatherland, 1987a,b; Nishioka et al., 1989; Hopkins, 1992) have noted relationships between growth, TH levels and the phases of the moon. However, it is possible that the effects of the moon are mediated much more by lunar attraction than by direct incident light (Noël and Le Bail, 1997).

5.4. Other hormones

Other hormones also have an effect on fish growth (e.g., insulin, steroids), but informations lacking in terms of their relation to the influences of light. With sex steroids, much information is available, but only related to reproduction and gonadal development. However, puberty is strongly dependant on photoperiod: the dependant-androgen secretion increase has an influence on somatic growth (Le Bail, 1988; Le Gac et al., 1993). Somatostatin (SRIF) is also known to strongly inhibit GH secretion in all vertebrates, including fish. McCormick et al. (1995) found higher levels of plasma somatostatin-25 in salmon reared at 9L:15D, but with no variation in levels after exposure to longer daylength. One study, published by Zhu and Thomas (1996), demonstrated an influence of different backgrounds and altered illumination on red drum *Sciaenops ocellatus* plasma and pituitary somatolactin (SL, which is a member of the PRL/GH family): they found that both plasma and pituitary SL levels were higher in fish exposed for 1 week to a black background and that circulating SL was maximal 1 day after transfer to a black background tank without illumination. SL may be involved in the adaptation to coloured surroundings (with α-MSH). However, at present, little is known about a possible involvement of SL in growth regulation.

6. Conclusions

Light can be a very limiting factor in water, depending on turbidity and depth. Linking growth in fish with light seems obvious, but from the data discussed in this review this is not always so straight forward. The mechanisms involved in light action are still not clear. Inner ear endolymph/otoliths probably represent an interesting model for investigations of photoperiod influence on fish physiology and growth. Endocrine control is obviously involved in otolith and somatic growth, and there is also interesting information on the effect of light on the release of several hormones, mainly somatotropin and thyroid hormones. However, their modes of action need to be elucidated, and relationships between light receptivity, rhythmical activities and triggering of growth have to be examined. This will also present a very interesting field for future research.

At present, it is very difficult to specify the influences of light quality (colour spectrum, with specific wavelengths) on growth, as there is a lack of information. This is a little surprising as the first induced characteristic of light in water is its rapid absorption and a profound change in the spectral composition. Even if aquaculture develops in shallow turbid waters, further investigations are needed to clarify present knowledge.

The effects of light quantity (intensity, irradiance) have been studied, but here the experiments are not also rigorous as could be expected, as there are problems in comparing results expressed in lux, as a unit of intensity. Thus, previous experiments should possibly be repeated under more controlled conditions. Light intensity is important for fish and larvae, which must be reared in a specific light range, depending on the developmental stage and the species. Most species need light to detect and catch food. A relationship between survival and growth can be established, and often optimal light for growth is not the same as for survival. A compromise has to be found. Too much light can be stressful or even lethal. In bigger fish, light intensity (in the optimal range) does not seem so important as a determining factor on growth.

Many living species depend on the diurnal and annual lighting cycles for normal development, growth and reproduction. Daylength appears to be an important 'zeitgeber' in fish. Many studies have demonstrated the positive influence of long daylength on growth and a few species, such as the Atlantic salmon, are extremely sensitive to it. Today, all this knowledge is used in salmoniculture, photoperiod manipulations being easily applied and not overly expensive. Long photoperiods or continuous daylight appear as a palliative for the compensation of low winter temperatures in highest latitude countries. This approach, however, may not be applicable to all species. Some fish do not respond and others need a (very) long time before expressing better growth. Research will have to be pursued in this area in the future to obtain more predictable responses.

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United States
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Intermountain
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Amended
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2010

Boise

National Forest

Land and Resource Management Plan 2003-2010 Integration

Photos by David Ede

Boise National Forest
Land and Resource Management Plan
2003-2010 Integration

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PURPOSE OF THE FOREST PLAN

The Boise National Forest Land and Resource Management Plan (hereafter referred to as "the Forest Plan" or "the Plan") guides natural resource management activities on lands administered by the Boise National Forest. It describes management goals and objectives, resource protection methods, desired resource conditions, and the availability and suitability of lands for resource management. The purpose of the Plan is to provide management direction to ensure sustainable ecosystems and resilient watersheds that are capable of providing a sustainable flow of beneficial goods and services to the public. The Plan is the implementing guide for fulfilling the Forest Service mission of "Caring for the land and serving people."

The Forest Plan embodies the provisions of the Forest and Rangeland Renewable Resources Planning Act (RPA), as amended by the National Forest Management Act (NFMA) and its implementing regulations. The management prescriptions in the Plan are designed to realize goals for achieving desired conditions; however, future projects planned to implement those prescriptions will be largely dependent on annual budgets.

Forest Plan Revision

The original Forest Plan for the Boise National Forest was released in 1990. The NFMA regulations require that forest plans are updated or revised every 10-15 years. To meet this requirement, the Boise National Forest teamed up with the Payette and Sawtooth National Forests in the Southwest Idaho Ecogroup (hereafter referred to as the "Ecogroup") to revise their Forest Plans together. The three-Forest or Ecogroup approach to Forest Plan revision:

- Applied an ecosystem management framework to management direction across the Forest. Through this framework, the Responsible Official, in consultation with the Forest Plan Revision Interdisciplinary Team, identified and prioritized areas at risk, and developed direction to maintain or restore sustainable and resilient ecosystems.

- Aimed for compatibility. Complete consistency across the three Forests is neither practical nor necessarily desirable. The Responsible Official, in consultation with the Interdisciplinary Revision Team, tried to achieve compatible outcomes relative to key Forest Plan direction. Consistency was emphasized for important issues or effects that transcend administrative boundaries.

- Collaborated with landowners across administrative boundaries to provide for compatible management direction. Collaboration included tribal, federal, state, county, and private entities that own or manage land within the Ecogroup zone of influence.

- Maintained an adaptive strategy using available information. As new information became available, the Responsible Official had the Revision Team incorporate it into the process as appropriate. This adaptive management strategy will continue after revision.

This revised Forest Plan defines the programmatic management strategy for the Boise National Forest for the next 10 to 15 years. However, the revised Forest Plan does not in itself implement any specific actions or projects. Rather the revised plan, through its land allocation prescriptions and management direction, sets the stage for:

- The actions needed to be taken, or not, to move toward desired conditions and goals;
- The management strategies (i.e., active or passive restoration, or conservation) that should be used to help frame when, where, and why action or inaction is needed to help move toward achievement of desired conditions during this planning period;
- The type of activities that are allowed or not allowed to best address management strategies and related Management Prescription emphasis and direction (i.e., MPCs);
- The intensity, duration, and limitations on management actions needed to manage risks and threats to resources and the social and economic environment, while maintaining or moving toward achievement of desired conditions.

The revised Forest Plans replace the 1990 Plan, which was amended by Pacfish and Infish[1] and associated Biological Opinions (BOs) for chinook salmon, steelhead, and bull trout (US Dept of Commerce NMFS 1995, US Dept of Commerce NMFS 1998, USDI FWS 1998).[2] In 2010, the revised Forest Plan for the Boise NF was updated to reflect a 2010 Forest Plan amendment that modified, deleted and added to Forest Plan direction in response to new information and changed conditions concerning wildlife habitat and to integrate components of a wildlife conservation strategy. The update also incorporated various errata issued since the 2003 Forest Plan was published in late 2003.

Ecosystem Management

In 1992, the Forest Service adopted ecosystem management as an operating philosophy (Overbay 1992). Ecosystem-based management has been described as "scientifically based land and resource management that integrates ecological capabilities with social values and economic relations to produce, restore, or sustain ecosystem integrity and desired conditions, uses, products, values, and services over the long term" (ICBEMP 1997a). An ecosystem

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[1] NMFS states in their 1998 Section 7 Consultation on the Effects of the Continued Implementation of LRMPs on ESA listed Salmon and Steelhead in the Upper Columbia and Snake River Basins that "*…a major weakness in Pacfish has been, and still is, the lack of a comprehensive aquatic conservation strategy [ACS] for list anadromous fish. Pacfish was intended to maintain or improve the environmental baseline while a long-term strategy is being developed. … Indefinite extension of Pacfish, delays the recovery of salmon and steelhead, and increase the risk that key population segments will be irretrievably lost. Pacfish maintains a fragmented network of habitats and degraded habitat conditions, where they presently exist, because it lacks a comprehensive restoration and management strategy for watersheds with anadromous fish.*"

[2] To address shortcomings of Pacfish, NMFS required implementation of the nine Action Agency BA recommendations and the five implementing mechanisms specified in their 1998 BO. The BO concludes that this additional interim direction will offer additional short-term conservation measures for listed species until a long-term ACS can be developed "*…if all provisions, including accelerated restoration, are fully implemented*". (1998 Section 7 Consultation on the Effects of the Continued Implementation of LRMPs on ESA listed Salmon and Steelhead in the Upper Columbia and Snake River Basins.)

management approach shifts emphasis from a traditional, single resource or species focus to a focus on ecosystems and landscapes. Ecosystem management also strongly considers the interactions between humans and ecosystems.

Some of the important concepts used in ecosystem management are described in the *Preliminary Analysis of the Management Situation Summary* (USDA Forest Service 1997) for the Southwest Idaho Ecogroup, and in the Introduction to Chapter 3 of the Final Environmental Impact Statement (USDA Forest Service 2003) that accompanies this Plan.

The Ecosystem Management Framework

For Forest Plan revision, the Boise National Forest has adopted an ecosystem management conceptual framework. This framework borrows from and builds on: (1) the current Forest Plan (USDA Forest Service 1990), (2) the Forest Service Region 4 *Desk Guide - Bridge to Revision* (USDA Forest Service 1993), and (3) *A Framework for Ecosystem Management in the Interior Columbia Basin* (ICBEMP 1996a). The intent of the framework is to integrate ecosystem elements with human needs to strengthen the essential link between economic prosperity, social continuity, and ecosystem processes and functions. Use of the ecosystem management framework will help provide for ecosystem resistance and resilience over time and space.

Ecosystem management recognizes that people are part of ecosystems and that collaborative stewardship may be able to address the complexity and controversy inherent in public land management. Furthermore, the ecosystem management framework will use adaptive management to improve our knowledge about environmental effects or the results of management actions, and incorporate this knowledge into future decisions and actions.

Ecosystem Management Components

The four basic components of ecosystem management are physical, biological, social, and economic, as well as all the diversity and connections contained therein. These components can be further broken down into elements. Examples of these elements include:

- Physical Diversity – the elements that comprise the basic building blocks of ecosystems, including geology, landforms, climate, air, water, soil, and hydrologic and soil processes.

- Biological Diversity – the elements that comprise life forms that live within ecosystems, including bacteria, fungi, plants, and animals.

- Social Diversity – the elements that describe how humans interact with ecosystems and how that interaction influences societies and cultures. These elements include human demographics, social organizations, attitudes, beliefs, values, and lifestyles.

- Economic Diversity – the elements that describe how humans generate goods and services from ecosystems and how those products influence economics. These elements include zone of influence, employment status, and economic opportunity and dependency.

These components represent the range of resources considered under the EM framework in this document, and most resources represent some combination of these components. For example, the timber resource manages tree vegetation (a biological element) to provide goods and jobs (economic elements) to support local community values and lifestyles (social elements). The forested vegetation, in turn, depends on productive soils, oxygen, and water (physical elements) to grow. Indeed, most social and economic resources related to Forest management are heavily dependent on the biophysical resources for long-term sustainability. Put another way, sustainable goods and services are the product of resilient and properly functioning ecosystems. Thus, ecosystem management focuses on maintaining or restoring the biophysical components of ecosystems in order to sustain economic opportunities and support social and cultural values.

RELATIONSHIP OF THE FOREST PLAN TO OTHER DOCUMENTS

RPA and the Intermountain Regional Desk Guide

The Boise Forest Plan was developed and revised within the framework of national and regional Forest Service direction. The Forest and Rangeland Renewable Resources Planning Act (RPA) and its implementing Program set direction and output levels for National Forest System lands. Goods and services are distributed based upon detailed, site-specific information concerning the capability and suitability of National Forest System lands being assigned various management activities and prescriptions at the Forest level. The Plan provides information for the RPA assessment and program updates.

Much of the Forest Plan revision was based on direction found in the *Intermountain Regional Desk Guide – Bridge to Revision* (USDA Forest Service 1993). Thus, Regional planning is a two-way street that conveys direction from the National to the Forest level, and transmits information from the Forest to the National level. While this planning Desk Guide ensures that a consistent approach to National Forest planning is followed throughout the Region, it also allows the individual Forests considerable latitude in formulation of their Plans.

Forest Plan Environmental Impact Statement (EIS)

During the Forest Plan revision effort, management alternatives were developed, analyzed, and compared, from which the Regional Forester selected an alternative for implementation. This Forest Plan represents the selected alternative, Alternative 7. The planning process and analysis procedures used in developing the selected alternative and Plan are described or referenced in the FEIS and supporting project record.

Relationship to Subsequent Multi-scale Analyses, Project or Site-scale Assessment and Planning

Management activities on National Forest System lands within the administrative boundary of the Boise National Forest will be planned and implemented in a manner that furthers the achievement of the goals and objectives described in this Forest Plan. Forest Plan direction serves as an umbrella for environmental analysis and project planning and implementation. Subsequent mid-, fine-scale analyses and project planning and implementation will be tiered to this Plan and its companion FEIS, as provided for in 40 CFR 1502.20.

Administrative Versus Proclaimed National Forest Boundaries

The Boise National Forest has both a "proclaimed" and an "administrative" boundary. There are an estimated 2,612,000 acres of National Forest System (NFS) lands within the proclaimed boundary of the Boise National Forest. Proclaimed Forest names and boundaries are designated by Congress and can only be changed by an act of Congress.

Administrative authority of National Forest System lands within the proclaimed boundaries of National Forests is shifted among respective Forest Supervisors for administrative efficiencies. The area administered by a particular Forest Supervisor is referred to as the "administrative" boundary. There are an estimated 2,267,000 acres of NFS lands within the administrative boundary of the Boise National Forest.

As shown on Figure I-1, the Boise National Forest administers NFS lands within the proclaimed boundaries of the Payette and Sawtooth National Forests. Likewise, the Payette, Sawtooth and Salmon Challis National Forests administer lands within the proclaimed boundary of the Boise National Forest.

This Forest Plan includes direction for the management of NFS lands within the administrative boundary for the Boise National Forest. This plan does not include direction for NFS lands within the Boise National Forest proclaimed boundary that are not within the administrative boundary. There are two areas within the Boise National Forest administrative boundary that are within the proclaimed boundaries of the Payette National Forest and the Sawtooth National Forest.

- The area within the proclaimed boundary of the Payette National Forest is east of Council, Idaho and south of McCall, Idaho. This area falls within Management Area 18 of this revised Boise Forest Plan. [Map Label 1a]

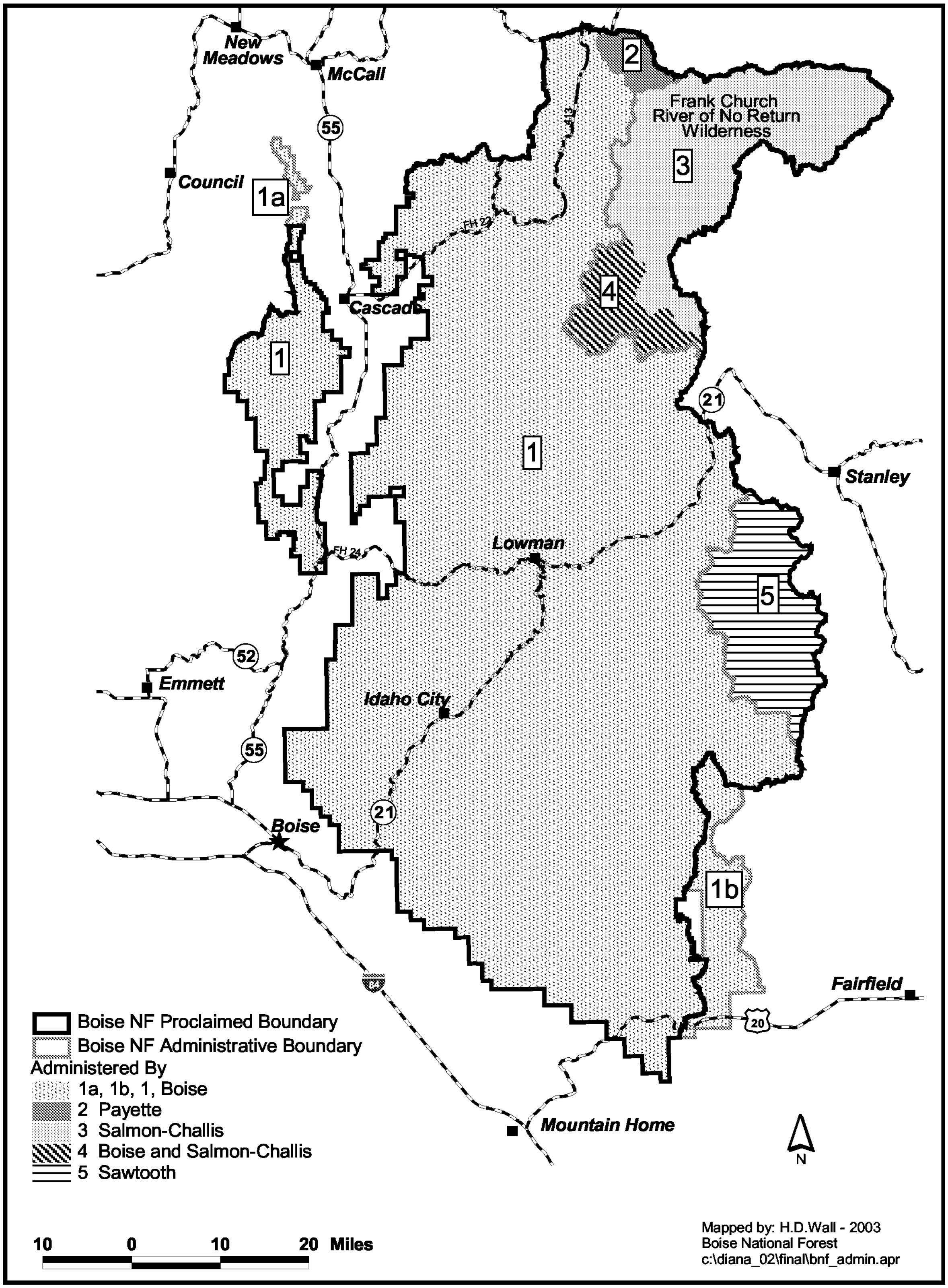
- The area within the proclaimed boundary of the Sawtooth National Forest is northeast of Mountain Home, Idaho and west of Fairfield, Idaho. This area falls within Management Areas 1 and 2 of this revised Boise Forest Plan. [Map Label 1b]

There are three areas within the proclaimed boundaries of the Boise National Forest that are administered by adjacent National Forests. Analysis and management direction for these areas can be found within the Forest Plan prepared by each of those Forests. These areas are:

- The Stibnite area in the upper East Fork South Fork Salmon River drainage, east of Yellow Pine is administered by the Payette National Forest. Direction for the area is in the Payette National Forest Plan. [Map Label 2]

- The Indian Creek, Pistol Creek, and Elkhorn Creek drainages in the Middle Fork of the Salmon River canyon are administered by the Salmon-Challis National Forest. Direction for the area is in the Frank Church-River of No Return Wilderness Management Plan. [Map Label 3]

Figure I-1: Boise National Forest Proclaimed and Administrative Boundaries



- The Part of the Sawtooth Wilderness, including part of the South Fork Payette River drainage, near Grandjean, is administered by the Sawtooth National Forest. Direction for the area is in the Sawtooth Wilderness Plan. [Map Label 5]

There is one area with the proclaimed boundary of the Boise National Forest where the Salmon-Challis and Boise National Forests share administration. This area falls within the Frank Church – River of No Return Wilderness. Direction for this area is located in the Frank Church – River of No Return Wilderness Management Plan. This area is identified as Management Area 22 in the revised Boise Forest Plan. The Boise National Forest administers permits related to term grazing permits and special uses, such as outfitter and guides. The Salmon Challis administers all other management activities on NFS lands in this area. [Map Label 4]

Plans for Special Areas

There are two existing plans that were mandated by separate Congressional actions that cover lands within the proclaimed and administrative boundaries of the Forest. These plans, listed below, are referenced so that the reader will know which documents provide direction for those unique portions of the Forest.

- Frank Church—River of No Return Wilderness Management Plan (USDA Forest Service 1986)

- Management Plan for the Middle Fork of the Salmon Wild and Scenic River (USDA Forest Service 1985)

Existing Forest Plan, Permits, Contracts, and Other Uses

This revised Forest Plan replaces the existing Plan. All permits, contracts, and instruments for use or occupancy of the Forest must conform to the revised Plan's direction. However, because some existing permits and leases are already committed, they will remain in effect until they can be adjusted to accommodate direction in the revised Forest Plan. The Record of Decision for the revised Forest Plan provides the Responsible Official's direction concerning transition of the permits, contracts, and other uses to reflect direction of the revised Plan.

ORGANIZATION AND STRUCTURE OF THE FOREST PLAN

The Forest Plan, as administered by the Forest Supervisor, provides direction for managing the Boise National Forest. The Plan contains the goals, objectives, standards, and guidelines needed to achieve the desired conditions for Forest resources. The Forest Plan is organized into the chapters and appendices described below. Subsections for the chapters and appendices are listed in the Table of Contents.

Chapter I – Introduction

Discusses the general purpose of the Forest Plan, the relationship of the Plan to other documents, and the Plan organization. Includes an integrated description of the Forest, as well as a breakdown of past and revised management prescriptions for the Forest.

Chapter II – Analysis of the Management Situation Summary

Describes the Need for Change in management direction for selected resources, the current condition of those resources, and how the Plan addresses the need to improve those conditions.

Chapter III – Management Direction

Presents management direction for the Forest as a whole, and for specific Management Areas. The first section provides Forest-wide desired conditions, goals, objectives, standards, and guidelines. The second section describes the resources of each Management Area, and provides more area-specific direction for the management of those resources.

Chapter IV – Implementation of the Forest Plan

Includes direction for implementing the Forest Plan, presents a plan for monitoring and evaluating the effects of management practices, and describes how the Plan will be amended or revised in the future.

Appendices

Appendix A – Vegetation (Desired conditions, mapping, classification, including the Vegetation and Wildlife Habitat Restoration Strategy map)
Appendix B – Soil, Water, Riparian, and Aquatic Resources (Matrix, RCAs, LSP areas, ACS)
Appendix C – Botanical Resources (TEPCS plants, trends, rare communities, cultural plants)
Appendix D – Wild and Scenic Rivers (Results of revised eligibility study)
Appendix E – Terrestrial Wildlife Resources (Wildlife Conservation Strategy, including the Vegetation and Wildlife Habitat Restoration Strategy map and the Source Environment Restoration Strategy map)
Appendix F – Recreation (ROS definitions and implementation relationships)
Appendix G – Land Capability Groups (Susceptibility to erosion)
Appendix H – Legal and Admin Framework for Forest Planning and Resource Management
Appendix J – Utility Corridors

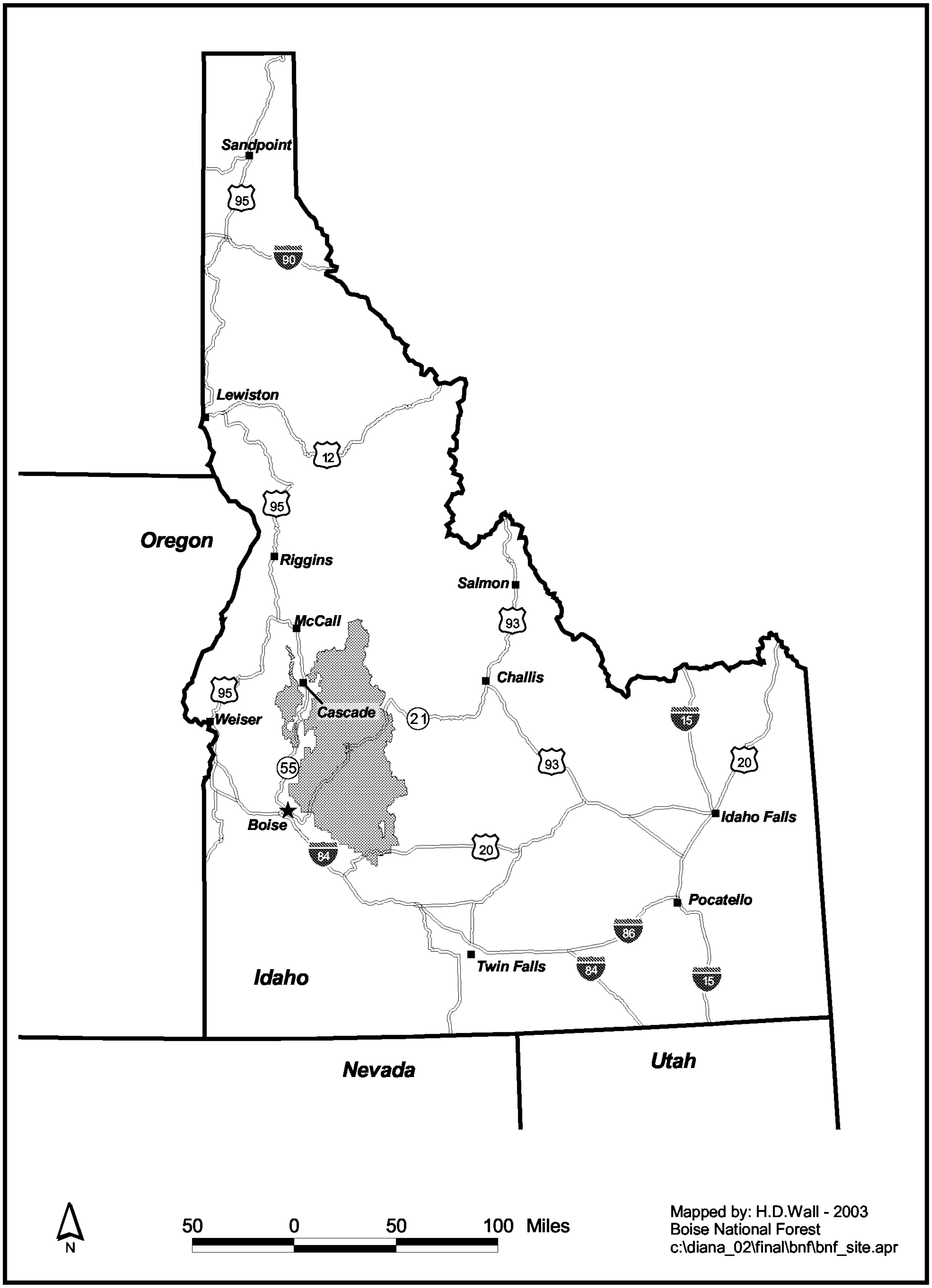
Glossary and Acronyms

Includes definitions of key terms, and commonly used acronyms.

LOCATION AND DESCRIPTION OF THE FOREST

The Boise National Forest is located in west central Idaho (see Figure I-2), north and east of the capitol city of Boise. Parts of the Forest are located in Ada, Boise, Elmore, Gem, and Valley Counties. The Forest borders the Sawtooth and Salmon-Challis National Forests on the east, and the Payette National Forest on the north. The Supervisor's Office is located in Boise. The Forest is comprised of five ranger districts—Mountain Home, Idaho City, Lowman, Emmett, and Cascade—with district offices located in each of those towns. The Forest is an administrative unit of the Intermountain Region (Region 4) of the Forest Service, U.S. Department of Agriculture. The Regional Forester's office is located in Ogden, Utah.

Figure I-2. Location Map – Boise National Forest



Physical and Biological Setting

The Forest administers an estimated 2.27 million acres of federal lands. A general description of the biophysical setting for the Forest appears below.

Climate

Climate patterns are typically moist and cold in the winter and early spring, and warm to hot and dry during the summer and early fall. The winter climate is influenced by mountain ranges that block most arctic air from entering the area. The deep Snake River and Salmon River valleys, however, can funnel dry arctic air into the basin where it often stagnates. In the late spring and summer, moisture from the Gulf of Mexico may move north and combine with warm seasonal temperatures and steep topography to increase high-intensity, short-duration thunderstorms. Late spring events generally have more precipitation, with 24-hour accumulations often greater than one inch. Dry lightning is more common during summer and fall.

Winter temperatures average between 29 and 9 degrees Fahrenheit. Snowfall ranges from about 55 to 70 inches, with greater amounts at higher elevations. Despite cold winter temperatures, occasionally warmer air off the Pacific Ocean brings rainfall mainly at elevations below 5,000 feet. This situation increases the risk for rain-on-snow events that can trigger floods and landslides. Increased exposure to maritime air masses creates moister vegetation regimes as one moves progressively north within the Forest. Maximum summer daytime temperatures can reach over 100 degrees at lower elevations, with higher elevations in the 80s to 90s. Growing seasons vary greatly, from less than 30 days in the alpine areas to over 150 days in the lower valleys.

Topography and Geology

Elevations vary greatly across the Forest, from 2,800 feet in the North Fork Payette River Canyon to nearly 10,000 feet atop Steel Mountain. This wide range of elevations encompasses a great diversity of geologic characteristics. At least five major landforms have resulted from past geomorphic processes:

1) High-elevation distinctive mountains and valley formed from alpine glaciation,
2) More subtle high-elevation topography formed by freezing and thawing processes,
3) Lands with sharply defined drainage patterns formed by stream-cutting action,
4) Depositional lands formed from eroded materials from higher lands, and
5) Lands formed by volcanic flows.

Geologically, the Forest is dominated by granitic rock, with inclusions of basalts to the west, and volcanic rock to the south. Major mountain systems include the Boise, Salmon River, and West Mountain Ranges. Much of the area lies within the Idaho batholith, the largest contiguous batholith in the United States. The batholith features steep slopes of coarse-textured soils that readily take in and transmit water. Unless these soils are disturbed, surface runoff is rare except during high-intensity storms or rain-on-snow events.

Water

Watersheds on the Forest provide a continuous supply of water to the Snake and Salmon River Basins. The annual water yield from the Forest has been recently estimated at just over 4,100,000 acre-feet. This water resource has many beneficial uses, including aquatic habitat, recreation, irrigation, hydropower, and domestic water supply. The Forest has an estimated 9,600 miles of perennial and intermittent streams, and 15,400 acres of lakes and reservoirs, and contains important portions of the Salmon, Payette, and Boise River systems.

Vegetation

The wide range of landforms, elevation, and climate across the Forest has produced a wide variety of vegetative conditions. An estimated 76 percent of the Forest's lands are considered forested, or capable of supporting trees on at least 50 percent of the area. Common tree species include ponderosa pine, Douglas-fir, aspen, lodgepole pine, subalpine fir, Engelmann spruce, and whitebark pine. Grand fir and western larch only grow in the northern portion of the Forest where conditions are somewhat moister. About 23 percent of the Forest is considered non-forested, or dominated by grass, forb, shrub, or brush species. Much of the non-forested vegetation is found at lower elevations or more southern latitudes, on dry southern aspects, or in high-elevation alpine settings. The Forest also contains potential habitat for Ute ladies'-tresses, listed as threatened under the Endangered Species Act (ESA).

For the purposes of effects analysis and management considerations, the Forest has been broken out into forested, woodland, shrubland, grassland, and riparian vegetation groups. These groups are listed and described in Appendix A.

Terrestrial and Aquatic Species

The Forest provides habitat for close to 300 terrestrial species of mammals, birds, reptiles, and amphibians. Elk and deer are the most common large animals, although moose, black bear, and cougar are also present. Habitat also exists for other wide-ranging carnivores such as wolverine and fisher. Bird species include sage grouse, great gray owl, northern goshawk, and many migratory land birds. The Forest also provides habitat for the bald eagle, listed under the ESA but proposed for de-listing, and an experimental/non-essential population of gray wolf. Habitat for the Canada lynx, listed as a threatened species, also occurs on the Forest.

An estimated 28 species of fish are found in Forest streams and lakes, including 11 species that have been introduced or moved to areas where they are not native. Native species include chinook salmon, steelhead trout, and bull trout, which are currently listed as threatened under the Endangered Species Act. Other native species of special concern include redband rainbow trout and westslope cutthroat trout.

Social and Economic Setting

A general description of the social and economic setting for the Forest appears below. Social and economic analyses are conducted by the Forest Service to determine what effects the agency has on local communities and the people using natural resources. The human dimension component is an important part of ecosystem management. Impacts on communities were considered in resource decisions made in the Forest Plan revision process. Social and economic impacts were determined for each alternative analyzed.

Just as the Forest Service can directly or indirectly *affect* social and economic conditions, the agency is also *affected by* changes in attitudes, values, and public desires at both local and national scales. Conflicting opinions over the uses of public lands have increased the complexity of national forest management, and the number and types of laws governing natural resources. In many cases these changes have narrowed the decision space available to local managers.

In the Forest Plan revision process, counties and communities were a focal area of analysis for social and economic purposes, although international, national, regional, and state perspectives were also assessed. This approach differs from that taken in the original Forest Plan analysis, which examined effects on counties and communities, with particular emphasis on counties.

Counties and Communities

The socio-economic overview area for the Boise National Forest includes six counties and six communities within and adjacent to the Forest. The six counties are Ada, Boise, Canyon, Elmore, Gem, and Valley. These counties were selected because they include National Forest System lands, and/or they have major social and/or economic ties to the Boise National Forest. The six communities are Cascade, Crouch-Garden Valley, Emmett, Idaho City-Centerville, McCall-Donnelly, and the greater Boise metropolitan area, commonly referred to as the "Treasure Valley," which includes Boise, Nampa, Caldwell, Meridian, Kuna, Eagle and other incorporated communities in Ada and Canyon Counties.

Population Trends

Table I-1 shows population trends of counties within the socio-economic overview area. This table shows Boise County, which adjoins urban Ada County to the north and east, as the fastest growing of the six counties. Other rapidly growing areas in the same time period were Canyon, Ada, and Elmore Counties.

Table I-2 shows that nearly all of the six communities selected for in-depth analysis grew at least slightly during the 1980-2000 period. For some of these communities, growth was substantial, and much of it occurred during the 1990-2000 period.

The populations of the urban and urban-adjacent areas have generally been growing rapidly and are predicted to continue this growth pattern through the next planning period. Rural areas, on the other hand, have been fairly static, and populations are predicted to remain so or increase at a slower rate.

Table I-1. Historic[1] and Projected[2] Populations

County	1980	1990	1995	2000	2010	2020	1990-2000 Change	2000-2010 Projected Change
Ada	189,811	207,505	252,251	300,904	358,495	416,167	45%	19%
Boise	3,285	3,552	4,669	6,670	7,902	8,971	88%	18%
Canyon	87,815	90,639	109,123	131,441	155,288	178,676	45%	18%
Elmore	21,764	21,232	23,547	29,130	34,504	40,284	37%	18%
Gem	11,789	11,940	13,871	15,181	17,267	19,246	27%	14%
Valley	6,525	6,150	7,848	7,651	9,621	11,426	24%	26%
Idaho	**977,617**	**996,553**	**1,149,284**	**1,293,953**	**1,506,581**	**1,717,847**	**23%**	**16%**

[1] “Historic” population figures (1985, 1990, 1995, 2000) are from the U.S. Department of Commerce, Regional Information System (Robison 1997, Robison and Gneiting 2002a).

[2] “Projected” population figures (2010, 2020) represent the median of projections compiled by Idaho Power and by ICBEMP (Robison 1997, Robison and Gneiting 2002a).

Table I-2. Community Populations: 1980-2000

Community	County	1980	1990	2000	90-00 Change
Treasure Valley[1]	Ada/Canyon	167,033	199,710	333,601	67%
Crouch	Boise	69	75	154	105%
Idaho City		300	322	458	42%
Emmett	Gem	4,605	4,601	5,490	18%
Cascade	Valley	945	877	997	14%
McCall-Donnelly		2,327	2,140	2,222	2%

[1] For the purposes of this discussion, the “Treasure Valley” includes the incorporated communities in Ada County (Boise, Eagle, Garden City, Kuna, Meridian and Star) and Canyon County (Caldwell, Greenleaf, Melba, Middleton, Nampa, Notus, Parma, Wilder).

Economic Trends

The following are important economic trends within the Forest.

Payments to Counties

Counties that contain federal lands receive payments from the federal government as follows:

The Secure Rural Schools and Community Self-Determination Act of 2000 – The Secure Rural Schools and Community Self-Determination Act of 2000 (Public Law 106-393) was signed into law on October 30, 2000. This law was enacted “to restore stability and predictability to the annual payments made to States and counties containing National Forest System lands and public domain lands managed by the Bureau of Land Management for use by the counties for the benefit of public school, roads and other purposes” for fiscal year (FY) 2001 through 2006 (October 1 – September 30).

Before Public Law 106-393 was enacted, the Forest Service returned 25 percent of the revenues from the sale of forest products and permitted operations to counties which contain National Forest System land, through the “25 Percent Fund Law of 1908.” The amount that a county received from each National Forest's 25 percent fund was proportional to the percent of the Forest located in that county. State regulations stipulated that 70 percent of the funds were to be used for public roads, with 30 percent used to fund public schools.

Under Public Law 106-393, counties will have the option of continuing to receive payments under the 25 Percent Fund Act, or electing to receive their share of the average of the three highest 25 percent payments made to the State during the period of FY 1986 through FY 1989 ("the full payment amount").

Table I-3 shows the 25 percent fund payments from the Boise National Forest to counties over the last several years, as compared to each county's share of the full payment amount. The table indicates that the level of 25 percent fund decreased in the last several years, as linked to the decrease in National Forest timber sales on the Forest, and that for most counties, their share of the full payment amount would be substantially greater than that received in the past few years.

Table I-3. 25 Percent Fund Payments to Counties

County	Payment From:	FY 1985 $	FY 1990 $	FY 1995 $	FY 2000 $	FY 95-00 Change	County Share – Full Payment
Ada	Boise NF	1,575	2,228	3,199	1,785	-44%	5,900
Boise	Boise NF	326,165	461,663	773,627	415,685	-46%	1,354,700
Canyon	Not applicable	0	0	0	0	0%	0
Elmore	Boise NF	237,720	337,373	564,660	309,284	-45%	1,023,000
Gem	Boise NF	22,587	32,311	54,007	29,219	-46%	94,800
Valley	Boise NF	400,553	567,790	951,301	515,217	-46%	2,970,000
Totals		**988,600**	**1,401,365**	**2,346,794**	**1,271,190**		**5,448,400**

Data reflects only 25 percent payments from Boise National Forest; some counties may also receive 25 percent fund payments from other national forests. Fiscal Year (FY) extends from October 1 of one year to September 30 of the next calendar year.

Payments in Lieu of Taxes – Counties also receive payments from the federal government based on the Payments in Lieu of Taxes (PILT) Act of 1976. The PILT is a federal revenue-sharing program designed to compensate local governments for the presence of tax-exempt federal lands within their jurisdiction. These payments are *not* linked to revenues generated by the sale of national forest products or permitted activities. The Act authorizes payments under one of two alternatives, based on the acres of qualifying federally managed acres ("entitlement acres") within the county, subject to a payment ceiling based on county population. The amount paid to the county is the higher of two alternative calculations. However, PILT payments are appropriated each year by Congress, and actual payments may be less than those calculated.

Table I-4 shows recent PILT payments for counties within the overview area. Between 1995 and 2000, PILT payments have increased, although in earlier years, payments had shown substantial decreases. In some counties, these decreases were compounded by similar decreases in 25 percent fund payments.

Table I-4. Payments in Lieu of Taxes

County	Entitlement Acres in 1995	FY 1980 $	FY 1995 $	FY 2000 $	FY 95—00 Change
Ada	199,368	228,181	155,748	155,073	< -1%
Boise	890,101	143,132	89,767	131,080	46%
Canyon	20,528 (BLM)	N/A	16,005	16,152	< 1%
Elmore	1,292,889	1,135,204	595,145	681,614	15%
Gem	134,324	117,247	13,547	96,685	614%
Valley	2,045,758	392,813	206,315	215,892	5%
Totals	**3,472,971**	**1,645,264**	**1,076,527**	**1,296,496**	

Native American Indian Tribes

No Native American Indian reservations are located within the Forest or the Forest's socio-economic overview area. However, the ancestors of the modern day Nez Perce, Shoshone-Bannock, and Shoshone-Paiute Tribes were present in this area long before the establishment of the Boise National Forest. Many of the treaties and executive orders signed by the United States government in the mid-1800s reserved homelands for the Tribes. Additionally, the treaties with the Nez Perce and Shoshone-Bannock reserved certain rights outside of established reservations, including fishing, hunting, gathering, and grazing rights. In addition, the Yakima, Umatilla, and Warm Springs Tribes have reserved certain rights to anadromous fish produced from the Forest.

The following excerpts from the treaties with the Nez Perce and the Shoshone-Bannock, and the Executive Order with the Shoshone-Paiute, provide examples of the rights that the tribes have, and where they can exercise these rights on the Boise National Forest.

Nez Perce Treaty of 1855: Article IV in this treaty states:

> *"The exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizen's of the territory; and of erecting temporary buildings for curing, together with privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands."*

Shoshone-Bannock Tribes Fort Bridger Treaty of 1868: Article 4 of the Treaty with the Eastern Band Shoshone and Bannock states:

> *"…but they shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts."*

Shoshone-Paiute Tribes Executive Order of 1877:

> This Order set aside the Duck Valley Reservation for several Western Shoshone bands who traditionally lived along the Owyhee River of southeastern Oregon, in southwestern Idaho, and along the Humboldt River of northeastern Nevada. Later they were joined by Paiute from the lower Weiser country of Idaho and independent Northern Paiutes from Fort McDermitt, Camp Harney, and Quinn River areas and from the Owyhee region of southwestern Idaho, and both settled on the reservation to take up farming and ranching. The aboriginal Northern Paiute territory includes portions of southwestern Idaho, eastern Oregon, and northwestern Nevada. Management of these historically occupied areas are still of interest to the Shoshone-Paiute tribes today.

The Nez Perce, Shoshone-Bannock, and Shoshone-Paiute interest in the Boise National Forest goes beyond that of spiritual and cultural, to the unique legal relationship that the United States government has with American Indian tribal governments. Federally recognized tribes are sovereign nations who work with the federal government and its agencies through the process of government-to-government consultation. The federal trust relationship with each tribe was recognized by, and has been addressed through, the Constitution of the United States, treaties, executive orders, statutes, and court decisions. In general, these mandates protect and enhance the ability of the tribes to exercise treaty rights and cultural practices off-reservation. The federal trust doctrine requires federal agencies to manage the lands under their stewardship with full consideration of tribal rights and interests, particularly reserved rights.

Historical and Cultural Setting

The Boise National Forest, and the ecosystems it encompasses, is as much a product of cultural history as of natural history. Contemporary land use patterns have important historical antecedents that provide the context for national forest management. Past uses of the ecosystem may encourage, condition, or preclude certain management practices.

The following historical sketch outlines significant periods in the development of the Forest's landscapes. The overview is by no means inclusive, but rather presented to convey general themes and patterns of the relationships between humans and their environments.

The First Inhabitants

Native American Indians were the first known human inhabitants to live in and use the natural resources of what is now central Idaho. Spear points recovered from archaeological sites in the area document the presence of Paleo-Indian peoples in the area as early as 12,000 years ago.

The Boise National Forest is within the traditional subsistence range of the Shoshone, Northern Paiute, and Nez Perce Tribes. Historically, their life ways were seasonal and cyclical. They spent the winter in warmer climates along the lower elevations, and summer and early fall in the mountains, where it was cooler. At different elevations, they harvested different plants, fish and game. Within the Forest area, camas and salmon were critical food sources for the tribes.

For hundreds, if not thousands of years, Native Americans played an active role in Idaho's environments. Fire was the most powerful tool at their disposal. American Indians deliberately burned forests and meadows for a number of reasons, including forage regeneration and campsite and trail clearing. Fur traders and Oregon Trail emigrants traveling through southern Idaho frequently observed Indian set fires in the mountains north of the Snake River Plain. These fires were set in late summer and early fall as they left for winter camps in lower elevations.

Over time, ecosystems were conditioned to the effects of fires set by Native Americans. The practice was not widespread across the landscape, but instead focused on habitats that supported specific food plants. Deliberate burning enhanced camas and berry crops. Seasonal burning fertilized the soil, discouraged the invasion of undesirable species, and prevented forest encroachment into camas meadows. Hand tilling in camas meadows aerated the soil, creating conditions later receptive to Euro-American crops. Fires ignited to keep transportation corridors open spread into the surrounding forest, contributing to the open, park-like stands shown in early photographs of Idaho's forests.

In the 1870s, stockmen and then settlers converted camas meadows in the Payette River drainage and Camas Prairie into pasture and agricultural fields. Camas crop destruction was a leading cause of the Bannock War and Sheepeater Campaign of 1878-1879, in which settlers and government troops skirmished with Paiute and Shoshone trying to pursue traditional life ways on lands increasingly occupied by miners and homesteaders.

By 1900, most Nez Perce, Shoshone, and Paiute lived on reservations far removed from the mountains of central Idaho. They continue, however, to exercise off-reservation treaty rights such as fishing, hunting, and gathering on what was to become national forest. According to eyewitness accounts, Indians also continued to set fires when leaving the mountains. White settlers and Forest Service regulations for fire suppression eventually discouraged the practice.

New Arrivals and the Fur Trade

Euro-American exploration, settlement, and industry profoundly changed central Idaho's landscape. Capitalism and a free market economy introduced social, economic, and environmental changes inextricably associated with the region's abundance of natural resources.

Shortly after Lewis and Clark's Corps of Discovery explored the Pacific Northwest in 1805-1806 for the United States, Euro-Americans moved into the region. At the time, Idaho was part of Oregon Country, the ownership of which was disputed between Great Britain and the United States. Until the Oregon Treaty of 1846, when Britain relinquished its claim, the two countries jointly occupied Oregon Country.

The first Euro-Americans to arrive in central Idaho were fur trappers and traders working for British companies in Montreal. The fur trade opened Oregon Country to commerce. It was the first large-scale, corporate enterprise in the region, and the first to market Idaho's resources in a global economy. The demand for beaver pelts was enormous—the hat-making industry alone required an estimated one hundred thousand pelts to supply European markets. The British quickly gained control of central Idaho. The Hudson's Bay Company sent its "Snake Brigades" to trap out the Snake River and its tributaries. In 1818, a party of fur trappers for the company named the Payette River in honor of their comrade, the French-Canadian, Francois Payette. He explored the Payette River and its tributary areas.

Though short-lived and on the decline by the 1840s, the fur trade had enormous environmental and social consequences. Hudson's Bay Company purposefully over trapped beaver, creating "fur deserts" to discourage American competition and settlement. Beaver occupy a special niche in forest environments, and their removal from certain watersheds initiated a host of complex, interconnected changes related to stream morphology, species composition, and disturbance events such as flooding and increased sediment loads.

The fur trade also changed relationships between Indians and Euro-Americans. Native American economies were drawn into new trading relations that transformed the way Indians perceived natural resources. Some tribes increased their hunting of ungulate species or began trapping beaver and other furbearers as commodities exchangeable for European trade goods. As a result, many became dependent on European trade goods, preferring them to traditional cultural goods.

Mining

In 1848, Congress made Oregon Country a United States territory. From 1848 until 1863, what is now Idaho was included at different times in Oregon and Washington territories? Mining was the impetus behind the establishment of Idaho Territory in 1863.

Emigrants and miners on their way to Oregon and California between 1840 and 1860 were unimpressed with the Snake River Plain. Southern Idaho was portrayed as a desert—hot, barren, and inhospitable to settlers and livestock. Although Goodale's Cutoff took thousands of travelers north into cooler, forested environments, the majority of Oregon Trail emigrants were unwilling to stop short of the Willamette Valley. Miners that were intent on California's gold fields largely ignored, for the moment, evidence of Idaho's mineral wealth.

In 1860, gold was discovered in northern Idaho, on a tributary of the Clearwater River. Miners, many of them depression-ridden settlers from Oregon, set out prospecting, and steadily moved south into central Idaho. In 1862, gold was discovered in Boise Basin. A year later, the basin's population of miners surpassed the population of Portland. Idaho's mining camps, like those elsewhere in the West, were remarkable for their ethnic diversity. Many of the miners were international immigrants from various European countries and Chinese provinces. By 1870, Chinese comprised thirty percent of Idaho's population. In Boise Basin alone, nearly half the population was Chinese.

Mining created new demands on central Idaho's natural resources. The industry required an enormous amount of timber to build and fuel mines. The effect that mining had on timberlands is clearly visible in historic photographs that show mining camps surrounded by cutover slopes. Mining, especially of placer deposits, also depended on vast amounts of controllable water. The industry built the first impoundments and diversions in the state. Mining reconfigured the physical and biological landscape—it moved vast amount amounts of earth, diverted the course of entire streams and rivers, and altered the composition, structure, and function of ecosystems.

Mining has continued to support Idaho's development throughout the twentieth century. The boom-bust cycle of mining prolonged the existence of mountain communities that otherwise might have become ghost towns. Agribusiness, however, has been Idaho's chief source of income since statehood. Today, mining's historical legacy contributes to the visitor's experience and provides educational and interpretive opportunities for the public.

Settlement

The demand of mining camps for agricultural products eventually encouraged settlement on the Snake River Plain and in forest valleys suitable for cultivation. Whereas settlement was initially a response to mining, goods and services from forest communities also supported regional urban development. In 1890, Idaho Territory became the nation's forty-third state.

Public land laws prior to the establishment of national forests promoted settlement in the West. The Homestead Act of 1862 and the Timber and Stone Act of 1878, were important in moving public land into private ownership. When national forests were later established, they often incorporated a mosaic of land ownerships with existing land use patterns.

Settlement imposed a new set of values on the use, allocation, and conservation of natural resources. Agriculture on the Snake River Plain could not survive without extensive irrigation development. Reclamation reached deep into central Idaho for the water necessary to support settlement and industry. The Minidoka Project, up and running by 1909, and the Boise Project, which included the construction of Arrowrock Dam in 1915, marked the beginning of extensive engineering projects within National Forests. In many cases, these water conservation measures ensured future water supplies, provided inexpensive electricity, and offered a variety of recreational opportunities. Dams, nevertheless, have also had environmental consequences, the most controversial of which are effects to anadromous fish.

Euro-American perceptions about fire, namely that it destroyed life and property, evolved into government policies and programs for fire suppression. Predators such as grizzly bears and wolves were also considered dangerous, and were eradicated from central Idaho. Conversely, Euro-Americans intentionally and unintentionally introduced or encouraged the spread of non-native plants and animals in the ecosystem.

Livestock Grazing

The livestock industry followed the 1860s mining boom into Idaho. Stockmen quickly divided into opposing camps. Prior to 1884, when the Oregon Short Line was built across southern Idaho, stockmen from other western states drove cattle across the territory on their way to stockyards in Cheyenne and Winnemucca. Mountain valleys north of the arid Snake River Plain became popular and highly coveted summer pastures. The range was unregulated, and serious overgrazing occurred, causing resentment among resident Idaho stockmen. Although the livestock industry had a reputation for opposing forest reserves, in Idaho, stockmen often petitioned for the establishment and enlargement of reserves to protect and regulate the range.

Prior to regulation, improved grazing practices, and progress in veterinary science, livestock had more impacts on the Forest. Overgrazing contributed to changes in the distribution and occurrence of native plant communities, erosion, and the amount of forage available to wildlife populations. Livestock can transmit disease, and this transmission played a role in the decline of certain species such as bighorn sheep.

The livestock industry made significant contributions to the development of Idaho's economy, and continues to support the state's rural communities. In the context of National Forest management, grazing was at one time widely believed to help the agency with fire suppression. Stockmen promoted the industry as a beneficial use of national forests, because cattle and sheep consumed much of the understory vegetation needed for the ignition and spread of fire.

Logging

In 1900, Idaho's economy received a much needed boost from a new industry—commercial logging. Prior to that time, sawmills and timber harvesting existed to meet the needs of mining and local settlement. Although independent contractors logged in the mountains of central Idaho, most of the small operators were eventually bought out by new companies with strong ties to Weyerhaeuser, a lumber giant from Illinois. Companies like Boise Payette Lumber purchased vast tracts of state and private lands, built large sophisticated mills, and established company towns within national forest boundaries.

Early loggers tended to prefer clear-cutting. Lumber companies commonly liquidated the timber, and then leased cutover land to stockmen who needed range. Cutover land was rarely rehabilitated. In 1924, Congress passed the Clarke-McNary Act to promote cooperation and incentives between federal, state, and private forestry for the improvement of private timberlands. Clarke-McNary programs focused on fire and tax relief, although there was a strong emphasis on convincing lumbermen to adopt better cutting practices. Over time, cutting practices did change in response to technological innovations, evolutions in silvicultural method and theory, federal laws and regulations, and prevailing public opinion about what constitutes responsible timber harvesting.

The timber industry was responsible for much of central Idaho's transportation network. When driving logs downriver through steep, rugged canyons proved unprofitable and highly dangerous, the timber industry persuaded Union Pacific to build subsidiary railroads into the Weiser and Payette River drainages to haul timber. The trains also carried passengers and freight, stimulating additional settlement. Although the Great Depression marked the end of the railroad logging era in Idaho, they continue to transport forest products to urban markets. In the late 1920s, Idaho lumber companies became famous for using a "modern" invention—the short bed log truck.

Forest Service Administration

The Forest Reserve Act of 1891 empowered the President of the United States to set aside forest reserves from the public domain. For decades, there had been growing public sentiment to protect what was left of American forests. In 1897, Congress passed the Organic Act, which clarified the purposes for which forest reserves could be established. The act stipulated that reserves could only be set aside to protect and improve the forest, secure favorable conditions of water flows, and to provide a continuous supply of timber for the citizens of the United States. In 1905, the Forest Service was established to administer forest reserves.

The Boise National Forest was created from the portions of the original Sawtooth, Payette, and Weiser Forest Reserves. In 1905, President Roosevelt established the reserves to protect the timber and watershed values of central Idaho from unregulated grazing and logging. Forest reserves, however, were unpopular in the West. In 1907, western congressmen endorsed a law prohibiting the enlargement of forest reserves in Idaho except by an act of Congress.

The most immediate impact of the new agency was regulation of occupancy and use of forest reserves. Settlement on national forest lands was prohibited until the Forest Homestead Act of 1906 allowed entry to those lands deemed suitable for agriculture. Mining was also regulated.

The Forest Service quickly implemented grazing permits and allotments. Dividing the range between resident and non-resident stockmen, and between cattlemen and sheepmen, was a controversial process. Overgrazing was brought under control, though it escalated again during World War I, when Chicago packers, attempting to boost meat production, loaned money to western stockmen to increase their herds. The result was a rush on national forests for pasture.

The Forest Service also developed policies for timber protection. Foresters worked closely with local communities and industry to implement fire prevention regulations and procedures. In 1908, the Payette National Forest Supervisor, Guy B. Mains, and Boise Payette Lumber Company's land agent, Harry Shellworth, formed the Southern Idaho Timber Protection Association. Known as SITPA, the alliance became a model for cooperative forestry, influencing the Weeks Law of 1911 and the Clarke-McNary Act of 1924.

The Forest Service established a network of fire lookouts through central Idaho, many of them built by the Civilian Conservation Corp (CCC) during the Depression. These structures, some of which are still in use, are historic properties eligible for inclusion in the National Register of Historic Places. They contribute to our understanding of Forest Service administrative history and CCC contributions to the conservation of the nation's natural resources in the 1930s.

The Forest Service sold timber from agency land, but only under certain conditions. National forest policy, prior to World War II, focused on supplementing, only when necessary, timber supplies from private land. The Forest Service also sold timber to meet local requirements, giving preference, when possible, to small, independent contractors. Disease and insect infestations were also occasions for a timber sale. After the war, however, private timberlands could not supply the nation's demand for lumber, and the Forest Service began selling more timber. That, combined with truck logging and technological advances in logging equipment, promoted road building and harvesting in steeper environments.

Recreation

One of the most obvious changes that occurred in twentieth century was the rise of recreation on public lands. A boom in outdoor recreation during the 1950s, related to post World War II increases in disposable income and leisure time, created an interest in natural environments and their aesthetic qualities.

Modern recreation, however, does have historical antecedents. Early national forest maps distributed to the public advertised scenic and recreational opportunities. In the 1930s, the Forest Service responded to the rise in recreation created in large part by the automobile. The agency began to approve special use permits for recreational residences and resorts, and employed the CCC to build public campgrounds.

The rise of recreation on national forests after World War II marks a departure point for federal agency management of public lands. Natural resources, though they retain their importance as commodities important to American society, are also prized for their non-market values. As a result, the Forest Service serves increasingly diverse publics. Today, the Boise National Forest manages the land as much for its wilderness and scenic integrity, biological diversity, recreational opportunities, and water and air quality, as it does for traditional uses.

MANAGEMENT DIRECTION

The 1990 Boise National Forest Plan emphasized the production of goods and services tied to the accomplishment of multiple-use objectives, including the production of wood fiber, maintaining or enhancing visual quality, providing recreation opportunities, and protecting and improving fish and wildlife habitat. The revised Plan strives to achieve desired outcomes for restoration or maintenance of vegetation and watershed conditions, including terrestrial, riparian, and aquatic habitats. Goods and services tied to accomplishment of multiple-use objectives will be the product of management actions designed to meet these desired outcomes.

Land management on the Forest is driven by the goals and objectives listed in Chapter III of the Plan. The Responsible Official, in consultation with the Revision Team, reviewed the goals and objectives in the 1990 Plan and found many to be still appropriate, and many that needed to be changed or strengthened. Similarly, some Plan standards and guidelines were also modified or deleted during revision.

Table I-5, on the following page, summarizes the changes in management prescription allocations made in the Plan. The Boise National Forest 1990 Forest Plan allocations, as amended by Pacfish and Infish and the 1998 Biological Opinions (i.e., Alternative 1B in the supporting FEIS), have been cross-walked to similar allocations values used in the revised plan to allow this comparison. Chapter III of the revised Forest Plan will described these allocations and their purpose in greater detail.

Table I-5. 1990 and Revised Boise Forest Plan Management Prescriptions In Acres and Percent of Forest

1990 Plan Management Prescriptions	Acres	%	Revised Plan Management Prescriptions	Acres	%
1.1 - Designated Wilderness	64,000	3	1.1 - Designated Wilderness	64,000	3
1.2 – Recommended Wilderness	179,000[3]	8	1.2 – Recommended Wilderness	184,000	8
2.2 – Research Natural Areas	8,000	<1	2.2 – Research Natural Areas	8,000	<1
2.4 – Boise Experimental Forest	7,000	<1	2.4 – Boise Experimental Forest	7,000	<1
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources	0	0	3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources	126,000	6
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources	0	0	3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources	284,000	13
4.1a – Undeveloped Recreation: Maintain Inventories Roadless Areas	0	0	4.1a – Undeveloped Recreation: Maintain Inventories Roadless Areas	28,000	1
4.1b – Undeveloped Recreation: Maintain Undeveloped Character with Allowance for Salvage Harvest	317,000	14	4.1b – Undeveloped Recreation: Maintain Undeveloped Character with Allowance for Salvage Harvest	0	0
4.1c – Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	0	0	4.1c – Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	567,000	25
4.2 – Roaded Recreation Emphasis	124,000	5	4.2 – Roaded Recreation Emphasis	31,000	1
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	672,000	30	5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	904,000	40
5.2 – Commodity Production Emphasis within Forested Landscapes	820,000	36	5.2 – Commodity Production Emphasis within Forested Landscapes	0[4]	0
6.1 – Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	10,000	0	6.1 – Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	64,000	3
6.2 – Commodity Production Emphasis within Grassland and Shrubland Landscapes	62,000	3	6.2 – Commodity Production Emphasis within Grassland and Shrubland Landscapes	0	0
8.0 – Concentrated Development	2,000	<1	8.0 – Concentrated Development	0	0
Totals	**2,267,000**	**100**	**Totals**	**2,267,000**	**100**

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[3] The 179,000 acres shown in this table is different than the 185,000 acres shown in the 1990 Forest Plan Record of Decision (ROD) due to use of improved mapping and calculation tools currently available.

[4] Acres and percent of Forest in revised Forest Plan management prescriptions updated in 2010 to reflect 2010 Forest Plan amendment.

INTRODUCTION

This chapter summarizes the Analysis of the Management Situation (AMS). The AMS is a collection of documents and project record information about the Forest that has been compiled over the past 15-20 years. The Boise National Forest completed an AMS in the 1980s as part of the forest planning process. The original AMS collected and analyzed data designed to display Forest management conditions, needs, products, and services. In the 1990s, the original AMS was used as baseline information to validate whether management direction in the 1990 Forest Plan was effective in addressing the needs that were identified in the 1980s.

As part of Forest Plan revision for the Southwest Idaho Ecogroup (i.e., the Boise, Payette, and Sawtooth National Forests) produced a Preliminary AMS (USDA Forest Service 1997). Although this document summarized current biophysical, social, and economic conditions of the Ecogroup, the focus was not on presenting benchmark information about the Forests, but rather determining any need to change or establish new management direction, following direction in the Region 4 Desk Guide – Bridge to Revision (USDA Forest Service 1993) and National Forest Management Act (NFMA) regulations {36 CFR 219.12 (e)(5)}. Sources for identifying Need For Change included Forest Monitoring Reports, past Forest Plan amendments, changes in national and regional management direction, and internal and external comments on parts of the Forest Plan that were not working well. The revision emphasized correcting the original plans, realizing that some of the original management direction was still working well and could be carried forward intact.

The Preliminary AMS also introduced the ecosystem management framework for revising the Forest Plans, and provided the basis for formulating a Proposed Programmatic Action and management alternatives. Thus, the Preliminary AMS was the beginning of the public scoping process for revision, based on the premise that the type and depth of information presented in the Preliminary AMS would more effectively involve the public early on in the revision process than would a more traditional but limited scoping letter. The Ecogroup wanted the public to use the information in this document, along with the Proposed Programmatic Action, to provide detailed comments for alternative development.

Chapter II of this Forest Plan represents a revised AMS summary that is based on the Need For Change topics in the 1997 Preliminary AMS, but also incorporates public comments, changes, and new information since the release of the Preliminary AMS. As such, this AMS is organized into the following sections:

- **Introduction –** Describes the purpose of the AMS and the organization of this chapter.
- **Determining Need For Change –** Describes how the Forest determined the Need For Change topics that generated and set the boundaries for forest plan revision.
- **Need For Change Topics –** Describes the major complex Need for Change topics and how the selected alternative for the revised Forest Plan and Final EIS addresses this Need For Change.

- **Strengthening Current Management Direction –** Describes Need for Change items that were addressed by simply changing or adding new management direction in the Plan.

- **Other Changes or Developments Since the Preliminary AMS –** Describes how the selected alternative for the revised Forest Plan and Final EIS addresses other changes or proposed changes in direction that have occurred since the release of the Preliminary AMS.

- **Continuous Assessment and Planning –** Describes the Forest's strategy for addressing changes that may occur following forest plan revision.

DETERMINING NEED FOR CHANGE

How Needs for Change Were Identified

In 1997, the Responsible Official documented the need to establish or change Forest Plan management direction (Need for Change) in the *Preliminary Analysis of the Management Situation Summary (*USDA Forest Service 1997*)*. The Responsible Official used four primary sources for determining Need for Change items:

1) Results of the three Forest Plan monitoring reports.

2) Comparison of the latest regulatory requirements and Agency Policy, Manual and Handbook direction with existing Forest Plan direction.

3) New information, such as the *Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portion of the Klamath and Great Basins* (Quigley et al. 1997), the *Federal Wildland Fire Management Policy and Program Review* (USDA Forest Service 1996) *Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery* (US Dept. of Commerce, NMFS 2000), and the *10-year Comprehensive Strategy, A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment* (USDA Forest Service et al. 2002*)*.

4) Comments from Forest employees who have been implementing the Forest Plans.

Upon review of the existing documentation, summarized below, the Responsible Official identified multiple, significant, Need for Change issues.

Forest Plan Monitoring Reports

National forests monitor and evaluate land management activities to determine how well objectives have been met and how well standards and guidelines have been applied. The Boise National Forest LRMP Five-Year Monitoring and Evaluation Report: 1990-1995 (USDA Forest Service 1996) was completed and made available to the public in 1996. The report described changed conditions since the Forest Plan was released and recommended changes where appropriate. Changed conditions in the most recent Forest-wide Monitoring and Evaluation Report include advances in scientific knowledge. Examples of important changes in Forest conditions identified through monitoring include:

- Since the early 1990s, wildfire has affected an estimated 14 percent of the land base on the Boise Forest. Nearly 10 percent of the acres suitable for timber production have been burned so severely through stand-replacing fires that forested acres have shifted to grass and shrubland.
- Substantial increases in non-native plants and tree mortality from insects have occurred in localized areas.
- Impacts to water quality from human-caused sediment and other pollutants (e.g. nutrients, temperature) have increased in some areas, and the State of Idaho has listed a number of stream segments on the Boise Forest as 303(d) water quality limited water bodies.
- Species listed under the ESA have changed. Some species have been added to the list (Chinook salmon, steelhead, bull trout, Canada lynx, and northern Idaho ground squirrel); some species are now proposed for listing, or are considered candidates for federal listing. Other species have been de-listed (peregrine falcon), or are proposed for de-listing (bald eagle). In addition, new plant species are proposed for the Region 4 Sensitive Species List.

Regulatory Requirements and Agency Policy, Manual, and Handbook Direction

The latest regulatory requirements and Agency policy, and Forest Service Manuals and Handbook direction were reviewed for all relevant resources to determine whether the Forest Plan follows or addresses the most current direction. Examples of important changes in regulatory requirements or agency policy, manual and handbook direction include:

- Federal Wildland Fire Management Policy and Program Review (USDA Forest Service 1996) and the 10-year comprehensive strategy A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment (USDA Forest Service et al. 2002).
- Amended Forest Plan direction (Pacfish/Infish and 1995 and 1998 Biological Opinions) and consultation for species recently listed under the ESA has required resource mitigation well beyond original Forest Plan estimates for protection. This, in turn, has affected estimated levels of services (e.g., recreation opportunities) and products (e.g., timber harvest and livestock grazing opportunities).

New Information

Since the Forest Plan was released, new information has come to light that might influence Forest management policies or procedures. Some of this new information is related to changed conditions like those mentioned above. Other sources include broad-scale research assessments—like the Interior Columbia Basin Ecosystem Management Project Scientific

Assessment, or the Canada Lynx Conservation Assessment—or changes in regional management direction, such as Interim Strategies of Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (Pacfish) and the Inland Native Fish Strategy (Infish). These new information sources were reviewed to identify what components need to be incorporated into new or changed Forest Plan management direction. Examples of new information include:

- The "Highlighted Scientific Findings of the Interior Columbia Basin Ecosystem Management Project" (Quigley and Cole 1997), identifies three common themes that successful land management strategies all share:
  a) Multiple risks to ecological integrity[1] and economic well-being must be recognized and managed.
  b) Risks and opportunities differ significantly across the planning unit. Management plans must recognize this variation.
  c) Individual sites are linked to ecological processes and human activities. These links must be understood and considered.

  To be successful, management strategies must recognize the need to manage multiple resource, social and economic risks in the temporary (0-3 years), short- (3-15 years) and long-term (15+ years), as well as across multiple spatial scales and in the context of broader scale science findings[2].

- Improved information gathering and organizing techniques (Geographic Information Systems, LANDSAT imagery, and new resource inventories) have expanded our knowledge about the Forests.

Internal Comments

Comments were solicited from Forest Service employees who have implemented the Forest Plan during the last planning period. These comments were reviewed to determine what implementation problems have occurred, how they might relate to specific Forest Plan direction, and what changes could be made to help solve or reduce those problems in the future.

For example, a key component of risk management is to allow administrative flexibility at the local level to the extent compatible with addressing mid- and broad-scale risks to resources. Probably the most significant internal comment received concerning current plan implementation was that direction resulting from Pacfish and Infish and associated 1995 and 1998 Biological Opinion amendments removed local manager flexibility needed to balance and address the

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[1] **Ecological integrity** describes the wholeness and resiliency of an ecological system. A system with high integrity functions properly because it has all its parts and processes intact. Such a system rebounds faster after wildfires, floods, road building, and other disturbances. In general, the more a system has been altered, the lower its integrity. However, low integrity areas should not necessarily be seen as "bad". Many low integrity areas are filling societal needs; examples include agricultural lands and roads related to recreation. From "*Highlighted Scientific Findings of the Interior Columbia Basin Ecosystem Management Project*" (Quigley and Cole 1997).

[2] **Examples of broader scale science findings considered in development of the Federal Action.** Findings generated through broad and mid-scale efforts such as ICBEMP, Federal Caucus All-H paper, Northwest Power Planning Council (NWPPC), PACFISH/INFISH Biological Opinions, State Recovery Plans for bull trout, Canada Lynx Conservation Strategy, TMDL development and implementation, and 303(d) related efforts, the National Fire Management Plan, the Healthy Forests Initiative, and the Western Governors' Association report "A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan May 2002") were all considered and utilized to look for complementary goal achievement opportunities.

different spatial and temporal resource, social, and economic risks. Decisions that attempt to address all risks across a large geographic area, with a "one-size-fits-all" approach, typically result in fewer management options at the site level and increase the probability that a decision may not be appropriate for a particular site.

The plan amendments noted above established standards and guidelines at levels above the local site, typically for an entire river basin, using averages or blanket prescriptions across a wide array of conditions. The result was that, for some sites, the standards were too high, and for others, too low. This incompatibility often affected desired outcomes, and in some cases prevented desired outcomes from being achieved. The direction also required additional process and analysis (e.g., watershed analysis) at the same level and intensity based on an action type or location. The common level and intensity for analysis required was not always needed to inform decisions and thus resulted in unnecessary delays and expense in implementation of actions.

Forest Plan Decisions

The results of the reviews cited above revealed that portions of the existing Forest Plan direction were still appropriate, while other direction needed adjustment in light of changed resource conditions, new or changed regulatory requirements or Agency policy and direction, and new information. The Responsible Official, in consultation with the Revision Team specialists, compared the initial list of Need for Change topics against the six decisions made in forest plans to identify which topics were planning-related versus project-level issues. The six types of decisions made in forest plans are listed below.

1) Establishment of Forest-wide multiple-use goals and objectives, including a description of the desired future condition of the Forest (36 CFR 219.11[b]).

2) Establishment of Forest-wide standards and guidelines to fulfill the requirements of 16 USC 1604 (NFMA) applying to future activities (36 CFR 219.13 to 219.27).

3) Establishment of management areas and direction applying to future activities in those management areas (36 CFR 219.11[C]).

4) Designation of lands not suitable for timber production (16 USC 1604[k] and 36 CFR 219.14) and the allowable sale quantity (ASQ) determination for timber that may be sold from the suited timber base during each decade (36 CFR 219.16(a)).

5) Establishment of monitoring and evaluation requirements that will provide a basis for a periodic determination of the effects of management practices (36 CFR 219.11[d]).

6) Recommendation to Congress of areas for wilderness classification where 36 CFR 219.17(a) applies.

Management Direction that Needs to be Changed or Established

Upon review of existing documentation, the Responsible Official made a determination to change or develop new management direction in the following Forest Plan revision topics. These topics are described in detail later in this chapter.

- Topic 1 - Biological Diversity
- Topic 2 - Fire and Smoke Management
- Topic 3 - Habitat Fragmentation and Disruption
- Topic 4 - Non-native Plants
- Topic 5 - Rangelands/Grazing Resources
- Topic 6 - Hydrologic, Riparian, and Aquatic Resources
- Topic 7 - Timberland Suitability
- Topic 8 - Management Emphasis Areas

These changes were presented to the public in the 1997 Preliminary AMS, and they have been modified somewhat since then based on external and internal comments and new information. The most recent changes are described below.

NEED FOR CHANGE TOPICS

This section describes the issues or areas where the Responsible Official identified a Need for Change in Forest Plan management direction. The topic descriptions are divided into five parts:

- **Background** - Briefly describes the resource or issue, and current management direction sources.

- **Current Condition** - Summarizes the current condition of the resource or issue, focusing on areas where current management direction is not being met or does not exist.

- **No Action** - This section presents the effects of continuing current management direction (No Action) associated with the Need for Change topics.

- **Need to Establish or Change Management Direction** - Targets the specific area where management direction needs to change or to be developed to address changed conditions.

- **Changes Under the Revised Forest Plan –** Summarizes changes in management direction, monitoring, area adjustments, etc. in the revised Plans that address Need for Change.

Topic 1 - Biological Diversity

Background

Biological diversity is the variety and abundance of life and its processes. It includes all living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. Biological diversity also refers to the compositions, structures, and functions of species and habitats and their interactions. The interactions of biological and physical components operate at multiple scales, from micro-sites to regional landscapes. The goal of conserving biological diversity is to support sustainable development by protecting and using biophysical resources in ways that do not diminish the world's variety of genes and species, or do not destroy important habitats or ecosystems.

The variety of habitats and species on federal and adjacent lands puts land management agencies in a key role for managing and protecting biological diversity. This is especially true for rare and unique ecosystems, and species that are highly valued or are considered to be on the brink of extinction (Salwasser 1989). Consequently, current management direction (ESA, CFR 219.26 and 219.27, FSM 2070, and the Forest Plans) for biological diversity concentrates on numbers of species and diversity of habitats.

In general, prior to human-caused disturbances, major changes in native biodiversity were results of substantial shifts in climate or geology. However, human influences have substantially affected ecological processes and biodiversity, and will likely continue to do so.

Current Condition

Although the 1990 Forest Plan addresses many of the key indicators of biological diversity, these indicators are largely described and analyzed as separate functional entities. There is little information on how these indicators interact with one another and with natural processes, particularly at the Forest-wide scale.

The 1990 Forest Plan does not adequately address all biological diversity elements (coarse filter, fine filter, Historical Range of Variability [HRV]) defined within the Ecogroup's Ecosystem Diversity Matrix and Management Framework. The 1990 Plan tends to focus on a species-by-species approach (fine filter) rather than looking at the interactions of whole ecosystems (coarse filter). This revised Forest Plan takes a multi-scale and temporal framework approach that addresses and analyzes fine- and mid-scale indicators (TES species, MIS, rare and unique species and habitats), broad scale indicators (vegetation communities and watersheds), and natural processes (fire, erosion, and hydrology) within an integrated ecosystem management framework.

In order to maintain healthy ecosystems and the multiple values they hold for humans, the following questions must be addressed:

- What is out there? (composition, structure, diversity, relative abundance)
- Where is it? (distribution, patterns, connectivity)
- Where did it come from? (processes and disturbances, geoclimatic capability, HRV)

The following discussion of biological diversity components begins with a description of landscape-level vegetation patterns and processes, and then moves to the structure and dynamics of key ecosystem components and species.

Composition/Structure/Function - Maintenance of compositional, structural, and functional diversity is essential to the continued provision of ecological processes, such as regulation of hydrologic cycles, carbon and nutrient cycling, and soil processes. Current conditions and trends in plant communities indicate that some of these communities have substantially changed from what they were historically (ICBEMP 1997a). The1990 Forest Plan lacks adequate definitions and direction for desired structural stages that provide for landscape diversity. An understanding of where these stages are on the landscape and how they are connected is critical for species habitat management.

Disturbance Processes - Disturbance processes, such as fires, droughts, landslides, floods, insects, and pathogens, are common in nature, and these agents of change and their interactions heavily influence the character of ecosystems. The 1990 Forest Plan generally does not recognize that disturbance processes can be desirable in many cases. The Plan does not consider or recognize the frequency, size, intensity, and severity of disturbance processes in determining vegetative conditions and how management practices have altered them. For example, with the exclusion of fire, stand and shrub densities are often much greater than they were historically. In addition, species composition has changed, and increased the susceptibility of some vegetative communities to large-scale infestations of insects, pathogens, and uncharacteristic wildfires. Desired conditions for stand components for all forest cover types and structural stages need to be designed to meet management goals and objectives that also take into account expected disturbance regimes.

The 1990 Forest Plan does not consider or recognize that the sustainability of soil ecosystem function and process (erosion and long-term soil productivity) is at risk in areas where redistribution of nutrients has resulted from changes in ground cover (combination of organic material plus plants), composition, pattern, removal of the larger size component of wood, and uncharacteristic fire.

Stand components for all forest cover types and structural stages need to be designed to meet management goals and objectives that also take into account expected disturbance regimes. Conifer plantations and the stands that surround them need to be managed to minimize the risk of loss due to wildfire, insects, and pathogens. Several large wildfires have occurred since the approval of the Forest Plan. These fires have resulted in the loss of several thousand acres of managed plantations, ranging in age from one to 35 years. The 1990 Plan does not adequately address retention or protection of plantations for long-term management.

Soils Functions and Processes - The physical, chemical, and biological properties of soils regulate biological productivity, hydrologic response, site stability, and ecosystem resiliency. Management direction for soils in the 1990 Forest Plan is based only on prevention and mitigation. Scientific information on soil processes, functions, and patterns related to vegetation and biological diversity is not identified in the 1990 Plan.

Snags, Down Logs, and Coarse Woody Debris – Snags, down logs, and coarse woody debris are critical elements of ecosystems that maintain soil productivity, provide terrestrial and aquatic habitat, and contribute to other critical ecological processes. Direction needs to be developed and refined for the Forest to ensure an adequate diversity of size and decay class of snags, down logs, and coarse woody debris. Also, Forest Plan direction needs to consider the effects of management activities on these ecosystem elements.

Threatened and Endangered Species - Federally listed Threatened and Endangered wildlife species on the Forest include the gray wolf, bald eagle, and Canada lynx. The peregrine falcon has only recently been de-listed. Listed fish species include Chinook salmon, steelhead trout, and bull trout. The only listed plant species with potential habitat on the Forest is Ute ladies'-tresses. The 1990 Forest Plan management direction for all listed species is generally to follow recovery plans developed by the appropriate regulatory agencies, with the ultimate objective of de-listing the species once stable viable populations are established and maintained.

Sensitive Species - Species are designated Sensitive by the Regional Forester because their populations or habitats are limited (narrowly endemic) or trending downward, or because little information is available on their population or habitat trends. The primary purpose of the sensitive species program is to conserve or improve habitat conditions for these species to prevent them from becoming federally listed. Currently, a number of species are designated Sensitive and have some probability of occurring on the Forest. Management direction from 1990 is to follow conservation assessments and plans developed at the Regional or Forest level. However, because the Forest Plan was developed before the sensitive species program began, there is little direction in the 1990 Plan regarding Sensitive species.

Management Indicator Species (MIS) - NFMA regulations direct national forests to identify MIS, whose populations and habitat conditions indicate potential impacts from human activities, including Forest management. By monitoring and assessing habitat conditions of indicator species, managers can estimate effects on other species with similar habitat needs. MIS in the 1990 Forest Plan were selected because their habitat requirements encompass a diverse range of conditions. However, monitoring and management experience with MIS since the Plan was developed have indicated that some species may not be the best indicators for the habitats they are supposed to represent. For instance, adult Chinook salmon may not be the best indicator for on-Forest habitat because their populations are affected by many off-Forest activities and conditions. Groups of species that use similar habitats may also be more useful as management indicators than individual species.

No Action

Implementation of the 1990 Forest Plan over the next ten years would result in a continued focus on a species-by-species approach, using short time frames rather than dealing with issues at larger spatial and temporal scales.

Ecosystem health would continue to change. Some forest species—such as Douglas-fir and whitebark pine—would become more susceptible to insect and pathogen infestations. Old, single-story structured ponderosa pine would continue to decrease. Sagebrush and grassland community types would continue to decline due to exotic plants and animals and other factors. Riparian area health would likely improve slowly over time under Pacfish/Infish direction.

Snags, down logs, and coarse woody debris guidelines in the 1990 Plan would continue to be inadequate for maintaining functional and structural diversity. Direction from 1990 would have an unknown effect on maintaining long-term soil productivity and the diversity of plants, wildlife, and fish habitats.

Under 1990 Forest Plan direction, habitat fragmentation would likely continue and connectivity across the landscape would decline.

Because the 1990 Forest Plan has little or no direction for Sensitive species, there is a possibility that Sensitive wildlife, fish, and plant species would decline and/or become listed under the ESA.

Efforts to lower risks to plantations from disturbance would continue at a low, but relatively ineffective rate.

Under 1990 Forest Plan direction, the Forest would continue to use narrow, single cover type definitions of old growth, without considering the amount, distribution, and importance of all structural stages on a Forest-wide scale in Forest management.

Need to Establish or Change Management Direction

There is a need to develop vegetation management direction that provides for short and long-term biological, physical, economic and social sustainability. The 1990 Forest Plan lacks adequate direction for potentially needed restoration, management, and maintenance of plant communities, including vegetative structure, species composition, distribution, and patterns, and how they are influenced by soil and disturbance processes in relationship to historical and current conditions. Land management practices alter the landscape dynamics, generating a greater need to integrate management direction for all resources including a concern for providing sufficient habitat to maintain viable species populations within the context of overall multiple use objectives.

Specific Needs for Change are:

- To provide management direction for maintenance and restoration of habitats for species of concern (TEPC, Sensitive, MIS, Candidate, Proposed, at risk, rare and unique species).

- To develop management direction that minimizes habitat fragmentation and maintains or restores landscape linkages and habitat edge.

- To develop snag, down log, and coarse woody debris guidelines that help maintain ecosystem structure and function.

- To provide management direction that addresses important soil processes (erosion rates, mass stability, infiltration, nutrient cycling...) as they relate to desired conditions and the management of other resources.

- To develop management direction that describes desired structural stages, composition, and density for each vegetation group or type.

- To establish management practices and standards and guidelines that address appropriate stocking levels, stand structure, and species composition that incorporate the extent and frequency of all types of disturbances.

Changes Under the Revised Forest Plan

Changes to habitat conditions in terms of composition/structure/function were analyzed for the Interior Columbia River Basin (Wisdom et al. 2000). Changes to habitat within the planning unit were evaluated in a similar manner and compared to the basin-wide findings. Based on this evaluation, habitats with the greatest change have been identified, and implications for species that use them were analyzed. Management direction including goals, objectives, standards and guidelines for habitats most changed should result in improved conditions for maintaining and restoring biological diversity under the revised plan. Additionally, new MIS better reflect those habitats that are of a concern, basin-wide and locally.

The development of desired conditions for vegetation components, based on the Historical Range of Variability, is the most significant change in management direction related to vegetation management. The lack of adequate definitions and direction for desired vegetation components in the current Forest Plan made it difficult to maintain the compositional, structural, and functional diversity across the landscape, and to sustain ecological processes and manage species habitat.

As many of the vegetation components are identified as being outside of historical ranges or properly functioning condition, the revised Forest Plan provides for management direction to maintain or restore plant community attributes (species composition, size class, canopy closure, snags and coarse woody debris) through the goals, objectives, standards and guidelines. Maintaining or restoring vegetation components to desired conditions, and the ecological processes that supported those vegetation components, will support efforts to achieve overall biological diversity necessary to sustain individual species of concern and minimize the risks of uncharacteristic disturbances, while providing economic, social, and cultural opportunities for Forest users

Topic 2 - Fire and Smoke Management

Background

The 1897 Organic Act states that forests shall be protected against destruction by fire. Subsequent laws describing land management practices often used the phrase "protect from" to describe fire management. Early Forest Service policy interpreted protection as suppression, and for several decades, fire management focused on suppression efforts. In the 1970s, emphasis began to shift from full suppression to responses that more appropriately reflected values that were at risk. In addition, information regarding the role and function of fire in ecosystems began to increase. However, wildfires in the past 15 years (particularly the 1994 and 2000 fire seasons) prompted the Departments of Interior and Agriculture to review fire policy and programs. This review resulted in an update of the Forest Service Manual, which includes direction that Forest Plans will be evaluated to ensure fire management considerations are incorporated. This direction includes the use of fire to achieve management objectives and consideration of the impacts of excluding fire.

The Federal Clean Air Act is a legal mandate to protect human health and welfare from air pollution. National Ambient Air Quality Standards are defined in the Act as levels of pollutant whereby detrimental effects on human health and welfare may result. Particulate matter emissions are produced from Forest Service activities such as prescribed fire, mining, and road construction and use. Another provision of the Clean Air Act that affects Forest Service activities is the Prevention of Significant Deterioration provisions. The premise behind these provisions is to prevent areas that currently have very clean air from becoming polluted. The 1977 amendments to the Clean Air Act established Class I areas that were to have specific Air Quality Related Values, including visibility identified for these areas. One such Class I area, the Sawtooth Wilderness, was recognized as being within the Forest's area of influence.

Current Condition

Average wildfire occurrence per year (lightning and human-caused) has not changed since the 1990 Plan was released, compared to the 20-year period before their release. However, the average number of acres burned per year by wildfire has risen dramatically. Since 1990, over 14 percent of the planning unit land base has been burned from wildfire. Quigley and Arbelbide found that acres burned within the Columbia River Basin during the 1980s exceeded those of the 1950s. They related the change to increased fuel loadings, both in amount and extent, from previous conditions (Quigley and Arbelbide 1997a, b, c, d).

Historically, fuel loadings were likely lower in many areas of the Forest, and areas with high loadings were smaller and more isolated. Currently, fuel loadings have increased, and areas with moderate to high fuels are larger and more contiguous. In addition, resources available to fight fire are sometimes limited, particularly when multiple fires are burning within the Forest and across the country. These factors, in combination with certain weather conditions, can lead to large fires. However, Quigley and Arbelbide noted that, even though acres burned by wildfire have been increasing over the past few decades, the amount of area burned is still well below historical levels (Quigley and Arbelbide 1997a, b, c, d).

Upper Columbia River Basin scientific findings indicate that, in some cases, fire regimes within the Forest area have changed from historical conditions. Currently, it is estimated that nearly 300,000 acres in the planning unit are in a National Fire Plan (NFP) Condition Class 3 (extreme risk to uncharacteristic wildfire), and 631,000 acres in a Condition Class 2 (moderate risk). Historically, the majority of acres were in a Condition Class 1 (low risk) and 2. The ICBEMP Integrated Scientific Assessment (ICBEMP 1996b) related these changes to the disruption of historical disturbance processes, combined with altered vegetative structure and composition.

Historically, wildfires throughout the Forest would have ranged from ground fire to stand replacing, depending on the vegetative community. Currently, some wildfires create more homogeneous landscapes than those that typically occurred within historical fire regimes. An example within the Forest is the 1992 Foothills Fire, which was primarily stand-replacing in vegetative communities that typically experienced ground fires in the past. Because of the nature of this uncharacteristic fire, species composition, vegetative structure, and associated habitats have been simplified in some areas. Investments have also been lost. For example, six percent of the plantations on the Boise National Forest were burned by wildfires that occurred over the past 10 years.

In other cases, however, some recent wildfires may have been more similar to historical wildfires. An example is the 1994 Thunderbolt Fire. This fire mostly burned through vegetative types that historically burned infrequently. The effects across the landscape from this kind of fire varied, depending on weather, fuel loadings, and the vegetative communities in which the fire burned. In some places, the same fire might have been a ground fire, and in other places stand replacing. These kinds of fires created a variety and diversity of vegetative communities and landscape mosaics.

Fire suppression costs have risen dramatically since the 1970s. Nationally, suppression costs have increased an average of $17.4 million per year since 1977. Suppression costs on the Forest are following this upward trend.

The 1990 Forest Plan generally does not address the role of fire as an ecosystem process or tool for maintaining or restoring ecosystem health, particularly in vegetative communities that historically burned more frequently. In the past few years, prescribed burning as a management tool has received national attention, emphasis, and funding. The ability to accomplish national fire management objectives, priorities for ecosystem management, and achievement of desired fuel loadings, may be limited by missing, vague, or conflicting Forest Plan direction.

In addition, updated Forest Service Manual direction requires Fire Management Plans for all areas subject to wildland fire. These plans are dependent on Forest Plan direction. In order to develop the needed Fire Management Plans, the Forest Plans must provide clear and integrated desired conditions, goals, and objectives for fire management.

Population growth within and around Forest boundaries has led to increases in wildland/urban interface. Much of this growth has taken place at lower elevations within or adjacent to dry forest or rangelands. In some of these areas, the risk of uncharacteristic wildfire is high. Often, small communities, isolated subdivisions, or owners of concentrated recreation facilities do not have the resources to address fire risk (protection or prevention) or to assist in the control of wildfires. The growth of the wildland/ urban interface increases the risk of wildfire spreading from private to federal lands, and vice versa.

Wildfires alter watershed conditions and subsequently increase the risk of floods and landslides, compared to unburned watersheds. In the wildland/urban interface, threats to life, property, and municipal watersheds from such events are much greater than in non-interface areas. The social and economic costs of mitigating these risks can be high.

Vegetation treatments that can reduce wildfire risks in wildland/urban interface areas may conflict with existing Forest Plan direction for various resources. In addition, planning and implementing treatments in or adjacent to wildland/urban interface areas depends on collaboration between the Forest Service, private landholders, local, county, and state governments, and other federal land management agencies. All parties must understand the risks associated with wildland/urban interface and their role in reducing those risks. Because of the complexity of the issues, goals and objectives for wildland/urban interface should be addressed during forest planning to clearly articulate management priorities, rather than on a project-by-project basis.

The 1990 Forest Plan provides flexibility in incorporating changes in the federal, state, and local air quality requirements, as directed in the Clean Air Act. The Forest Plan gives strong direction to meet or exceed these requirements. However, there have been several subsequent changes and additions to these requirements that have not been incorporated into the Forest Plan. The 1990 Forest Plan did not consider the potential air quality conflicts associated with increasing fire use to restore fires as an ecosystem process. Increases in smoke emissions from fire use, coupled with the potential environmental consequences, were not analyzed for the 1990 Forest Plan. In addition, the trade-offs between smoke produced from fire use and wildfires were not evaluated.

No Action

Suppression actions would continue to be the primary focus of fire management to protect life, property, and resources. Preventative activities to reduce the risks and costs of fire may vary, even though national emphasis on these types of treatments has been increasing. Within Region 4 and the Forest, acres treated with prescribed fire have increased since the Plan was developed, and this increase is projected to continue. However, the ability to fully achieve the objectives of risk and cost reduction may be limited because fire management goals and objectives currently conflict with the goals and objectives for some other resources. These conflicts may reduce opportunities to treat areas at an appropriate scale.

Under the 1990 Plan, information about the role of fire as an ecosystem process and opportunities to restore that process to ecosystems would be limited. Prescribed fire would continue to be planned and implemented on a project-by-project basis rather than at a programmatic level, which would be more effective and efficient. The 1990 Plan may have to be amended to reflect new manual direction that resulted from recent changes in national fire management policy and related program reviews conducted by the Departments of Interior and Agriculture.

Wildfire occurrence throughout the Forest is currently high. From 1991 through 2000, an average of 154 fires per year occurred, 77 percent of them from lightning. Under the right weather conditions, large uncharacteristic fires would continue to burn in areas without fuel treatments and where vegetation has not been altered to a structure and composition that is more resistant to fires spread and intensity. Where uncharacteristic fires occur, vegetative communities would become more homogeneous. Burned Area Emergency Response (BAER) activities like grass seeding would further increase vegetative homogeneity (see Non-native Plants). Landscape mosaics of structural stages would be simplified, particularly if uncharacteristic fires occur adjacent or within areas burned in the last 10 years. This trend may reduce biological and wildlife habitat diversity, long-term soil productivity, and nutrient cycling.

Suppression costs would continue to increase, particularly on lands within or next to the wildland/urban interface. Additional costs may be incurred to reduce post-wildfire threats to life and property from floods, debris flows, and landslides. Investments such as plantations, bridges, and campgrounds may be at risk.

The approach for conducting air quality analysis on the effects of prescribed fire may not be consistent or appropriate, as the 1990 Forest Plan does not adequately provide direction. Without specific and consistent direction, the Forest may not adequately protect Air Quality Related Values, including visibility, as required by the Clean Air Act, for the Sawtooth Wilderness, a Class I area. This would increase the risk of potential legal action against the Forests from state and federal regulatory agencies.

Need to Establish or Change Management Direction

There is a need to integrate fire management goals and objectives into Forest-wide desired conditions. In addition, there is a need to develop resource-specific fire-related goals and objectives. The 1990 Forest Plan does not adequately address fire starts, especially fires that escape initial attack and, under certain circumstances, cross multiple management areas and become landscape-scale in size. The Plan does not provide adequate goals and objectives for evaluating and comparing appropriate suppression response alternatives to factors such as social-political implications, economics, environmental considerations, public and firefighter safety, and values at risk. The role of fire as an ecological process was not considered during the development and analysis of the 1990 Forest Plan. The use of fire as a management tool was described for some resources; however, fire over large areas (landscapes) was not considered, and the potential impacts on timber, wildlife, watershed, and other resources were not analyzed.

There is a need to address National Fire Plan communities and wildland/urban interface in the Forest Plan. Interface was not considered when the 1990 Forest Plan was developed. Since the Plan was released, increasing wildfires in wildland/urban interface areas--both on the Forest and nationally--have made the interface issue a significant social and economic concern.

There is a need to incorporate consistent air quality and smoke management direction, desired conditions, and monitoring plans into the Forest Plan based on new air quality requirements at federal, state and local levels, including new Forest Service direction.

There is also a need for the Forest Plan to address the recent emphasis on increased prescribed fire to improve ecosystem health and reduce the risk of large uncharacteristic fire, and the impacts that emphasis may have on air quality.

Changes Under the Revised Forest Plan

Under the revised forest plan, fire use is considered and integrated into Forest-wide desired conditions and goals where appropriate.

Management area goals consider the juxtaposition of adjacent areas and, where possible, are consistent in order to reduce conflicts when wildland fires cross management area boundaries.

Management area characterizations and goals highlight management area priorities in order to assist in selection of appropriate suppression alternatives. In addition, the allowable range of Appropriate Management Responses (including wildland fire use) is identified for each management area, considering the effects on resources and social-economic factors.

Fire's role as an ecosystem process is integrated into desired conditions and goals at the Forest-wide and management area level. Potential impacts from fire use have been evaluated. Fire use is limited in areas where it could have undesirable effects on resources.

National Fire Plan communities and wildland-urban interface areas are identified by management area, and objectives have been developed to prioritize fuels reduction treatments in these areas.

Topic 3 - Habitat Fragmentation and Disruption

Background

Fragmentation is the separation or isolation of similar types of habitat, either by natural events or human activities. Fragmentation is essentially the opposite of connectivity. Connectivity is the arrangement of habitats that allows organisms and ecological processes to move across the landscape. In landscapes with high connectivity, patches of similar habitats are either close together or linked by corridors of appropriate vegetation, stream channels, and waterways.

Habitat connectivity is a fundamental concept in considering species viability and sustaining biodiversity. Connectivity is needed to ensure genetic interaction and species recruitment following random catastrophic events. Some habitats are naturally patchy in distribution, as opposed to once contiguous habitat blocks that have become fragmented due to management actions. Some of the forested habitats on the west and south sides of the Boise National Forest are naturally patchy in distribution, so fragmentation may not be a major concern.

The NFMA regulations direct that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species." The NFMA further defines a viable population as "one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed (36 CFR 219.19)." Historically, fire, insects, and disease were the disturbance processes that modified habitat connectivity and caused disruption to species and habitats. Currently, management practices and facilities—including roads, trails, utility corridors, and vegetation management—may be causing fragmentation of habitats.

Some species of wildlife and fish are sensitive to human activities in close proximity during the breeding, nesting, and wintering portions of their life cycles. Human activities, whether intentional or unintentional, can increase stress to these species and may reduce their reproductive success. Mitigation measures that restrict human activities in close proximity to the species during these life cycle periods can reduce stress at these critical times [36 CFR 219.19(a)4, and 36 CFR 219.21(d)(g)].

Current Condition

The ICBEMP Integrated Scientific Assessment (ICBEMP 1996b, Wisdom et al. 2000) identified roads as a major impact on many physical and biological processes. Road access increases human-related conflicts with wildlife and aquatic species by fragmenting habitats and increasing disruption. Increasing human access was also identified as a major impact on large predators, big-game populations, and many fish populations (Quigley and Arbelbide 1997c, Wisdom et al. 2000). Impacts include increased disruption, displacement, vulnerability to mortality, and migration barriers.

One of the mitigation measures often used for Threatened and Endangered species is restricting access during the breeding and rearing stages. In addition, access management is currently being used on the Forest to help achieve harvest goals for elk and, in some cases, other species.

The 1990 Plan does not address road-related effects from a multi-resource approach, or consider effects on both plants and animals. Direction from 1990 is focused on harvestable species of big game. For instance, road closures affect not only hunting pressure and big game populations, but also recreation opportunities, watershed restoration, fish habitat, livestock grazing management, fire suppression, soil productivity, minerals access, and so on. Currently, monitoring strategies often measure effectiveness for one issue or concern, but not for others.

Increases in habitat fragmentation within and between blocks of habitat have isolated some plant, wildlife, and fish populations, reducing their ability to move across the landscape. For some species, habitat fragmentation has reduced genetic interchange and increased population isolation.

Connectivity is important in aquatic, as well as forested, ecosystems. Disruptions affect the connectivity of riparian areas and the linkages between aquatic and forested ecosystems. Where road crossings and concentrated human activity exist in aquatic ecosystems, some level of connectivity has been lost compared to what existed historically. Aquatic systems can be affected by dams, culverts, changes in stream channel or water quality, and de-watering, all of which create migration barriers.

No Action

Under 1990 Plan direction, road construction levels and usages are likely to be affected by Pacfish, Infish, Biological Opinions, and new roads-related regulations. Any effects to habitat fragmentation would be addressed at the project level, if fragmentation were raised as an issue. Disruption would also be assessed for site-specific projects where there is a wildlife-related issue. State and federal agencies (Idaho Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service) would likely be involved in developing alternatives or mitigation when there are specific concerns about terrestrial or aquatic populations.

Need to Establish or Change Management Direction

There is a need to develop integrated and consistent Forest Plan direction to provide connectivity of fish, wildlife, and plant habitat. The 1990 Forest Plan has inadequate and ineffective direction concerning habitat fragmentation from roads, trails, timber harvest, fire, culverts, utility corridors, and other sources.

There is also a need to manage disruption in order to reduce species avoidance behavior, displacement, and mortality, and impacts to cover, nutrient cycling, hydrologic function, sex/age ratios in harvestable species, and species viability. These impacts have biological, physical, economic, and social implications.

There is a need to apply management strategies that improve habitat connectivity and decrease the adverse affects of roads, trails, dispersed use, and access.

Changes Under the Revised Forest Plan

Habitats that have changed from historic times were evaluated against conditions within the Ecogroup area. The evaluation found that some habitats/species have become isolated due to fragmentation within the Ecogroup area, and to a greater extent on lands of other ownerships and jurisdictions. Management direction is provided to reduce the extent of fragmentation for habitats within Forest Service jurisdiction.

Fragmentation has also occurred where Forest Service activities have been a minor contributor, but major problems have occurred for the habitat over a large area. Some activities on other ownerships have caused problems for some habitat/species. The remaining isolated Forest habitats are important to the persistence of species still using them. Management direction is provided to maintain, or if possible improve, these remaining habitats, although historical conditions likely can never be achieved.

Species have been identified to which disruption is a concern during important life stages. Direction is provided to eliminate or reduce known disruptions to some species.

Topic 4 - Non-native Plants

Background

Non-native plants are species that do not have their origin in a local geographic area. They have not evolved with the local environment, including native plants, animals and disturbances. Non-native plants include exotics and noxious weeds. Exotic plants are species that have been introduced to an area, usually from a different continent. Some non-native plants have been intentionally introduced for restoration purposes such as road stabilization, range improvements, and Burned Area Emergency Response (BAER). Noxious weeds are plant species designated by law that can have detrimental effects on agriculture, commerce, or public health. They spread aggressively and are difficult to manage. These species are generally new or not common to the United States.

Some exotic and noxious weed species thrive in areas so well that they tend to out-compete native species. Their success is often due to the lack of natural control agents in their new environment, prolific seed production, physiological advantages, and a propensity to establish in early to mid-successional vegetation communities. These plants can spread quickly and affect the amount and distribution of native plant species, along with the animals that have evolved to rely on the native plants. This can result in a substantial change in the overall biological diversity of the affected area.

Non-native plant introduction, both intentional and unintentional, is a national, regional, and Forest concern. The National Forest Management Act (NFMA) addresses this concern, as do the Forest Service Manual and the Forest Plan. However, none of these documents describes a specific, aggressive strategy for identifying and controlling non-native plants, or restoring ecosystems to native plant populations and distributions.

Forest Service direction is to "control the establishment, spread, or invasion of non-indigenous plant species in otherwise healthy native vegetative ecosystems" (FSM 2080.1). Also, direction requires that Integrated Weed Management (IWM) determine the factors that are favoring the establishment and spread of non-native plants, and then design prescriptions that reduce the risks, in accordance with the 1990 Farm Bill amendment of the 1974 Noxious Weed Act. The first priority of IWM is to prevent the introduction of new populations.

Current Condition

The ICBEMP Draft EIS (ICBEMP 1997a) and the ICBEMP Integrated Scientific Assessment (ICBEMP 1996b) have identified that non-native plant species are spreading rapidly throughout the Upper Columbia River Basin, which includes the Boise National Forest.

The Boise National Forest – Forest Plan Five-Year Monitoring and Evaluation Report also describes a growing concern with the spread and effects of non-native plants. Specifically, the expansion of non-native plants within the Forest is out-pacing containment and control efforts. There are many new infestations along highways and road systems--both on National Forest System lands and on adjacent jurisdictions--that pose significant risk of further expansion (USDA Forest Service 1996).

Non-native plants are being introduced unintentionally (e.g., seeds from vehicle tires or livestock, bird, and big-game droppings), and intentionally (e.g., restoration and rehabilitation seeding). Roads provide the primary corridors of access for non-native plants to establish new populations.

The 1990 Forest Plan does not address non-native plants from a multi-functional approach (recreation, timber, special uses...). Direction from 1990 only addresses the treatment of noxious weed infestations, rather than taking an approach that considers prevention, containment, and control. While an IWM approach is incorporated in national Forest Service direction, it is not addressed in the Forest Plan.

Currently there is no management direction or Desired Future Condition for designing or implementing BAER treatment strategies to assist in evaluating the trade-offs between the short-term needs of post-fire rehabilitation and the long-term compatibility with ecosystem management. Due to the emergency nature and critical time requirements to plan and implement BAER activities, sufficient consideration may not be given to the long-term desired conditions for ecosystems. This may lead to improper BAER treatment strategies, rehabilitation measures, and inaccurate estimates for funding requests.

Seeded non-native plants have an impact on the establishment and growth of native vegetation in fire rehabilitation areas. Certain species have been purposely introduced to provide forage and cover in arid regions where vegetation has been removed. As a result, sites with monocultures or a few selected species have developed. In general, there is little likelihood that these introduced species will encroach into undisturbed areas. However, these conditions have affected fire regimes and wildlife habitat.

Fire regimes have been altered in some ecosystems due to exotic species. For instance, cheatgrass has taken over many dry shrubland types, increasing soil erosion and fire frequency. Such changes can have long-term impacts on ecosystem processes, composition, and structure.

No Action

The current exponential spread of non-native plants would be expected to continue. Spotted knapweed, yellow starthistle, rush skeletonweed, and leafy spurge would become much more prevalent on the landscape, with impacts on agriculture, wildlife habitat, recreation, and community interests. These species would spread in areas where roads access the Forest and vegetative communities are susceptible to invasion.

Management direction would continue to emphasize containing and controlling new or established populations. Effectiveness would be minimal due to limited economic ability to treat the invaded areas. Cheatgrass and other exotics would increase, particularly in the sagebrush and dry forest communities where large uncharacteristic wildfires occur. In lower to mid-elevation areas where watershed and fire rehabilitation have occurred, homogeneous stands of non-native grasses would continue to dominate the landscape. BAER activities would continue to be based on the immediate short-term risks and would not be balanced with potential effects on long-term ecosystem conditions and needs.

Need to Establish or Change Management Direction

There is a need to modify 1990 management direction to adequately address non-native plants and their effects on ecosystem structure, composition, and function. Non-native plants have greatly increased from historical conditions, and they have contributed to changes in fire regimes.

There is a need to establish a containment/control strategy that recognizes the difficulty and expense of controlling large and firmly established populations of non-native plants. This strategy needs to consider both jurisdictional boundaries and all functional resource areas.

There is a need to incorporate non-native plant management direction and desired conditions for implementing post-fire BAER activities and non-structural range improvement projects. There is also a need to review seeding and revegetation practices associated with erosion control, fire rehabilitation, non-structural range improvement, and watershed restoration to ensure compatibility with the desired conditions and priorities established for management activities.

Changes Under the Revised Forest Plan

The revised Forest Plan establishes Forest-wide standards and guidelines that assist in preventing the establishment of new infestations and the transport of weed seed to other locations. This direction is primarily associated with road-related, fire suppression, and Forest-authorized activities. The revised Forest Plan also gives direction for restoration to reduce the potential for exotic invasion of disturbed sites. It also identifies areas of high susceptibility to invasion and provides precautionary measures when planning and implementing site-specific management activities. Finally, the revised Forest Plan provides Integrated Weed Management goals and objectives at the management area level for specific species and sites of concern.

Topic 5 - Rangeland/Grazing Resources

Background

The NFMA regulations require that Forest Plans determine potential capability and suitability for producing grazing animal forage and provide habitat for Management Indicator Species (MIS)(36 CFR 219.20). Range capability is defined as lands that have the potential to be grazed, given the physical constraints of grazing (distance from water, slope, access, etc.). Capability criteria (constraints) are used to determine a Forest’s estimated acreage capable of producing forage. Rangeland capability is not a decision to graze and is only determined at the Forest Plan level.

Suitability can only be addressed once capability is determined. Suitability identifies areas within the capable land base where grazing is appropriate within the context of land management considerations such as economics, environmental consequences, rangeland conditions, and other uses or values of the area. Typically, suitability decisions are made at the forest plan level, but can be done at the project or allotment level. Suitability issues are usually broad in scope and extend across a larger landscape than a single allotment. The Forest Plan revision EIS analysis should also clearly identify areas where grazing is not appropriate. The Forest Plan revision process will be used to evaluate different grazing suitability alternatives and will review range management prescriptions as directed in 36 CFR 219.20.

Current Condition

The extent to which the demand for livestock forage is being met has not been determined. However, actual average livestock use levels (Head Months/year), though vary from year to year, are generally lower than originally anticipated in the Forest Plan.

Some probable contributing factors to this downward trend are:

- Protection of Threatened and Endangered species habitat,
- Increased livestock operator costs due to mitigation measures identified to protect habitat,
- Limited agency funding to implement capital improvements,
- Voluntary and involuntary reductions for resource protection, and
- Permit waivers back to the government that are not re-issued due to resource concerns.

Capability and Suitability - Current rangeland capability determinations do not make a clear distinction between cattle and sheep use.

Allotment stocking and capacity determinations have been corrected or contested on a recurring basis. There is a concern that some sites within existing allotments are not meeting resource objectives related to soil productivity, erosion, hydrologic function, vegetation, and aquatic and terrestrial habitat.

The 1990 Plan direction does not meet requirements outlined in Forest Service national direction, specifically regarding the determination of rangeland capability and suitability. The capability and suitability assessments in the original Forest Plan need to be updated to include direction and research findings that have occurred since the release of the Plan. Updates to the capability and suitability assessments need to include the following:

- Wildlife - There is inconsistent or insufficient management direction for some wildlife wintering areas that are also used by livestock. The combined use by livestock and wildlife may exceed desired use levels on vegetation [36 CFR 219.20(b)].

- Recreation - Within the last 10 to 15 years, recreation use has increased above the projections made in the 1990 Forest Plan. Reports of user conflicts between livestock and recreationists have also increased. No direction or monitoring process exists in the 1990 Plan to address this concern.

- Range Management Direction - New information regarding the proper functioning condition of rangelands susceptibility to drought, and the identification of areas susceptible to soil erosion and recovery need to be reviewed when determining allotment stocking, grazing capacities, and grazing management strategies. See Topic 6—Hydrologic, Riparian, and Aquatic Resources—for more discussion about range management and its relationship to riparian resources.

<u>No Action</u>

Site-specific development of grazing capacity determinations would continue to occur on an allotment-by-allotment basis. Where existing suitable rangelands are in unsatisfactory condition, recovery would be slow or would not occur due to the limited economic resources to implement recovery strategies.

Management during drought conditions would be dealt with through the administration of utilization standards on an allotment-by-allotment basis. Range deterioration would be possible where grazing management is inflexible, where stocking remains high, where long grazing durations and high intensities occur, and where compliance with grazing standards is difficult to administer due to limited economic resources.

Conflicts between livestock and competing uses, such as recreation and wildlife, would continue in some locations. Resolution would occur at a slow rate due to lack of direction and limited funding, time, and personnel.

Need to Establish or Change Management Direction

There is a need to establish grazing capacity determination guidelines for the Forest that adequately reflect site conditions and give direction for assessing allotments on a site-specific basis. The guidelines need to distinguish between sheep and cattle use.

Management direction is needed to reduce or eliminate potential conflicts between livestock and wildlife that use common areas. These conflicts include the risk of reduced forage availability in wildlife wintering areas.

User conflicts between recreationists and livestock in localized areas need to be validated so that a determination can be made whether management area direction needs to be changed.

There is a need to consider rangeland suitability that addresses such issues as non-native plants, recreation conflicts, and the economics of reinstating management on vacant allotments.

Changes Under the Revised Forest Plan

The revised Forest Plan establishes Forest-wide standards and guidelines for rangeland resources that assist in: (1) restoring and maintaining riparian and upland vegetation, (2) achieving watershed condition indicators, (3) providing for the physiological needs of plants, and (4) protecting Threatened and Endangered species.

Suitable rangeland decisions and direction under the revised Forest Plan prevent grazing in developed recreation sites, administrative sites, and Research Natural Areas; and closes vacant allotments that contribute low management value and have other resource considerations.

The revised Forest Plan also provides direction at the management area level for specific concerns, such as areas with high susceptibility to surface erosion, habitats for terrestrial and aquatic species at risk, vegetation cover types functioning at risk, key watershed areas for improving livestock grazing management, and other important resource values that need to be considered when conducting site-specific planning.

Topic 6 – Hydrologic, Riparian, and Aquatic Resources

Background

Aquatic ecosystems are watersheds, water bodies, riparian areas, and wetlands, as well as the species (fish, wildlife, plant, amphibian, invertebrate...) they contain. Riparian refers to areas with distinctive soil and vegetation between a stream or other body of water and an adjacent upland. Riparian areas include wetlands and the portions of floodplains and valley bottoms that support riparian vegetation (ICBEMP 1997a).

The Forest manages significant aquatic habitat for both anadromous and resident fish populations, including Chinook salmon, steelhead trout, redband trout, westslope cutthroat trout, and bull trout. The Forest has over 9,600 miles of perennial and intermittent streams, and 15,400 acres of lakes and reservoirs, supporting an estimated 28 native and non-native fish species. Important fish habitat is found in major portions of the Boise, Salmon, and Payette River drainages. These areas are also important to species dependent on fish as a food source (bald eagles, otters...), as well as some rare plant species.

Current Condition

In 1992 and 1997, Snake River Chinook salmon and steelhead trout, respectively, were listed as Threatened under the Endangered Species Act (ESA), as amended. In 1998, bull trout populations within the Forest were also listed as Threatened. Any proposed federal action that may adversely affect these species or their habitats must be consulted on with the USDI Fish and Wildlife Service or the National Marine Fisheries Service (NMFS) prior to implementing the action. Programmatic planning, such as Forest Plan revision, must follow the same requirements.

In 1995, the Forest Plan was amended by management direction in the *Interim Strategies of Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California*, or Pacfish (USDA Forest Service and USDI BLM 1995), the *Inland Native Fish Strategy*, or Infish (USDA Forest Service 1995) and the Biological Opinions (BOs) for Chinook salmon, steelhead, and bull trout (US Dept of Commerce NMFS 1995, US Dept of Commerce NMFS 1998, USDI FWS 1998). These strategies include the identification of interim Riparian Management Objectives (RMOs), standards and guidelines, and watershed analysis requirements. These interim strategies are in effect until long-term management direction is developed through geographically specific environmental analyses or Forest Plan revisions.

The effectiveness of the Pacfish/Infish standards and guidelines has not been determined for the Forest. Project-level analysis since 1995 has revealed that, in some areas, existing Forest Plan direction exceeds or is more restrictive than Pacfish/Infish direction. In other areas, Pacfish/Infish and the Chinook salmon, steelhead, and bull trout BO RMOs are not appropriate for the watersheds being analyzed. For example, RMOs cannot be met because certain habitat features (large woody debris, pool frequency) are not available naturally in the amounts the RMOs specify. In addition, Pacfish/Infish RMOs do not cover all riparian-related parameters (sedimentation, water chemistry, vegetation composition, and natural disturbance processes).

Pacfish/Infish and the BOs amended the Forest Plan to address soil, water, riparian, and aquatic (SWRA) issues. However, 1990 Forest Plan direction for other resources now sometimes conflicts with this direction. For instance, protective measures and objectives for range, recreation, and mining are not always intensive or extensive enough to sufficiently protect or restore riparian values. During the Forest Plan revision process, this direction needs to be rewritten to be consistent.

Some inland native fish species (such as bull trout and cutthroat trout) are declining. The decline of these fish is primarily due to habitat degradation and fragmentation, blockage of migration corridors, poor water quality, past fisheries management practices, fishing, and introduction of exotic fish species.

Although impacts to fisheries from livestock grazing, water diversions, timber harvesting, mining, and recreation continue on the Forest, substantial progress has been made regarding fish habitat protection. Future land management by the Forest will continue to play an important role in recovery of declining fish populations. Emphasis will be on restoring depleted habitat as well as maintaining and protecting those populations that are currently considered stable. Also, non-consumptive instream uses of water flows (including fish habitat and channel maintenance) will need to be considered in light of other water rights claims and conflicting appropriation.

The 1990 Forest Plan does not adequately or consistently define SWRA Desired Conditions. Existing parameters for defining appropriate SWRA conditions are inconsistent and do not adequately reflect the condition of SWRA resources. The Plan also does not include management direction to emphasize management activities to assist in the de-listing of 303(d) water quality limited water bodies

The 1990 Forest Plan lacks adequate and consistent direction for intermittent streams and landslide-prone areas. Identification and direction for these areas could result in a substantial change in the long-term supply of goods and services from other resources, as these areas could comprise as much as 25 percent of the land base within the Forest.

Since 1990, the Regional Forester has designated several species as Sensitive. Because the sensitive species program was being developed when the Forest Plan was finalized, the Plan contains little or no management direction concerning these species.

In 1998, the Idaho Department of Environmental Quality submitted a list of water quality limited water bodies that were not fully meeting their designated beneficial uses under Section 303(d) of the Clean Water Act. In early 2000, the Environmental Protection Agency approved this list. This list affects several dozen subwatersheds within the Forest. A priority list has been compiled for developing Total Maximum Daily Load limits for pollutants in these water bodies that may establish new standards and guidelines, criteria for water quality parameters, and watershed restoration measures. Also, there have been subsequent changes and additions to the State water quality rules and regulations based on supporting beneficial uses that need to be incorporated into the Plan.

In December of 2000, the Conservation of Columbia Basin Fish: The Final Basin-wide Salmon Recovery Strategy (US Dept of Commerce, NMFS 2000) was released. This strategy, also called the "All H Paper", was developed by NMFS in consultation with eight federal agencies (Corps of Engineers, Bonneville Power Administration, Bureau of Indian Affairs, Bureau of Land Management, Bureau of Reclamation, Environmental Protection Agency, Fish and Wildlife Service, and the Forest Service). The All H Paper focuses on four elements for salmon recovery—hydropower, fish hatcheries, harvest, and habitat. Habitat is the key element addressed by forest plan revision. For habitat on federal land, the salmon recovery strategy strongly emphasizes the following management objectives:

1) Protect existing high quality habitat.
2) Restore degraded habitats on a priority basis and connect them to other functioning habitats.
3) Prevent further degradation of tributary and estuary habitat and water quality.

Currently, two of the Management Indicator Species (MIS) for the Forest are anadromous species; fish that spend part of their life in the ocean and part in freshwater streams or lakes. Because anadromous fish are influenced primarily by off-Forest activities, adult population numbers of these fish are not good indicators of effects from Forest management activities. Better indicators may be habitat conditions or seasonal levels of selected life stages.

The three Forest Monitoring Reports for the Ecogroup were not consistent in their analysis methods and indicators for water quality and aquatics. These inconsistencies led to the development of the *Monitoring and Evaluation Strategy - Southwest Idaho Ecogroup Version 1.2* (USDA Forest Service 1997). This strategy should be incorporated into Forest Plan revision.

No Action

Under 1990 Forest Plan direction, SWRA management would continue to be inconsistent across the Ecogroup Forests. Forest Plan amendments resulting from Pacfish, Infish and associated Biological Opinions would continue to be implemented. The "major weakness" of the short-term Aquatic Conservation Strategy (ACS) currently being implemented would continue. As stated in the 1998 Biological Opinion for listed salmon and steelhead in the Upper Columbia and Snake River Basins, page 57:

> *"In spite of additional recommendations, a major weakness in PACFISH has been, and still is, the lack of a comprehensive aquatic conservation strategy for listed anadromous fish. PACFISH was intended to maintain or improve the environmental baseline while a long-term strategy is being developed. Given the degraded baseline conditions were part of the rationale for listing salmon and steelhead, maintenance of baseline conditions cannot suffice as a long-term strategy. Indefinite extension of PACFISH, delays the recovery of salmon and steelhead, and increases the risk that key population segments will be irretrievably lost. PACFISH maintains a fragmented network of habitats and degraded habitat conditions, where they presently exist, because it lacks a comprehensive restoration and management strategy for watersheds with anadromous fish."*

The 1990 Forest Plan direction, as amended, does not adequately emphasize habitat restoration, population viability, or biodiversity. The 1990 Plan direction does not address habitat connectivity, a major need identified in the ICBEMP project for native fish recovery. Because direction is inconsistent and insufficient at present, this direction may not have the desired beneficial effects on declining fish populations.

The 1990 Plan desired conditions and monitoring strategies would not provide accurate monitoring data or analyses. Forest Plan direction would not emphasize an accelerated rate of recovery to assist in de-listing of water quality limited water bodies. Attaining full support of beneficial uses for these streams may be delayed.

Need to Establish or Change Management Direction

There is a need to develop a long-term ACS that includes a comprehensive restoration and management strategy for watersheds that includes protective and conservation direction, as well as restoration essential to the recovery of listed native inland and anadromous fish. In addition, the long-term ACS needs to include restoration and management strategies needed to restore water quality limited water bodies and their related beneficial uses.

The long-term ACS needs to provide consistent and appropriate SWRA restoration or conservation strategies across the planning area. Existing SWRA management direction is inconsistent among the Forest Plans, is often vague or too general, and does not fully incorporate new SWRA management emphasis on protection and restoration. In addition, there is a need to provide direction for the management of intermittent streams and landslide-prone areas that are not adequately addressed in the existing Forest Plans.

The long-term ACS needs to include appropriate Riparian Management Objectives (RMOs) and desired conditions that reflect the inherent diversity and capability of the Forest's SWRA resources. Interim RMOs identified in Pacfish and Infish are not applicable for all streams within the Forest; neither are the more restrictive water temperature RMOs for bull trout added to the State Water Quality Standards, and the proposed RMOs for steelhead trout identified in the 1998 programmatic biological assessment. Some streams, for example, are inherently incapable of meeting these RMOs. Other critical RMOs--such as riparian vegetation, soils and soil processes, sediment, and water quality--are not included in Pacfish and Infish. These missing RMOs need to be developed for the Forest Plan. The RMOs must be designed to fully support the designated beneficial uses for water bodies, as identified by State Water Quality Standards.

There is a need to establish fish MIS or management indicators that more accurately reflect the effects of Forest management activities.

There is a need to establish a consistent monitoring strategy by incorporating *Monitoring and Evaluation Strategy - Southwest Idaho Ecogroup Version 1.2* into the Forest Plan.

Changes Under the Revised Forest Plan

The revised Forest Plan provides a long-term comprehensive ACS that includes the following eight components (see Appendix B):

1. Goals to Maintain and Restore SWRA Resources
2. Watershed Condition Indicators for SWRA Resources
3. Delineation of Riparian Conservation Areas (RCAs)
4. Objectives, Standards, and Guidelines for Management of SWRA Resources, including RCAs
5. Determination of Priority Subwatersheds within Subbasins
6. Multi-Scale Analyses of Subbasins and Subwatersheds
7. Determination of the Appropriate Type of Subwatershed Restoration and Prioritization
8. Monitoring and Adaptive Management Provisions

Bull trout were selected as the aquatic MIS for the Forest, except the North Fork Payette River drainage, in the revised Forest Plan. Reasons for selecting bull trout as an MIS, other than in the North Fork Payette are as follows:

- Bull Trout have a low tolerance to habitat and watershed disturbances.
- Bull trout are present throughout most of the Ecogroup area.
- Bull trout represent a wide range of aquatic habitat needs for other aquatic species.
- Local populations of bull trout generally do not extend beyond the Ecogroup area.
- Bull trout have not been stocked.
- There is a fair amount of information on bull trout collected within the Ecogroup.

The *Monitoring and Evaluation Strategy - Southwest Idaho Ecogroup Version 1.2* has been incorporated into the revised Forest Plan, therefore monitoring of watershed and aquatic systems across the Ecogroup will be more consistent.

Topic 7 - Timberland Suitability

Background

The NFMA and its implementing regulations include requirements to identify those lands that are suited for timber production. Suited lands include forested lands outside of withdrawn areas, such as designated wilderness areas, lands where reforestation can be assured, and lands where timber management activities can take place without causing irreversible resource damage to soil productivity or watershed conditions. Lands identified as not suited for timber production are required to be reassessed at least once every 10 years to determine if they should be reclassified as suited.

A complete reassessment of suited lands has been completed to account for changes in land status that may have occurred, such as land exchanges and acquisitions, Pacfish/Infish and BO direction, and other Forest Plan amendments. The reassessment has benefited from the availability of analytical tools--including Landsat Imagery and Geographic Information Systems (GIS) data--that were not available during the development of the 1990 Forest Plan.

The suitability assessment includes the identification of tentatively suited timberlands (capable and available forest lands that are physically suited for timber management) and suited timberlands (the tentatively suited lands considered appropriate for timber management). The suited timberlands are then evaluated to determine the range of timber harvest levels for the revision alternatives. Timber harvest levels are expressed as Allowable Sale Quantity (ASQ) and Long Term Sustained Yield Capacity (LTSYC). The ASQ represents the average annual maximum volume that a Forest may sell during each decade. The LTSYC represents the maximum level of sustainable timber production that suited lands are capable of producing.

Current Condition

Changes in ownership and policies since the 1990 Forest Plan was released have created a need to reassess the suitability of timberlands for timber production. Land exchanges are undertaken for a number of reasons, including improved efficiency in land management or increased protection of habitat or resources. These exchanges are accomplished on an equal value basis, and may result in either a net increase or decrease in timberland area. The lands that are received in land exchanges need to be assessed to determine their timberland suitability status.

The Forest Plan has been amended by interim direction developed through the Pacfish and Infish environmental assessments and BOs. This direction is designed to protect and restore habitat for anadromous and inland fish species. This direction reclassified lands located within Riparian Habitat Conservation Areas (RHCAs), including landslide-prone areas, as being not suited for timber production. These lands thus are not included when determining the ASQ. These areas were reclassified as not appropriate for timber production under the FEIS no action alternative, Alternative 1B.

Timber harvest may occur in RHCAs where appropriate as a tool designed to achieve desired vegetation characteristics, if management does not retard attainment of RMOs and avoids adverse effects to Threatened or Endangered fish. The 1990 Forest Plan was reconciled to reflect the change in suited land area and the resultant change in ASQ and LTSYC through development of Alternative 1B, the no action alternative in the FEIS supporting forest plan revision.

The revised Forest Plan replaces the 1990 Forest Plan direction, including the interim direction in Pacfish and Infish and associated Biological Opinions (BOs) for Chinook salmon, steelhead, and bull trout (US Dept of Commerce NMFS 1995, US Dept of Commerce NMFS 1998, USDI FWS 1998) that amended the 1990 Forest Plan. This will, as currently proposed, modify the standards for determining the width of RHCAs, rename RHCAs to Riparian Conservation Areas (RCAs), and extend the direction for reclassifying suited lands within RCAs for all watersheds, not just those watersheds with current or potential listed fish populations. .

No Action

Suited timberland acres and volume outcomes for the FEIS No Action Alternative (Alternative 1B) show a decrease from the 1990 Forest Plan because of the following:

- ➢ The Pacfish/Infish and BO amendments of the Forest Plan changed the classification of suited lands in RHCAs, resulting in fewer acres classified as suited timberlands and less area that can be managed with the objective of timber production.

- Pacfish and Infish and BO amendments to the Plan have identified RHCAs with separate standards and guidelines. This change has generally reduced the availability of timber volume from RHCAs.

- Budget levels for timber management not associated with salvage opportunities are anticipated to remain static or show a slight decrease.

- Large-scale salvage efforts associated with catastrophic fire and insect epidemics have mostly been completed. Although additional salvage opportunities could result from future mortality, the amount and timing of mortality in the next planning period is unpredictable.

Table II-1 displays compares suited timberland acres, ASQ, and Total Sale Program Quantity (TSPQ) of the 1990 Forest Plan with the No Action Alternative for the revised Forest Plan.

Table II-1. Comparison of Suited Acres, ASQ, and TSPQ from 1990 Forest Plan to 2003 FEIS No Action Alternative (1B)

Year – Alternative	Suited Timber Land (Acres)	Allowable Sale Quantity (MMBF)	Total Sale Program Quantity (MMBF)
1990 Forest Plan	1,084,000[1]	85.0	85.0[2]
2003 FEIS No Action Alternative (1B)	922,000	72.0	72.3

[1] Total suited acres in the 1990 plan were determined by combining those suited acres selected by the Forplan model (656,000 acres) with the suited acres not selected (428,000 acres). Refer to Appendix E, page 9, 1990 FEIS.

[2] The 1990 plan calculated TSPQ by estimating projected salvage and fuelwood. The 1990 plan assumed there would be little, if any, removal of “green” trees from unsuited timberlands that would contribute to TSPQ. Conversely, TSPQ for Alternative 1B (as well as other action alternatives in the FEIS for revision) only includes “green” tree volume removed from unsuited timberlands and does not include any projection of salvage contributions. Thus, to be comparable to alternatives in the FEIS for revision, TSPQ contributions from salvage estimated in the 1990 plan were removed from TSPQ.

Need to Establish or Change Management Direction

There is a need to reassess National Forest System lands to determine which lands are suited for timber management, as required by the NFMA. Specifically, there is a need to assess changes in the suited land base. These changes include reclassification of some lands previously identified as not suited, and changes in National Forest System lands resulting from land exchanges or acquisitions. The reassessment of suited lands is needed to determine changes in the LTSYC and the ASQ.

Changes Under the Revised Forest Plan

Suited timberlands for the revised Forest Plan are identified through the allocation of Management Prescription Categories. Tentatively suited forest land within areas allocated to management prescriptions that include timber production objectives are classified as suited, or in other words, are appropriate for timber production. The 1990 Forest Plan classified suited timberlands as the forest lands selected for timber production by the model during the planning horizon, and placed the remaining suited timberlands in a category for "Lands similar in character to suited lands, but not selected in the FORPLAN analysis due to binding constraints, or are less economically efficient" (1990 FEIS, Appendix E, Page 9). In the revised plan, this distinction in suited acres was not made and thus, for comparison purposes, is not broken out.

Table II-2 displays differences in suited timberland acreage, ASQ, TSPQ, and LTSYC between the 1990 Forest Plan, as amended (Alternative 1B in the FEIS for revision) and the revised Forest Plan (Alternative 7 in the FEIS for revision).

Table II-2. Comparison of Suited Acres, ASQ, TSPQ, and LTSYC for FEIS Alternative 1B vs. Alternative 7

Plan – Alternative	Suited Timber Land (Acres)	Allowable Sale Quantity (MMBF)[2]	Total Sale Program Quantity (MMBF)	Long-Term Sustained Yield Capacity (MCF)
1990 Plan, as amended[1] (FEIS Alternative 1B)	922,000	72.0	72.3	167.3
Revised Forest Plan (FEIS Alternative 7)	527,500	28.2	39.7	83.4

[1] 1990 Forest Plan direction, including the interim direction in Pacfish and Infish and associated Biological Opinions (BOs) for Chinook salmon, steelhead, and bull trout (US Dept of Commerce NMFS 1995, US Dept of Commerce NMFS 1998, USDI FWS 1998) that amended the 1990 Forest Plan.

[2] Updated to reflect 2010 Forest Plan amendment. Expressed in average annual MMBF.

Topic 8 - Management Emphasis Areas

The Boise National Forest includes many different areas with various combinations of biophysical resources and social interests. When these areas receive formal recognition from Congress or the Forest Service, they are given an appropriate emphasis in management direction in the Forest Plan. This direction is designed to protect the qualities that earned these areas their designation. Management emphasis areas with a Need for Change include Wild and Scenic Rivers, Inventoried Roadless Areas, and Management Areas.

Wild and Scenic Rivers

Background

The Wild and Scenic Rivers Act (Public Law 90-542, 1968) establishes objectives, goals, and procedures for Wild, Scenic, and Recreational River designation.

Agency policy related to the Wild and Scenic Rivers Act in land management planning requires that rivers identified as potential Wild and Scenic Rivers (WSRs) be evaluated as to their eligibility, with the findings documented in the Forest Plan. An eligible river or river segment must be free flowing and possess at least one feature that is judged to be outstandingly remarkable. Additionally, it is recommended, but not required, to complete the WSR suitability studies during the Forest Plan revision process. To be found suitable, the benefits of designating the river should outweigh the disadvantages. If a recommendation is deferred on those rivers identified as eligible where the Forest Service has primary responsibility, the Forest Plan must also provide interim management direction for protection of the outstanding features.

Current Condition

The Boise National Forest completed an eligibility study as part of the Forest Planning process in 1990. As a result of that process, 32 river segments from 16 rivers were identified as being eligible for inclusion into the Wild and Scenic River System. See Appendix D for names and locations of eligible segments.

Although interim management direction is in place on the Forest, suitability studies have not been conducted on the eligible rivers listed in the Forest Plan.

No Action

Management direction for the designated Wild and Scenic Rivers would not change. These areas would continue to be affected primarily by natural processes and human recreation. Management activities would not affect the Outstandingly Remarkable Values of eligible or suitable river segments or their free-flowing status.

Need to Establish or Change Management Direction

The Forest needs to re-evaluate previous eligibility studies based on the need to improve upon earlier inventories and apply a consistent inventory and assessment approach across the Ecogroup. Specifically, the process for determining Outstandingly Remarkable Values needs to be refined and expanded. Reevaluation also needs to incorporate new information and changed conditions since the last eligibility studies were completed, such as new species listings and large uncharacteristic events. Any rivers found eligible during the re-evaluation process will be filtered through the suitability study prioritization shown below.

The Forest has completed suitability studies for priority 1 rivers in the Forest Plan revision process, and priorities 2, 3, and 4 will be addressed after the revision effort. The priority streams are:

> *Priority 1.* Commitments made in a settlement agreement between American Rivers, Inc. and the Payette National Forest. These commitments cover the South Fork Salmon River on the Boise and Payette National Forests.
>
> *Priority 2.* Coordinated study with Idaho Department of Water Resources. This study involves the Payette River System on the Boise National Forest, including the North Fork Payette River, Middle Fork Payette River, and South Fork Payette River.
>
> *Priority 3.* Shared rivers, such as the South Fork Boise River on the Boise and Sawtooth National Forests.
>
> *Priority 4.* All other eligible rivers.

In addition, regardless of priority, any rivers found eligible during the re-evaluation process will undergo suitability studies if site-specific projects may affect the Outstandingly Remarkable Values (ORVs) or classification.

Changes Under the Revised Forest Plan

The Forest Plan revision process focused on changed condition, such as listing of new species on the Threatened and Endangered species list or changed condition of the river area, and new information such as adding botanical and ecological to the outstandingly remarkable value categories. This resulted in portions or all of 15 rivers found eligible for inclusion in the national system. The eligible river segments and their classifications can be found in Appendix D of the Forest Plan. Management direction for interim management of these segments can be found in the Wild and Scenic Rivers section of Chapter III of this Forest Plan, and in the Management Areas in which the river segments appear.

Suitability studies were not completed as part of the Boise National Forest planning process in 1990, and only one was completed as part of this Forest Plan revision process. The South Fork Salmon River was found to be suitable for inclusion in the national system. See Appendix D to the Forest Plan for more information on the Wild and Scenic River eligibility process. See Appendix J to the EIS for more information on the suitability study.

Inventoried Roadless Areas

Background

"Roadless Areas" refer to areas that are without constructed and maintained roads, and that are substantially undeveloped. The Forest has many Inventoried Roadless Areas, which have varying degrees of wilderness characteristics. Wilderness is specifically defined in the Wilderness Act (Public Law 88-577, 1964); one requirement is a roadless, undeveloped condition.

NFMA regulations direct that, "Unless otherwise provided by law, roadless areas within the National Forest System shall be evaluated and considered for recommendation as potential wilderness areas during the forest planning process." The Forest Service does not have the authority to designate wilderness areas, but rather evaluates and considers roadless areas for recommendation as potential wilderness areas. Formal designation of wilderness areas occurs through Congressional action, and two wilderness areas have been established within the Forest proclaimed boundaries.

Current Condition

The Boise National Forest currently has about 1.1 million acres of Inventoried Roadless Areas. The 1990 Forest Plan assigned management prescriptions to each roadless area. These prescriptions range from recommended wilderness, where activities are consistent with preserving wilderness attributes, to general forest management, where activities may include road construction, timber harvest, range improvement, recreation development, and habitat improvement projects. Depending on the size and intensity of these projects, land may be considered developed and subsequently removed from a roadless area, resulting in a change in roadless area size and boundaries.

The 1990 Forest Plan recommended nearly 185,000 acres of Inventoried Roadless Areas for Wilderness designation (see Table II-3). These areas were assigned management area prescriptions to help preserve wilderness characteristics until Congress decides whether to officially designate them as Wilderness.

No Action

Roadless areas would continue under management prescriptions in the 1990 Forest Plan. Effects to these areas would vary considerably, depending on those prescriptions. Areas with prescriptions for recommended wilderness or semi-primitive recreation emphasis would likely retain their current wilderness characteristics and roadless boundaries. However, areas with a general forest management prescription would receive new or additional development that would reduce wilderness characteristics and the overall size of their roadless area that would be considered for wilderness designation in the future. Wilderness evaluation was documented was documented in Appendix C of the 1990 Forest Plan EIS.

Table II-3. Roadless Areas Recommended for Wilderness – 1990 Forest Plan

Recommended Wilderness Area	Acres
Red Mountain	84,300
Ten Mile / Black Warrior	77,100
Hanson Lakes (contiguous with Sawtooth NF)	13,500
Needles (contiguous with Payette NF)	4,000
Total	179,000

Need to Establish or Change Management Direction

Roadless areas need to be reevaluated for wilderness capability, availability, and need. After the evaluation of roadless areas is completed, the need to establish or change management direction for recommended wilderness will be identified. No programmatic changes were identified from monitoring and evaluation.

Changes Under the Revised Forest Plan

The Forest has re-inventoried its roadless areas since the release of the Preliminary Analysis of the Management Situation Summary. During the re-inventory process, changes were made to the roadless area boundaries based on project-level decisions, improved mapping, and decommissioning of classified roads. Any areas within the roadless areas that had been developed by projects were removed from the inventory. The Forest was also examined, using Geographic Information System (GIS) technology, to identify roadless areas that may have been missed in past inventories. Changes in the roadless areas are shown on the maps in Appendix C of the Forest Plan EIS.

A subsequent evaluation of the re-inventoried roadless areas was also completed and the results are documented in Appendix C of the Forest Plan EIS. This evaluation reviewed the roadless areas for their potential as Wilderness using capability, availability, and need criteria.

Based on the roadless area evaluation, the revised Forest Plan carried forward Wilderness recommendations from the 1990 Forest Plan. However, minor acreage changes occurred due to changes in technology used to measure the areas and minor boundary adjustments. Revised acres for recommended Wilderness are shown in Table II-4. Changes in management direction for recommended Wilderness are in Chapter III of this Forest Plan, in the Wilderness section. Management emphasis disposition for all roadless areas is in Appendix C of the Forest Plan EIS. In addition, a roadless characteristic analysis was completed for the Final EIS, the results of which can be found in Appendix H to the EIS.

Table II-4. Roadless Areas Recommended for Wilderness in the Revised Forest Plan

Recommended Wilderness Area	Acres
Red Mountain	86,100
Ten Mile / Black Warrior	79,900
Hanson Lakes (contiguous with Sawtooth NF)	13,600
Needles (contiguous with Payette NF)	4,300
Total	183,900

Management Area Boundaries

Background

A management area is an identifiable unit of land that has specific land management emphasis and prescriptions. A management prescription is a composite of multiple-use direction applicable to all or part of the management area. The prescription generally includes goals, objective, standards and guidelines, and probable management practices.

Current Condition

Management area boundaries on the Boise National Forest were developed based on a combination of geographic and political features, social issues, and land capability. Prescriptions for the Boise management areas were written to apply over the entire areas, which have not been mapped as smaller units. When implementing prescriptions, the Ranger Districts have to validate where the prescriptions do or do not apply on the landscape.

No Action

Management area boundaries would not change.

Need to Establish or Change Management Direction

There is a need to define management area boundaries where feasible along watershed boundaries in order to more effectively manage and track cumulative effects to resources within those definable areas.

Changes Under the Revised Forest Plan

New management area boundaries have been established and are described in the Management Area Description and Direction section in Chapter III.

STRENGTHENING CURRENT MANAGEMENT DIRECTION

This section describes changes that are needed to clarify 1990 management direction or to create direction that supports and is consistent with Forest Service or other national direction that has been changed or created since the release of the Forest Plan. These changes are different from the major Need for Change topics above in that they could be made without detailed analysis or alternative development in the Draft or Final EIS. However, they represent important Need for Change in specific Forest Plan direction that is being tracked through the revision process.

Ecosystem Management

Need to Establish or Change Management Direction

In 1992 the Forest Service adopted ecosystem management (EM) as an operating philosophy (Overbay 1992). EM has been described as "scientifically based land and resource management that integrates ecological capabilities with social values and economic relations to produce, restore, or sustain ecosystem integrity and desired conditions, uses, products, values, and services over the long term" (ICBEMP 1997a). An EM approach shifts management emphasis from traditional, single resource or species focus to a focus on ecosystems and landscapes. EM also strongly considers the interactions between humans and ecosystems. A framework built around EM principles and elements needs to be incorporated into the revised Forest Plan.

Changes Under the Revised Forest Plan

For Forest Plan revision, the Boise National Forest has adopted an EM conceptual framework. This framework borrows from and builds on: 1) already existing Forest Plan (USDA Forest Service 1990), 2) The Forest Service Region 4 *Desk Guide - Bridge to Revision* (USDA Forest Service 1993), and 3) *A Framework for Ecosystem Management in the Interior Columbia Basin* (ICBEMP 1996a). The intent of the framework is to integrate ecosystem elements with human needs to strengthen the essential link between economic prosperity, social continuity, and ecosystem processes and functions. The use of the EM framework will help ensure ecosystem sustainability and resilience over time and space.

Treaty Rights and the Federal Trust Responsibilities

Need to Establish or Change Management Direction

In 1855, the federal government signed treaties with Indian Nations that inhabited or used what is now the Boise National Forest, including the Nez Perce, Shoshone-Bannock, and Shoshone-Paiute Nations. These intergovernmental treaties reserved rights for traditional uses such as hunting, fishing, and gathering forest products on unoccupied public lands. Treaties are laws that pre-date the establishment of National Forest System lands; thus, rights reserved by treaties take precedence over many federal laws. However, the 1990 Forest Plan does not contain specific language concerning treaty rights and the federal government's obligation to protect those rights. As a result, Forest managers and decision makers lack sufficient direction to coordinate resource management activities with treaty rights. The Forest Plan needs to include this language to meet the federal government's trust responsibilities, to foster a better understanding of tribal concerns, to enhance relationships, and to develop shared goals in land management.

Changes Under the Revised Forest Plan

New Forest-wide management direction is located in the Tribal Rights and Interests section in Chapter III. This direction addresses the protection of treaty rights and the need for the Forest to consult local tribes regarding any management activities that would affect those rights.

Heritage Program

Need to Establish or Change Management Direction

The 1990 Forest Plan needs to be revised to incorporate new management direction into the Heritage Program's goals, objectives, and guidelines. Specific direction that has been enacted since the Plan was released includes:

- 1992 amendments to the National Historic Preservation Act that include (1) the development of educational and interpretive programs for public outreach and involvement (Section 110), (2) increased protection for historic properties on federal lands or lands where federal jurisdiction exists (Sections 106 and 301), and (3) consultation with appropriate Indian tribes for the management of traditional religious and cultural properties (Section 101).

- The Native American Graves Protection and Repatriation Act of 1990 and its 1995 implementing regulations that require the Forest Service to consult with Indian tribes when Native American human remains and certain cultural objects are identified in the agency's archaeological collections or are discovered during the course of federal actions.

- 1996 Executive Order #13007 that requires federal agencies to protect and make accessible Indian sacred sites on public lands for Indian religious practitioners. This includes consultation with Indian tribes for the identification of sacred sites, and for when federal actions or policies may restrict access to or use of a ceremonial site, or may adversely affect the physical integrity of the site.

The revised Forest Plan should also acknowledge the agency's 1992 change from a "Cultural Resources Program" focused primarily on compliance, to a "Heritage Program" that emphasizes a balance between protection of historic properties and public outreach for the enjoyment of American history.

Changes Under the Revised Forest Plan

New Forest-wide management direction has been added to the Heritage Resources section in Chapter III. This direction addresses compliance with cultural resource protection and consultation as well as the expansion of the Heritage Program to emphasize more interpretation, education, and outreach activities.

Forest Land Acquisition Priorities

Need to Establish or Change Management Direction

The 1990 Forest Plan emphasizes consolidating ownership patterns when exchanging or acquiring land in order to increase land management efficiency. In the past few years, national and local emphasis in land exchange or acquisition has shifted to other priorities, including the protection of habitat for Threatened or Endangered species. The revised Forest Plan needs to reflect this shift in emphasis to clarify our policy.

Changes Under the Revised Forest Plan

New Forest-wide management direction is located in the Lands and Special Uses section of Chapter III. Guidelines have been established that prioritize land acquisitions based on criteria such as protection of Threatened and Endangered species habitat, cultural resources and historical properties, public access, and sensitive environmental areas, as well as land management efficiency.

Special Uses

Need to Establish or Change Management Direction

Direction in the 1990 Forest Plan for some special uses merely refers to direction in the Forest Service Manual or Handbooks. However, the direction in the Manual or Handbooks either does not exist or refers back to the Forest Plan. This endless loop of non-direction means that some special use decisions are based on subjective interpretations rather than objective information or criteria. The Forest Plan needs to provide that objective information and criteria for making decisions on some special use permits.

The 1990 Boise Forest Plan is inconsistent in its treatment of current and historic communication and electronic sites. These sites need to be recognized in the Plan as "designated" sites, except as provided for in FSH 2709.11. The Forest Plan also needs to address emerging needs for communication, transportation, and utility corridors. These corridors need to be recognized as acceptable locations for future linear communication uses such as cellular phones.

Changes Under the Revised Forest Plan

New Forest-wide management direction has been added to the Lands and Special Uses section in Chapter III to consistently address special uses, including communication and electronic sites.

Scenic Byway Designations

Need to Establish or Change Management Direction

The Boise National Forest has portions of three state-designated Scenic Byways: the Ponderosa Scenic Byway, the Payette River Scenic Byway, and the Wildlife Canyon Scenic Byway. The Payette River Byway (State Highway 55) is also a National Scenic Byway. The Forest Plan recognizes the possibility of Scenic Byways, but provides little management direction for them. Management direction needs to be established for Scenic Byways in the Forest Plan.

Changes Under the Revised Forest Plan

New Forest-wide management direction has been added to the Recreation Resources sections in Chapter III, as well as to specific Management Areas where the byways occur. The established Visual Quality Objectives also reflect Scenic Byway status.

Winter Recreation Areas

Need to Establish or Change Management Direction

Recreation managers are observing a rising level of winter recreation conflicts in a number of areas within the Ecogroup. In most cases, these conflicts are terrain use conflicts between snowmobilers and skiers and are occurring in developed ski areas as well as backcountry areas. However, most of these conflicts will only be fully resolved by site-specific access determinations. In that this Forest Plan revision process analyzes and adjusts management direction at the programmatic level, full resolution of these conflicts is beyond the scope of this revision process. However, programmatic management direction related to winter recreation management is being reviewed and adjusted as part of the Forest Plan revision process. Site-specific winter access management will be addressed in separate travel management planning processes, which will follow this revision.

Changes Under the Revised Forest Plan

New Forest-wide direction has been added to the Recreation Resources section in Chapter III to provide a foundation for subsequent analysis and access management determinations. In some cases, specific management direction has been included for the appropriate management areas as well.

South Fork Salmon River

Need to Establish or Change Management Direction

The South Fork Salmon River drainage was identified in the Boise Forest Plan as an area of special concern, primarily because of its important habitat for anadromous fish. Natural and human-caused damage has imperiled this resource, requiring the need to establish standards, guidelines, goals, and objectives specific to this area. After the Forest Plan was released, the river was identified as not meeting the beneficial uses of salmonid spawning and coldwater biota, based on requirements of the Clean Water Act. A Total Maximum Daily Load (TMDL) for sediment delivery was developed for portions of the river in 1992. The TMDL includes additional management direction, sediment reduction projects, instream sediment criteria, and monitoring requirements. In 1996, additional streams within the South Fork drainage were also identified as not meeting beneficial uses. A priority list has been created for the analysis of these streams to determine if a TMDL is required in the year 2000. If so determined, this is likely to result in the establishment of new standards and guidelines, criteria for water quality parameters, and watershed restoration measures. These changes need to be reflected in Forest Plan direction.

Changes Under the Revised Forest Plan

Although the South Fork Salmon River drainage remains an area of special concern on the Forest, management areas containing portions of the drainage have not been separated out in the revised Plan as they were in the 1990 Plan. The reasons for this change are:

- Many of the short-term goals and objectives for the drainage stated in the 1990 Plan have since been achieved,
- Management areas containing portions of the South Fork drainage have been reconfigured based on watershed boundaries to reflect ecosystem management,
- Management direction for the new management areas has incorporated the intent of protection measures from Pacfish/Infish and the associated 1995 and 1998 Biological Opinions for Chinook salmon, steelhead trout, and bull trout,
- Management direction associated with the development of the long-term ACS for SWRA resources has been strengthened across the entire Forest, including the South Fork drainage, and
- Management emphasis for the South Fork, as depicted by the Management Prescription Categories for the revised Forest Plan, primarily focuses on conservation and restoration of aquatic, terrestrial, and watershed resources.

See Forest-wide and Management Area Description and Direction in Chapter III for more detailed information.

Predator Control

Need to Establish or Change Management Direction

Some livestock are lost to predators each year on National Forest System lands. The Forest, in cooperation with state and federal wildlife agencies, was previously responsible for determining control measures on Forest System lands. The 1990 Forest Plan provides some guidance on these control measures. Since the Plan was completed, however, the responsibility for predator control activities and NEPA compliance has shifted to the jurisdiction of Wildlife Services, formerly called the Animal Damage Control agency. There is a need in the Forest Plan to clarify the role of the Forest Service related to predator control activities on the Forests.

Changes Under the Revised Forest Plan

An objective has been added to the Wildlife Resources section in the Forest-wide Management Direction of Chapter III that alerts the Forest to “Coordinate animal damage management with the Animal and Plant Health Inspection Service (APHIS), in compliance with USDA Wildlife Services’ most current direction for southern Idaho.”

Management Area Direction

Need to Establish or Change Management Direction
Management goals and objectives and standards and guidelines need to be reviewed and updated to provide consistent, implementable direction designed to achieve management area desired conditions. Improvements should include the correction of conflicting direction, such as mutually exclusive goals and objectives that are occasionally found in the 1990 Forest Plan. Standards and guidelines should also be revised to incorporate new information that helps to achieve goals, objectives, and desired conditions.

Changes Under the Revised Forest Plan
New management area direction has been added to the Management Area Characterization and Direction in Chapter III. Improvements were made to correct conflicting direction and to incorporate new information that should help the Forest achieve its goals, objectives, and desired conditions.

OTHER CHANGES OR DEVELOPMENTS SINCE THE PRELIMINARY ANALYSIS OF THE MANAGEMENT SITUATION

Interior Columbia Basin Ecosystem Management Project

Need to Establish or Change Management Direction
The Boise National Forest is within the area of land covered by the Interior Columbia Basin Ecosystem Management Project (ICBEMP). The Project, which was initiated as a joint effort between the Bureau of Land Management and the Forest Service in January 1994, addressed landscape health issues facing the Interior Columbia Basin. These issues included threats from wildfire and non-native plants, and protection and restoration of fish and wildlife habitat.

The ICBEMP issued an Integrated Scientific Assessment in 1996 that described the current condition of the Interior Columbia Basin. The information base of this package provides context at a broad, multiple-state scale and was used by the Revision Team, in addition to more localized information, to identify current habitat conditions and trends (ICBEMP 1996b). The Upper Columbia River Basin (UCRB) Draft EIS was issued for comment in June 1997 (ICBEMP 1997a), a Supplemental Draft EIS was released for comment in March of 2000 (ICBEMP 2000a), and the Final EIS was released in December 15, 2000 (ICBEMP 2000d). Based on comments received on the FEIS—including concerns that the direction was too broad in scale to make decisions at the local level, and did not consider the USFS Roadless Area Conservation Rule (USDA Forest Service 2000) and National Fire Plan (USDA Forest Service 2000)—no Record of Decision for the Project was released.

On February 19, 2003, the Project was completed with the signing of a Memorandum of Understanding (MOU) between the Forest Service, Bureau of Land Management, National Marine Fisheries Service, US Fish and Wildlife Service, Environmental Protection Agency, and the Forest Service's Forest and Range Experiment Stations, to cooperatively implement the *"A Strategy For Applying The Knowledge Gained By The Interior Columbia Basin Ecosystem Management Project To The Revision Of Forest And Resource Management Plans And Project Implementation"* (USDA Forest Service et al. 2003).

The purpose of this MOU is to cooperatively implement the "*The Interior Columbia Basin Strategy*" to guide the amendment and revision of forest (FS) and resource management (BLM) plans and project implementation on public lands administered by the Forest Service and Bureau of Land Management throughout the Interior Columbia Basin. This strategy incorporates the scientific assessment information in, *"An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins"* " (Quigley and Arbelbide 1997), the analyses supporting or developed as part of the ICBEMP, the "*Integrated Scientific Assessment for Ecosystem Management*" (Quigley et al. 1996) developed by the Interior Columbia Basin Ecosystem Management Project (ICBEMP) as guidance for implementation, and all reports generated by the ICBEMP project.

Changes Under the Revised Forest Plan

Key science findings and basin-wide issues developed in the ICBEMP Final Environmental Impact Statement (FEIS) were considered and used in the development of the revised forest plan. These key findings relate to:

- Landscape Dynamics
- Terrestrial Species Habitat
- Aquatic and Riparian Habitat
- Social-Economics
- Tribal Governments
- Coordination with other management efforts
- Adaptive Management

The revised Forest Plan tiers from this information, forming a link between the broad-scale ICBEMP assessment and project-specific assessments and proposed actions.

2001 Road Management Final Rule and Administrative Policy

Need to Establish or Change Management Direction

The final rule and administrative policy is referred to as the "Road Management Policy". The Road Management Policy was published in the Federal Register on January 12, 2001. It applies to existing and future roads on National Forest System lands. It emphasizes local, science-based decisions designed to maintain a road system that is safe, responsive to public needs, environmentally sound, and affordable to manage. It also established official definitions regarding road management terms.

The policy requires responsible officials to conduct a science-based roads analysis to help make better decisions on all new construction, reconstruction, and decommissioning activities made after July 12, 2001. Currently, the August 1999 process entitled "Roads Analysis: Informing Decision about Managing the National Forest Transportation System" (USDA Forest Service 1999) is the only approved analysis process.

FSM 7712.15 requires that "units that have begun revision or amendment of their forest plans but will not adopt the final revision or final amendment by July 12, 2001, must complete a roads analysis prior to adoption of the final plan or amendment". The Forest completed a Forest-scale Roads Analysis as part of the revision effort (refer to the SWIE Roads Analysis contained in the project record). The information generated was used by the responsible official to make informed programmatic decisions needed to ensure that the road system on a forest planning unit was safe, responsive to public needs, environmentally sound, and affordable to manage.

Changes Under the Revised Forest Plan

Transportation system management will be consistent with direction provided by the Roads Management Policy. The following objectives and standard were incorporated into Forest-wide direction, Facilities and Roads section, in Chapter III.

Objective - Analyze road system needs and associated resource effects in accordance with the established agency policy direction for roads analysis.

Objective - Coordinate transportation systems, management, and decommissioning with other federal, state and county agencies, tribal governments, permittees, contractors, cost-share cooperators, and the public to develop a shared transportation system serving the needs of all parties to the extent possible.

Objective - Identify roads and facilities that are not needed for land and resource management, and evaluate for disposal or decommissioning.

Standard - In support of road management decisions, use an interdisciplinary science-based roads analysis process such as Roads Analysis: Informing Decisions About Managing the National Forest Transportation System (USDA Forest Service 1999).

Lynx Listing

Need to Establish or Change Management Direction

On March 21, 2000, the USDI Fish and Wildlife Service (USFWS) listed the Canada lynx in the contiguous United States as Threatened under the Endangered Species Act. The lynx is found predominantly on federal lands, especially in the West. The USFWS concluded that one threat to lynx in the contiguous United States is the lack of guidance to conserve the species in current Federal land management plans. The Forest Service has signed a Lynx Conservation Agreement that would affect forest plans within lynx habitat.

Changes Under the Revised Forest Plan

Conservation measures in the Agreement have been incorporated into Forest-wide management direction in Chapter III. The TEPC Species section has the following direction specifically related to lynx: Objectives 12, 13, 14, 28, 29, 30, 31, and 32; and Standards 14, 15, 16, and 34. In addition, vegetation desired conditions for size class, density, snag, and coarse woody debris components should help protect or improve lynx foraging and denning habitats Forest-wide (see Appendix A).

2001 Roadless Area Conservation Rule

Need to Establish or Change Management Direction

In October 1999, President Clinton announced a roadless area initiative, which led to the release of the Forest Service Roadless Area Conservation Draft EIS (USDA Forest Service 2000). The Forest Service Roadless Area Conservation Final EIS (USDA Forest Service 2000) was published in November 2000, and the Record of Decision on the Roadless Rule came out on January 12, 2001. However, before the Forest Service could implement the rule, the United States District Court for the District of Idaho issued a preliminary injunction of the rule nationwide.

On May 4, 2001 Agriculture Secretary Ann M. Veneman announced her decision to move forward with an open and fair process to address reasonable concerns raised about the rule so implementation, following resolution of the injunction, would occur in a responsible, common sense manner. The Forest Service then conducted an Advanced Notice of Proposed Rulemaking to solicit public comments on the Roadless Rule to help the Forest Service determine the next appropriate steps regarding roadless area protection and management. Over 700,000 responses were received. The respondents provided information on a much wider range of concerns and issues than just the rule.

The agency’s goal is to provide a long-term protection and management policy for inventoried roadless areas using a responsible and balanced approach that fairly addresses concerns raised by affected local communities, tribes, and states. Recently the Forest Service agreed to participate in a public dialogue sponsored by the Forest Roads Working Group, which is composed of representatives from several non-government organizations. The group is interested in forging agreement and developing workable solutions related to roadless area management.

In the meantime, the Chief of the Forest Service has issued interim directives concerning management within roadless areas until long-term protections are in place or legal actions are concluded. The direction issued by Chief Bosworth on June 7, 2001 reserves to himself final approval of proposed road building and timber harvest in roadless areas, with limited exceptions (Bosworth 2001). To date, Chief Bosworth has not approved any projects in roadless areas on the Boise National Forest. The Forest Service is committed to protecting and managing roadless areas as an important component of the National Forest System.

The current Forest Plan has management prescriptions for some roadless areas that would maintain their roadless character, but other areas are available for road building, timber harvest, and other development.

Changes Under the Revised Forest Plan

The revised Forest Plan has applied management prescription categories (MPCs) and associated standards to IRAs that would limit the types and amounts of development that could occur.

Under MPC 1.2, for IRAs that are Recommended Wilderness, management actions must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act. Mechanical vegetation treatments, including salvage harvest, are prohibited. Road construction or reconstruction may only occur where needed to provide access related to reserved or outstanding rights, or to respond to statute or treaty.

Under MPC 4.1a, management actions must be designed and implemented in a manner that does not adversely compromise the area's roadless and undeveloped character in the temporary, short term, and long term. Road construction or reconstruction may only occur where needed to provide access related to reserved or outstanding rights, or to respond to statute or treaty.

Under MPC 4.1c, management actions must be designed and implemented in a manner that would be consistent with the Management Area ROS objectives in the temporary, short term, and long term. Within IRAs, road construction or reconstruction may only occur where needed to provide access related to reserved or outstanding rights, or to respond to statute or treaty.

Under MPC 3.1, management actions may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years). Mechanical vegetative treatments may only occur where: (a) the responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and (b) they maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or (c) they maintain or restore habitat for native and desired non-native wildlife and plant species. Road construction or reconstruction may only occur where needed to: (a) provide access related to reserved or outstanding rights, or (b) respond to statute or treaty, or (c) address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.

Under MPC 3.2, management actions may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary or short-term time periods, and must be designed to avoid resource degradation in the long term (greater than 15 years). Mechanical vegetative treatments may only occur where: (a) they maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or (b) they maintain or restore habitat for native and desired non-native wildlife and plant species, or (c) reduce risk of impacts from wildland fire to human life, structures, and investments. Road construction or reconstruction may only occur where needed to: (a) provide access related to reserved or outstanding rights, or (b) respond to statute or treaty, (c) support aquatic, terrestrial, and watershed restoration activities, or (d) address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.

With the exception of a few relatively small areas on the Cascade and Lowman Ranger Districts, there were no suited timberland MPCs (4.2, 5.1, 6.1, and 6.2) allocated to IRAs.

National Fire Plan, Cohesive and Comprehensive Strategies, Healthy Forests Initiative

Need to Establish or Change Management Direction

National Fire Plan (USDA Forest Service 2000) - The Departments of Agriculture (Forest Service) and Interior (NPS, USFWS, BLM) developed the National Fire Plan in 2000 in response to a Presidential request on how best to respond to the severe fire season of that year. The plan is a long-term, multi-faceted strategy designed to manage the impacts of wildland fire to communities and ecosystems, and to reduce wildfire risk. It focuses on improving fire preparedness, restoring and rehabilitating burned areas, reducing hazardous fuels, assisting communities, and identifying research needs.

Protecting People and Sustaining Resources in Fire-Adapted Ecosystems - A Cohesive Strategy (USDA Forest Service 2000) – The Forest Service developed this strategy in 2000 to address the need to reduce the identified fuel build-up in the West. The strategy establishes a framework to restore and maintain conditions in fire-adapted ecosystems where lower-intensity ground fires were a powerful force in shaping the make-up and structure of vegetative communities. The strategy identified Condition Class categories for these ecosystems, and prioritized areas for hazardous fuel treatments called for in the National Fire Plan. These priority areas include:

- Wildland-Urban interface
- Municipal supply watersheds
- Threatened and endangered species habitat
- Maintenance of low risk Condition Class 1 areas.

10-Year Comprehensive Strategy Implementation Plan, A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment (USDA Forest Service et al. 2002) – Developed in 2001 in collaboration with governors and a broad range of stakeholders, this is a 10-year strategy to comprehensively manage wildfire, hazardous fuels, and ecosystem restoration on federal, state, tribal, and private lands. The strategy was designed to extend the concepts of the National Fire Plan and Cohesive Strategy into a broader and more collaborative effort. In 2002, an Implementation Plan for the 10-year Comprehensive Strategy was released. The plan identifies 22 specific tasks to achieve the four goals of the 10-year strategy; and specific performance measures for achievement. The plan emphasizes a collaborative, community-based approach to address wildfire-related issues, and translates the conceptual framework of the 10-year Comprehensive Strategy into specific actions.

Healthy Forests - An Initiative for Wildfire Prevention and Stronger Communities (Bush 2002) – Released in 2002, this Presidential initiative is designed to facilitate projects that reduce wildfire hazard and risk by making decisions in a more timely and efficient manner. In facilitating fuels reduction projects, the initiative would speed implementation of projects, improving implementation of the National Fire Plan and the 10-Year Comprehensive Strategy. It emphasizes using collaborative processes in identifying projects and priorities.

The administrative proposal would:

- Seek to increase the use of Categorical Exclusions for fuel reduction projects,
- Seek to streamline the appeals process within the existing appeals framework, and
- Seek to streamline the Environmental Assessment documentation process.

The current Forest Plan does not have any specific information or direction to address the national policy changes in wildfire and fuels hazard reduction described above.

Changes Under the Revised Forest Plan

The revised Forest Plan addresses the wildfire hazard plans, strategies, and initiative described above by:

- Analyzing potential effects from wildfire and hazardous fuel conditions in the Vegetation Hazard and Fire Management sections of Chapter 3 in the FEIS,
- Revising Forest-wide Fire Management direction in Chapter III of the Forest Plan to incorporate national fire and fuel management objectives; specifically FMGO04, FMGO06, FMOB01, FMOB02, FMOB04, FMOB05, FMOB06, and FMOB07.
- Identifying National Fire Plan communities and wildland-urban interface areas within each appropriate Management Area in Chapter III of the Forest Plan, and
- Developing specific Management Area direction to prioritize treatment, suppression, prevention, and coordination efforts within and around National Fire Plan communities and wildland-urban interface areas.

Planning Regulations and Committee of Scientists Report

The Forest Service issued a proposed planning rule in October 1999 that would change the Forest Service regulations for implementing the NFMA. This proposed change was based upon decades of experience implementing the existing regulations as well as the March 15, 1999 Committee of Scientists Report. The Committee of Scientists Report, *Sustaining the People's Land – Recommendations for Stewardship of the National Forests and Grasslands into the Next Century* (Committee of Scientists 1999), highlighted needed changes in four areas:

- Sustainability
- Collaboration (public involvement, partnerships)
- Role of Scientists
- Living Documents

The proposed rule change is in the process of being finalized. When the rule is final, it could result in changes in the planning process used to revise future Forest Plans. The type and extent of changes will not be known until changes in the planning regulations are made final. However, forest plan revision efforts already initiated, including this one, are not be required to follow the new planning regulations.

CONTINUOUS ASSESSMENT AND PLANNING

The first round of planning in the 1980s required that each Forest build a plan from scratch. This effort became an all-consuming task for the Forest Service and required a big budget, many employees, and lots of time. As the time came to revise these first generation plans, planning philosophy evolved to fit the task at hand and available budget and work force.

It is important to remember that the Forest is proposing changes to a Plan that has already been developed and implemented. Therefore, there have been years to determine what direction is working and what changes need to be made. In revising the Forest Plan, the Forest focused on those areas that must be reviewed in accordance with federal regulations, and on critical issues identified through new information, monitoring, and public concerns.

The regulations focus the revision process; “The Forest Supervisor shall determine the major public issues, management concerns, and resource use and development opportunities to be addressed in the planning process” [36 CFR 219.12(b)]. Throughout the revision process, only those portions of the Plan that were identified as needing change were addressed. Budget considerations were also used to validate that alternatives developed were appropriate for detailed consideration.

In June 1990, the Forest Service, in coordination with The Conservation Foundation and Department of Forestry and Natural Resources at Purdue University, published recommendations on how to improve the planning process. After reviewing the Land Management Planning Critique, Region 4 of the Forest Service adopted a more adaptive planning process, known as Continuous Assessment and Planning. There are three primary goals of this process:

- Work more collaboratively with customers and interested publics to achieve shared land management expectations;
- Use the revision effort to create an adaptive Forest Plan that will meet current management needs but is readily amended with new information, and;
- Effectively and efficiently utilize information and analysis across scales to improve land management.

Through this process, issues that were better addressed at a later time or at a different scale were deferred. This has allowed the Forest to focus on the most compelling needs for change in Plan direction, or in some cases, make changes where needed prior to the year 2000.

The Forest has already forged a strong beginning for the Continuous Assessment and Planning process by adopting ecosystem management, responding to monitoring results and public concerns, changing management areas and direction, making the Forest Plan more flexible, and incorporating new and valuable information from a wide variety of sources. This Continuous Assessment and Planning process will continue to be used throughout the next planning period to:

- Fine-tune Forest Plan direction and effectiveness with amendments as needed to address new information or changed conditions, or adapt direction to better address site-specific situations,
- Evaluate Forest-wide effectiveness and validation monitoring, reporting results, and make any necessary changes to plans, and
- Address broad-scale issues that were not covered in detail during Forest Plan revision, such as travel management planning.

INTRODUCTION

Chapter III describes management direction for the Forest that will guide Forest personnel to achieve desired outcomes and conditions for both land stewardship and public service. This direction is presented in two sections: (1) Forest-wide Management Direction, which begins below, and (2) Management Area Description and Direction, immediately following. These two sections are closely interrelated and need to be considered together in order to understand the full scope and intent of Forest management direction.

The Forest-wide Management Direction section provides general direction for all Forest resources and the foundation for more specific direction at the Management Area level. For more efficient and effective management, the Forest has been divided into smaller units called Management Areas organized around a combination of watershed and administrative boundaries. The Management Area Description and Direction section describes these areas in detail, highlights resource areas of importance or concern, and prescribes specific management direction to address these concerns. The Management Area direction is designed to tier to the Forest-wide direction, and to help achieve Forest-wide goals and desired conditions.

Multi-Scale Analysis

Direction contained in this plan was developed from analyses completed at multiple scales. This approach was necessary in order to better understand context and the inter-relationship of forest plan direction on resource, social and economic factors that span multiple scales. Direction (i.e., goals, objectives, standards, and guidelines) in this plan was developed considering the context of the ICBEMP Science, available Northwest Power Planning Council (NWPPC) subbasin assessments and plans, species recovery plans and conservation strategies, 303(d) watershed plans, and other broad[1]-, mid[2]-, and in some cases fine[3]-scale information that was available.

A guide to Mid Scale Ecosystem Inquiry (August 1999), and other information sources, will be used by project planning interdisciplinary teams to help link the broad-, mid-, and fine-scale information utilized in development of this plan direction to site/project-scale[4] design efforts, including establishment of work priorities. The official responsible for project planning and implementation associated with this plan will determine when and what additional fine and site-scale analyses are needed to ensure project implementation decisions are sufficiently linked to the broad-, mid- and fine-scale information utilized in development of this plan.

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[1] Broad-scale: A regional land area that may include all or parts of several states. An example of a broad-scale assessment is the Interior Columbia Basin Ecosystem Management Project.

[2] Mid-scale: An area varying in size from a U.S. Geological Survey 4th-field hydrologic unit (HU) to groups of 4th-field HUs, approximately 500,000 to 5,000,000 acres; however, a particular mid-scale analysis may not follow hydrologic boundaries when other boundaries are more appropriate to address mid-scale issues. Subbasin Review and Land Management Planning unit analyses occur at this scale.

[3] Fine-scale: A landscape area varying in size from a 6th-field HU to a combination of 5th-field HUs, approximately 10,000 to 100,000 acres; however, a particular fine-scale analysis may not follow hydrologic boundaries when other boundaries are more appropriate to address fine-scale issues. Ecosystem Analysis at the Watershed Scale (EAWS) and Lynx analysis units (LAU) occur at this scale.

[4] Site-scale: A project area or site, typically associated with project-level NEPA analysis. Any scale less than a broad, mid or fine scale.

Continuous Assessment and Planning (CAP)

A proactive approach to ecosystem management within an adaptive strategy is needed in order to effectively move toward, and maintain, higher ecological integrity and social and economic resiliency. To respond to this, the intent of future management is to use a continuing process of planning, implementing, monitoring, evaluating, and incorporating new knowledge into forest planning management strategies, for adjustment purposes, where:

- A planned direction is adapted to a site-specific situation, which is different than what was assumed during planning.
- An event changes the characteristics of the environment.
- New information accumulates over time through monitoring that indicates planned objectives are not being met, and/or research indicates a need for change.

Monitoring and evaluation are an integral part of adaptive management and are key to achieving the short- and long-term goals and desired conditions described in this plan. The need for amending or revising direction in this plan will be based on (1) ongoing broad- and mid-scale monitoring programs (e.g., Interagency Implementation Team (IIT) Biological Opinion efforts, ongoing efforts of the NWPPC, State water quality efforts and other broad-scale monitoring programs), *and* (2) specific planning unit monitoring and evaluation efforts identified in Chapter IV of this document, independent of basin-wide efforts, to address unique local needs. Local monitoring efforts described in Chapter IV of this plan avoid duplication with basin-wide efforts, but are compatible to those efforts whenever possible.

FOREST-WIDE MANAGEMENT DIRECTION

Definitions

This section describes management direction that applies generally to National Forest System lands across the entire Forest. There are basically five types of direction described for the Forest resource programs in the pages that follow: desired conditions, goals, objectives, standards, and guidelines. Each of these types is defined in detail, below.

Desired Conditions are descriptions of how Forest resources should look and function to provide diverse and sustainable habitats, settings, goods, and services. Taken together, the desired conditions should present an integrated vision of a properly functioning Forest that supports a broad range of biodiversity and social and economic opportunity.

Goals are concise statements that help describe desired conditions, or how to achieve those conditions. Goals are typically designed to maintain conditions if they are currently within their desired range, or restore conditions to their desired range if they are currently outside that range. Goals are normally expressed in broad, general terms that are timeless, in that there are no specific dates by which the goals are to be achieved. Goal statements form the basis from which objectives are developed.

Objectives are concise time-specific statements of actions or results designed to help achieve goals. Objectives form the basis for project-level actions or proposals to help achieve Forest goals. Like goals, objectives are typically designed to maintain conditions if they are currently within their desired range, or restore conditions to their desired range if they are currently outside that range. The timeframe for accomplishing objectives, unless otherwise stated, is generally considered to be the planning period, or the next 10 to 15 years. More specific dates are not typically used because accomplishment can be delayed by funding, litigation, environmental changes, and other influences beyond the Forest's control.

Standards are binding limitations placed on management actions. Standards are typically action restrictions designed to prevent degradation of resource conditions, or exceeding a threshold of unacceptable effects, so that conditions can be maintained or restored over time. However, exceptions are made in some cases to allow temporary or short-term degrading effects in order to achieve long-term goals (e.g., SWRA Resources Standard #04). Standards must be within the authority and ability of the Forest Service to enforce. A project or action that varies from a relevant standard may not be authorized unless the Forest Plan is amended to modify, remove, or waive application of the standard.

Guidelines represent a preferred or advisable course of action generally expected to be carried out. Guidelines often indicate measures that should be taken to help maintain or restore resource conditions, or prevent resource degradation. Deviation from compliance does not require a Forest Plan amendment (as with a standard), but rationale for deviation should be documented in the project decision document.

See Glossary for definitions of "maintain", "restore", and "degrade".

Timeframes

As noted above, management objectives in this Plan are generally designed to be achieved within the planning period (the next 10 to 15 years), unless otherwise stated. Similarly, standards and guidelines are expected to apply for the planning period, although there may be deviations, as explained in the definitions above. In addition, the Continuous Assessment and Planning process, under which this Plan was developed, will allow the Plan to adapt through time. If, for instance, monitoring shows that a certain standard is not working, or that a new guideline is needed, these changes can be made during the planning period with Forest Plan amendments.

Desired conditions and goals are more timeless in nature. For certain resources, the desired conditions may already exist, in which case both the short-term and long-term goal may be to maintain those conditions over time. In other cases, there may be short-term impediments to achieving desired conditions, but the long-term goal is to move resources toward those conditions. One example would be a desired condition of having more large ponderosa pine trees and snags in specific vegetation types. The Forest can retain existing large trees over the short-term planning period, but to achieve the desired condition of more trees may take much longer due to the extended time needed for trees to grow to a large size.

In some management direction that follows, there are references to temporary, short-term, or long-term effects. These time periods were also used in the Forest Plan Revision EIS, and were consistently defined for modeling purposes so that effects could be analyzed on an equal basis across alternatives. The definitions used in the EIS were:

- Temporary = 0 to 3 years
- Short term = greater than 3 years to 15 years
- Long term = greater than 15 years.

This Forest Plan uses these temporal definitions as starting points but recognizes that they vary depending on species, life cycles, mobility, ecological processes, and other influences. For example, a relatively long-lived, mobile species like a bear may be able to avoid or adapt to the temporary effects of prescribed fire or recreation disturbance, whereas a short-lived, stationary plant species may not survive the same effects. Because the plant may only have one brief reproductive period and cannot move to avoid fire or trampling, those disturbance effects have a more long-term impact relative to the plant species than they would to the bear. These different temporal relationships need to be determined and analyzed at the project level where site-specific circumstances can be taken into account.

Similarly, the Plan recognizes that all effects are not the same just because they may occur within the same temporary, short-term, or long-term time period. The duration or repetition of an effect within that time period can vary greatly, as can the intensity, location, or type of effect. Again, Forest personnel should have the flexibility to determine these differences during project-scale analysis.

Limited Authority – Guidelines vs. Standards

As a federal land management agency, the Forest Service has limited authority to influence certain activities or uses—such as mining and hydropower development—on its administered lands. However, the agency does have authority to require reasonable terms, conditions, or measures to minimize or mitigate the effects of some of these activities or uses. In the Forest-wide management direction, these activities or uses are typically addressed by guidelines rather than standards, to reflect the Forest's limited authority. In such cases, the Forest remains committed to minimizing or mitigating effects from these activities, where they cannot be avoided or eliminated.

TEPC Species

Although all Threatened, Endangered, Proposed, or Candidate species on the Forest may not be individually addressed in the Forest Plan management direction, the Forest is obligated to provide sufficient habitat to contribute to their survival and recovery. This obligation is spelled out in more detail in the Endangered Species Act, Magnuson-Stevens Act, Forest Service Manual and Handbook direction, and various recovery plans, conservation strategies and agreements, and MOUs. In addition, Section 7 consultation will occur at the project level for all proposed actions that may affect these species or their habitats. The Forest Plan does not authorize or implement specific actions and cannot predict potential effects. The actions and effects would occur at the project level and will be addressed in consultation at that level.

Pacfish/Infish and Biological Opinions

The revised Land and Resource Land Management Plan (LRMP) direction replaces Pacfish/Infish standards, guidelines, and terms and conditions specified in the 1995 BO for chinook salmon and the 1998 BOs for steelhead and bull trout. Analysis in the Forest Plan Biological Assessment provides the linkage between Pacfish/Infish and the 1995/1998 BOs, and the LRMP direction that follows.

Organization

The Forest-wide desired condition, goals, objectives, standards, and guidelines are organized by resource program area. These resource areas, in turn, are organized by ecological groupings, beginning with biophysical resources, and then moving to socio-economic resources. Although management direction is presented by individual resource area for efficient reference and retrieval, this direction has been integrated across resource areas.

Laws, Regulations, and Policies

Besides the management direction described in this chapter, numerous federal and state laws, regulations, and policies govern the use and management of resources on National Forest administered lands. Some of the more important ones are described in *Appendix H, Legal and Administrative Framework for Forest Planning and Resource Management*. The Forest has no legal obligation to repeat these laws, regulations, and policies in its Forest Plan; however, direction in the Plan has been designed to guide Forest resource management in such a way that the laws, regulations, and policies should be met. Wherever the laws, regulations, or policies have more stringent requirements than Forest Plan direction, the Forest must and will comply with those requirements.

Existing administrative policy, procedure, and guidance to Forest Service employees issued through the Forest Service Directive System are not typically duplicated in this plan. These directives (i.e., Forest Service Manual and related Forest Service Handbooks) that provide further guidance to a resource area are referenced at the beginning of each resource section.

The Forest Service Manual and Handbook System codifies the agency's policy, practice, and procedure affecting more than one unit and the delegations of continuing authority and assignment of continuing responsibilities; serves as the primary administrative basis for the internal management and control of all programs; and is the primary source of administrative direction to Forest Service employees.

- **Forest Service Manual (FSM)**. The component of the agency Directive System that contains legal authorities, management objectives, policies, responsibilities, instructions, and guidance needed on a continuing basis by Forest Service line officers and primary staff in more than one unit to plan and execute assigned programs and activities (FSM 1111).

- **Forest Service Handbooks (FSH)**. The component of the agency Directive System that provides detailed procedures, instructions, and guidance needed on a continuing basis by employees in more than one unit on how to proceed with a specialized aspect of a program or activity. Handbooks either implement direction as required by the Manual or incorporate external directives (FSM 1110.3, 1112).

- **Interim Directive**. An internal directive issuance that modifies previous manual or handbook direction or establishes new direction for a period of up to 18 months. FSM 1113.3 describes the criteria related to issuance and policy on the duration of interim directives, including re-issuance.

When an FSM, FSH, or related interim directive is issued, its force and effect do not depend upon the component of the Directive System to which the directive is issued; rather, it is the use of the helping verbs "must," "shall," "ought," "should," or "may," or the use of the imperative mood (where “you” is understood) that determines the force and effect of the direction. These words have the same force and effect whether they are used in a manual, handbook or interim directive. FSM 1110.8 provides guidance on the degree of compliance and restriction imposed by helping verbs and imperative mood.

While directives may refer to procedures or requirements imposed on those outside the agency, Forest Service employees do not use internal directives to assign responsibility to or mandate requirements on employees of local, state, or other federal agencies or on the public. Instead, Forest Service officials use correspondence, agreements, contracts, authorizations, regulations, or other appropriate instruments where necessary to impose requirements on other agencies or on persons not employed by the Forest Service.

DESIRED CONDITIONS COMMON TO ALL RESOURCES

The desired condition for the Forest is to care for the land and serve people through the maintenance and restoration of productive and sustainable ecosystems. The Forest features a broad array of landscapes and opportunities, from wilderness areas where natural conditions predominate, to concentrated development areas where conditions have been highly altered to meet a specific resource concern.

Ecosystems on the Forest:

- Have ecological and watershed integrity, meaning they have a viable combination of all the diverse elements and processes needed to sustain the systems and to perform desired functions,

- Are dynamic in nature and resilient and resistant to natural and man-caused disturbances,

- Have a range of vegetative composition and structure that provide habitat for desired plant, wildlife, and aquatic species, and

- Are managed in an environment of public and interagency trust, and cultural and socio-economic sustainability.

- Are managed to promote meaningful relationships with American Indian Tribes to understand and incorporate tribal cultural resources, needs, interests, and expectations.

Ecosystems have the following physical, biological, social, and economic components and conditions:

- Soils retain all or most of their natural productivity and are in a condition that promotes vegetative growth, hydrologic function, long-term nutrient cycling, and erosional stability. Streams and lakes provide clean water, appropriate temperatures, and a variety of connected habitats to support native and desired non-native aquatic species. Air quality is occasionally affected by smoke from fire use and wildfire.

- Forest, grassland, shrubland, and riparian plant communities are within a desired range of variability for composition, structure, patterns, and processes. Vegetation forms a diverse network of habitats and connective corridors for wildlife, and provides desired levels of snags, coarse woody material, and soil organic matter. Terrestrial and aquatic habitats support species diversity, with emphasis on maintaining or restoring threatened, endangered and sensitive species, rare and unique plant communities, and species of cultural, commercial, and recreational significance. Riparian areas connect upland and aquatic habitats, and promote stable and diverse stream channel conditions. Existing noxious weed populations are not expanding, and new invader species are not becoming established.

- Disturbance processes--such as fire, insects, disease, floods, and landslides--contribute to functioning ecosystems. Fire plays its natural role where appropriate and desirable, but is suppressed where necessary to protect life and resources. Fire is used to manage vegetation where appropriate to enhance ecosystem resiliency and lower hazardous fuel levels.

- Recreational settings range from primitive to developed, offering a wide spectrum of opportunities and uses. Facilities--such as roads, trails, campgrounds, and administrative sites--are constructed, reconstructed, or eliminated as needed to provide a balance of safe, effective, and environmentally responsible management activities. Visitors enjoy a variety of special attractions, including National Recreation Areas, Wilderness Areas, Wild and Scenic Rivers, Scenic Byways, historic landmarks, and winter recreation areas. People have the opportunity to explore and learn about their cultural heritage. Significant cultural sites are preserved and accessible through working tribal and public partnerships.

- Sustainable ecosystems provide a variety of sustainable products and services for current and future generations alike. Timber, range, recreation, minerals, and special use programs offer opportunities for economic development, and contribute to local community needs, while maintaining ecological integrity.

THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE SPECIES

Forest Service Manual and Handbook direction for Threatened, Endangered, Proposed, and Candidate species is in: FSM 2600 – Wildlife, Fish, and Sensitive Plant Habitat Management; and in FSH 2609.13 – Wildlife and Fisheries Program Management Handbook. See also FSM and FSH direction for other appropriate resources in this section.

DESIRED CONDITION

Habitats for Threatened and Endangered Species are managed consistent with established and approved Recovery Plans. Management actions either contribute to, or do not prevent recovery or de-listing of these species. Habitats for Proposed and Candidate species are managed to help preclude listing as Threatened or Endangered under the Endangered Species Act (ESA). Degrading effects from Forest programs are at levels that do not threaten the persistence of Threatened, Endangered, Proposed, or Candidate species populations.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
Goals	TEGO01	Habitat within the respective ranges of species listed under ESA contributes to their survival and recovery.
	TEGO02	Habitat within the respective ranges of Proposed or Candidate species contributes to keeping them from becoming listed under ESA.
	TEGO03	Restorative actions to address the long-term threats to listed and proposed species are balanced with the short-term need to protect listed and proposed species and their habitats.
	TEGO04	Environmental conditions and habitat components support reproductive needs important to sustainable populations of Threatened, Endangered, Proposed, and Candidate (TEPC) species.
	TEGO05	Well-distributed habitat capable of maintaining self-sustaining, complex interacting groups of TEPC species exists within their respective ranges across the planning unit.
	TEGO06	Habitat capable of maintaining stable or increasing trends in abundance of TEPC species in all recovery units within the planning unit exists.
	See also Goals for Soil, Water, Riparian and Aquatic (SWRA) Resources (09, 10, 11, 12, 13, 14, 15); Vegetation (04); Botanical Resources (04, 05, 06); and Recreation Resources (04).	
Objectives	TEOB01	Continue to map and update locations of species occurrence and habitat for TEPC species during fine- or site/project-scale analyses. Incorporate information into a coordinated GIS database and coordinate with the Idaho Conservation Data Center.
	TEOB02	Cooperate with USFWS and NMFS to develop an Information and Education program for special use authorizations within TEPC habitat.
	TEOB03	Identify and reduce road-related effects on TEPC species and their habitats using the Watershed and Aquatic Recovery Strategy (WARS)**,** *the Vegetation and Wildlife Habitat Restoration Strategy* and *Source Environment Restoration Strategy*, and other appropriate methodologies.
	TEOB04	Follow emergency consultation procedures after an emergency event as defined in 50 CFR 402.05.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
	TEOB05	Coordinate with research efforts for TEPC species to determine basic life history requirements and potential effects from management activities. Coordinate efforts and information with the Idaho Conservation Data Center, universities, Forest Service Research Stations, etc.
Objectives	TEOB06	Develop an agreed upon process with NOAA Fisheries and USFWS for project-level consultation that addresses multi-scale analyses and tracking environmental baselines.
	TEOB07	During fine-scale analyses, identify practices or facilities that are adversely affecting TEPC species or their habitats, and prioritize opportunities to mitigate, through avoidance or minimization, adverse effects to TEPC species.
	Soil, Water, Riparian, and Aquatic Resources	
	TEOB08	Maintain and update the Watershed and Aquatic Recovery Strategy for restoration of TEPC aquatic species habitat. Update the plan biennially by using the Watershed and Aquatic Recovery Strategy prioritization process, or other appropriate methodologies.
	TEOB09	As funding allows, implement restoration activities in accordance with the current Watershed and Aquatic Recovery Strategy or Forest Service-approved portions of recovery plans to: a) Restore listed fish species distribution, b) Restore desired habitat conditions, c) Conserve genetic diversity, and d) Provide for genetic exchange.
	TEOB10	Over the planning period, initiate habitat restoration for at least two subpopulations of anadromous fish and two populations of resident fish in each subbasin where these species occur. Use the current Watershed and Aquatic Recovery Strategy (i.e., WARS), or Forest Service approved portions of recovery plans, to assist in determining watershed priorities for habitat restoration within a subbasin.
	Wildlife Resources	
	TEOB11	Update appropriate NRIS database modules for TEPC species and their habitats on a biennially basis to incorporate latest field data.
	TEOB12	During project-level planning, field review lynx analysis units (LAUs) that overlay project areas to determine the suitability for denning, foraging, security and connectivity of habitat within the project area.
	TEOB13	Design and implement vegetation management actions in lynx habitat within LAUs to maintain or restore conditions for lynx foraging and denning habitat.
	TEOB14	During mid- or project-scale analysis, identify and prioritize opportunities for restoration of habitat linkage zones for terrestrial TEPC species to promote genetic integrity and species distribution (refer to Source Environment Restoration Strategy Map in Appendix E).
	TEOB15	Maintain or restore vegetative conditions that contribute to the recovery of northern Idaho ground squirrel habitat.
	TEOB16	Deleted as part of the 2010 Forest Plan Amendment for WCS.
	TEOB17	Deleted, as part of 2010 Forest Plan amendment for WCS.
	TEOB18	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Vegetation	
	TEOB19	During fine-scale analyses in areas where TEPC species occur, identify opportunities to maintain desired habitat conditions or restore degraded habitat for TEPC species.
	TEOB20	Design vegetative activities to maintain or restore denning habitat on landscape settings with the highest probability of escaping stand replacing wildfire events.
	Botanical Resources	

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
Objectives	TEOB21	Coordinate with research efforts for TEPC plant species to determine habitat dynamics, seral conditions, pollination ecology, phenology, distribution, and susceptibility to adverse affects. Coordinate efforts and information with the Idaho Conservation Data Center, universities, Forest Service Research Stations, etc.
	TEOB22	Develop Integrated Weed Management plans to maintain or restore habitats for TEPC plants and other native species of concern where they are threatened by noxious weeds or non-native invasive plants.
	Fire Management	
	TEOB23	Develop operational resources (maps, keys, desk guides, etc.) within 1 year of signing the ROD, to coordinate TEPC species concerns and practical mitigations, and include those resource tools in the Fire Management Plan. Consult with NMFS and USFWS on operational resources on an annual basis. As part of this process consider the following relative to initial attack: a) How these resource tools will be provided to initial attack personnel. b) Locations or identification of occupied TEPC plant habitat, TEPC fish-bearing streams, surface water with direct delivery to TEPC fish bearing streams and associated RCAs. c) Criteria and potential mitigation concerning decisions to place incident bases, camps, helibases, helispots, and other centers for incident activities within occupied TEPC plant habitat or RCAs. d) Criteria and potential mitigation concerning decisions to use draft hoses in TEPC fish- bearing streams that do not have appropriate screening. e) Criteria and potential mitigation concerning decisions to use chemical retardant, foam or other additives in RCAs where surface waters have direct delivery to TEPC fish-bearing streams. f) Criteria and potential mitigation concerning decisions to use heavy equipment in RCAs.
	Rangeland Resources	
	TEOB24	Manage livestock grazing to be compatible with the maintenance or restoration of desired lynx habitat.
	Mineral Resources	
	TEOB25	Continue coordination with the State of Idaho in determining areas that should be considered available for suction dredge mining. Determinations concerning availability should consider: a) Avoid suction dredge mining in bull trout and chinook salmon habitat after August 15 and through the remainder of the calendar year where it will adversely affect spawning and rearing fish and associated redds. b) Seasonal closures should also be considered for other fish species as necessary to protect spawning adults, rearing juveniles and incubating redds, including steelhead trout, especially during drought years. c) Avoid adverse effects from suction dredging to occupied TEPC plant habitat.
	Lands and Special Uses	
	TEOB26	Use land acquisition, exchange, and conservation easements, where appropriate, to meet riparian and aquatic goals and objectives, and to facilitate restoration of TEPC species habitat.
	TEOB27	Where the authority to issue special-use authorizations and agreements was not retained (i.e., FERC, mineral leases), work with permit holders to negotiate changes to meet TEPC species desired habitat conditions.
Objectives	**Recreation Resources**	

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
	TEOB28	During fine-scale analyses in areas where dispersed and developed recreation practices or facilities are identified as a potential concern or problem contributing to adverse affects to TEPC species or degradation of their habitats, evaluate and document where the problems are and prioritize opportunities to mitigate, through avoidance or minimization, adverse effects to TEPC species.
	TEOB29	During travel planning, identify areas of concentrated snow compaction activities (designated trails, snow play areas) in lynx habitat within LAUs, and minimize snow compaction in those areas to reduce potential conflicts.
	TEOB30	Allow for expansion of winter recreation facilities that maintain opportunities for lynx movement and dispersal.
	TEOB31	Manage recreational activities to maintain lynx habitat and connectivity.
	TEOB32	Concentrate activities within existing developed areas rather than developing new areas in lynx habitat.
	TEOB33	Ensure the development or expansion of developed recreational sites or ski areas, and adjacent lands provide for landscape connectivity and lynx habitat needs.
	See also Objectives for SWRA Resources (11, 12, 13, 14, 15, 16, 18); Wildlife Resources (08, 09); Botanical Resources (03, 04, 08, 11, 12, 13, 14); Non-native Plants (06, 08); Mineral and Geology Resources (08); Facilities and Roads (10, 11, 12); and Tribal Rights and Interests (03).	
Standards	TEST01	The Forest shall consult with the NMFS and U.S. Fish and Wildlife Service (USFWS), as needed and appropriate, to comply with consultation requirements under the Endangered Species Act and Magnuson-Stevens Act.
	TEST02	For Forest-wide, watershed, or project-level Biological Opinions (BOs) and Biological Assessments (BAs) with letters of concurrence, requirements shall continue to apply until their expiration date unless these documents are specifically updated during further review with related regulatory agencies. Exception to this standard: The 1995 and 1998 Chinook and Steelhead Biological Opinions and 1998 Bull Trout Biological Opinion are replaced by the Biological Opinion for this Forest Plan revision (refer to page 4 of this Chapter).
	TEST03	Design and implement projects to meet the terms of Forest Service approved portions of recovery plans. If a recovery plan does not yet exist, use the best information available (for example, BAs, BOs, letters of concurrence, Forest Service-approved portions of Conservation Strategies) until a recovery plan is written and approved.
	TEST04	Management actions that have adverse effects on Proposed or Candidate species or their habitats, shall not be allowed if the effects of those actions would contribute to listing of the species as Threatened or Endangered under the ESA.
	TEST05	For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats.
	TEST06	Management actions shall be designed to avoid or minimize adverse effects to listed species and their habitats. For listed fish species, use Appendix B for determining compliance with this standard.
	Soil, Water, Riparian, and Aquatic Resources	
	TEST07	In TEPC fish-bearing waters, do not authorize new surface diversions unless they provide upstream and downstream fish passage and, if needed, include either fish screens that meet NMFS and/or USFWS criteria or other means to prevent fish entrapment or entrainment.
	Botanical Resources	
	TEST08	Avoid management actions within occupied TEPC plant species habitat that would adversely affect the long-term persistence of those species
Standards	TEST09	In revegetation and seeding projects in occupied TEPC plant habitat, a Forest botanist shall be consulted to ensure appropriate species are used.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
	TEST10	Management actions that may contribute to establishment or spread of non-native invasive weed species within occupied TEPC plant habitat shall include measures to avoid weed establishment and spread.
	TEST11	New facilities for storage of fuels and other toxicants shall be located outside of occupied TEPC plant habitat.
	Wildlife Resources	
	TEST12	Mitigate, through avoidance or minimization, management actions within known nest or denning sites of TEPC species if those actions would disrupt reproductive success during the nesting or denning period. During project planning, determine sites, periods, and appropriate mitigation measures to avoid or minimize effects.
	TEST13	Mitigate, through avoidance or minimization, management actions within known winter roosting sites of TEPC species if those actions would adversely affect the survival of wintering or roosting populations. During project planning, determine sites, periods, and appropriate mitigation measures to avoid or minimize effects.
	TEST14	Vegetative management activities within lynx foraging habitat in LAUs shall not degrade, nor retard attainment of desired habitat for the lynx and its prey except: a) Within 200 feet of Forest Service administrative sites, dwellings, and/or associated outbuildings as needed to reduce risk of loss from wildfire. b) Research studies and genetic tests (i.e., performance tests, long-term field tests and realized gain trials) necessary to evaluate genetically improved reforestation stock. c) Within the wildland urban interface in order to develop or maintain fuel profiles that are necessary to reduce the risk of wildfire. d) Where outweighed by demonstrable short- or long-term benefits to lynx and its prey habitat conditions. This standard does not apply to activities that are not vegetation management proposals that may affect vegetation, such as removal of vegetation for ski runs, mineral extraction, etc.
	TEST15	Unless a broad-scale assessment has been completed that substantiates different historical levels of unsuitable habitat, limit disturbance within each LAU as follows: If more than 30 percent of lynx habitat within a LAU is currently in unsuitable condition, no additional habitat may be changed to unsuitable habitat as a result of vegetative management projects. Fire use, or fire hazard reduction and associated vegetation management activities within the wildland urban interface watersheds, that develop or maintain fuel profiles needed to reduce the risk of wildfire threats to the wildland urban interface areas, are NOT bound by this standard.
	TEST16	Lynx LAU boundaries will not be adjusted except through consultation with US Fish and Wildlife Service.
	Fire Management	
	TEST17	Once a Wildland Fire Situation Analysis (WFSA) is approved, heavy equipment shall not be used to construct fire lines within occupied TEPC plant habitat unless: a) The line officer or designee determines that imminent safety to human life or protection of structures is an issue; OR b) The incident resource advisor determines and documents an escaped fire would cause more degradation to occupied TEPC plant habitat than would result from the disturbance of heavy equipment. In no case will the decision to use heavy equipment in occupied TEPC plant habitat be delayed when the line officer or designee determines safety or loss of human life or protection of structures is at imminent risk.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species

Type	Number	Direction Description
Standards	TEST18	Once a WFSA is approved, incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities shall be located outside of occupied TEPC plant habitat unless the only suitable location for such activities is determined and documented by the line officer or designee to be within occupied TEPC plant habitat. In no case will the decision to place these activities inside occupied TEPC plant habitat be delayed when the line officer or designee determines safety or loss of human life or structures is at imminent risk.
	TEST19	Once a WFSA is approved, hoses used to draft water from TEPC fish-bearing streams for suppression activities shall be screened with the most appropriate mesh size (generally 3/32), or as determined through coordination with NOAA and/or USFWS, unless: a) The line officer or designee determines that imminent safety to human life or protection of structures is an issue; OR b) The incident resource advisor determines and documents an escaped fire would cause more degradation to TEPC fish and their habitat than risk to individuals within TEPC fish-bearing streams affected by the use of unscreened, or inappropriately screened, draft hoses. In no case will the decision to use draft hoses without screening in TEPC fish-bearing streams be delayed when the line officer or designee determines safety or loss of human life or protection of structures is at imminent risk
	TEST20	Once a WFSA is approved, avoid delivery of chemical retardant, foam, or additives to all surface waters with direct drainage to TEPC fish bearing streams or occupied aquatic TEPC plant habitat unless: a) The line officer or designee determines that imminent safety to human life or protection of structures is an issue; OR b) The incident resource advisor determines and documents an escaped fire would cause more degradation to TEPC fish and their habitat, or occupied aquatic TEPC plant habitat, than would be caused by chemical, foam or additive delivery to waters containing these TEPC fish or plants. In no case will the decision to avoid delivery of chemical retardant, foam or additives to TEPC fish bearing waters or occupied TEPC aquatic plant habitat be delayed when the line officer or designee determines safety or loss of human life or protection of structures is at imminent risk
	TEST21	Water dipping points and criteria for determining dipping points, shall be identified in the operation resources for TEPC fish-bearing streams and occupied TEPC aquatic plant habitat. In situations where dipping points have not been approved in advance, the operational resources criteria for dipping points shall be used until the line officer or designee can approve sites following a review and recommendation by a resource advisor, unless the line officer or designee determines that imminent safety to human life or protection of structures is an issue.
	Rangeland Resources	
	TEST22	Livestock trailing, bedding, watering, and other handling efforts shall be mitigated, through avoidance, to address adverse effects to occupied TEPC plant habitat.
	TEST23	New water developments, corrals, and other handling or loading facilities shall not be located within occupied habitat of TEPC plant species unless it can be demonstrated these facilities shall not adversely affect occupied TEPC plant habitat.
	TEST24	Livestock salting and/or bed grounds shall be located outside occupied TEPC plant habitat so that plants shall not be adversely affected by associated trampling.
	TEST25	Mitigate, through avoidance, the adverse effects of livestock access or activities that may result in trampling of redds or disturbance of spawning or reproductive staging of ESA listed fish species.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
Standards	TEST26	Mitigate, through avoidance, effects to occupied TEPC plant habitat through grazing system design and implementation, and livestock handling adjustments.
	Mineral Resources	
	TEST27	Do not approve new development of saleable or leasable mineral operations in occupied TEPC plant habitat.
	TEST28	Avoid adverse effects from locatable mineral operations to TEPC plant species and occupied habitat.
	TEST29	Avoid or minimize adverse effects from locatable mineral operations to TEPC animal species or their habitats.
	TEST30	In new and existing quarry projects, keep equipment and activities out of occupied TEPC plant habitat.
	Lands and Special Uses	
	TEST31	Adverse effects from new facilities to occupied TEPC plant habitat shall be avoided.
	Facilities and Roads	
	TEST32	When taking water from TEPC fish-bearing streams for road and facility construction and maintenance activities, intake hoses shall be screened with the most appropriate mesh size (generally 3/32 of an inch), or as determined through coordination with NMFS and/or USFWS.
	Recreation Resources	
	TEST33	Where it is documented that float-boating activities may have an adverse effect on TEPC species, consult with USFWS and/or NMFS to determine what action is appropriate and necessary to minimize or avoid those effects.
	TEST34	Allow no net increase in groomed or designated over-the-snow routes or play areas, outside of baseline areas of consistent snow compaction, by LAU or in combination with immediately adjacent LAUs unless the Biological Assessment demonstrates the grooming or designation serves to consolidate use and improve lynx habitat. This does not apply within permitted ski area boundaries, to winter logging, and access to private inholdings. Also, permits, authorizations or agreements could expand into baseline routes and baseline areas of existing snow compaction, and grooming could expand to routes of existing snow compaction and routes that have been designated but not groomed in the past and still comply with this standard.
	See also Standards for Wildlife Resource (02, 03, 04); Fire Management (01, 02, 03); and Non-native Plants (01-12); and Tribal Rights and Interests (01).	
Guidelines	TEGU01	Discretionary actions should avoid take of listed species, and actions where the Forest's discretion is limited should minimize adverse effects that could lead to a take.
	TEGU02	For proposed actions that may affect potential habitat of TEPC species, identify potential habitat and determine species presence within or near the project area. Document the rationale for not identifying potential habitat and determining species presence for TEPC species in the project record.
	TEGU03	Management actions in occupied Proposed or Candidate species habitat should be modified or relocated if the effects of the actions would contribute to a trend toward ESA listing for these species.
	TEGU04	The Forest should cooperate with USFWS and NMFS, as appropriate, by providing information, data, and assistance for the development of recovery plans for species listed under the ESA.
	TEGU05	The Forest should cooperate with USFWS and NMFS, as appropriate, by providing information, data, and assistance for the evaluation of species that are petitioned, or proposed, or candidates to be listed under the ESA, and for evaluation of proposed critical habitat.

Management Direction for Threatened, Endangered, Proposed, and Candidate Species		
Type	**Number**	**Direction Description**
Guidelines	TEGU06	Coordinate with Forest resource specialists to consider TEPC habitat needs when designing and implementing management activities that may affect TEPC species and their habitats.
	Botanical Resources	
	TEGU07	During site/project-scale analysis and review, a Forest botanist should review insecticide or herbicide spray plans and prescribed burning plans to determine whether effects to TEPC plant species and their pollinators should be mitigated, through avoidance or minimization.
	Fire Management	
	TEGU08	Fire Resource advisors should be trained in techniques to mitigate, through avoidance or minimization, adverse effects to TEPC species.
	Rangeland Resources	
	TEGU09	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Lands and Special Uses	
	TEGU10	Land exchanges that would result in a net loss of quality or quantity of habitat for TEPC species should not be considered unless benefits of the exchange outweigh the benefits to those species in the long term.
	TEGU11	The Federal Energy Regulatory Commission should be notified that hydroelectric proposals in watersheds with TEPC fish species, and/or occupied TEPC plant habitat are inconsistent with Forest Plan management objectives when adverse effects can not be effectively avoided for plant species or avoided or minimized for TEPC fish species.
	TEGU12	Where the authority to do so was retained, proposed or existing special use authorizations should be issued, re-issued, or amended upon expiration, only if adverse effects of the authorizations on TEPC species can be minimized.
	Facilities and Roads	
	TEGU13	To protect TEPC plant species and their occupied habitat, water supply points, service areas, and other needs for road and facility construction projects should be specified in project planning and used in project implementation.
	TEGU14	For watersheds with listed aquatic species, essential fish habitat, or designated critical habitat, transportation system design criteria for fish passage should be coordinated with NMFS or USFWS, as appropriate.
	See also Guidelines for Botanical Resources (01, 02, 03, 04); Non-native Plants (01, 03, 05); Fire Management (03, 05); Lands and Special Uses (01, 09, 12, 13, 18); and Facilities and Roads (09, 11).	

Air Quality and Smoke Management

Forest Service Manual and Handbook management direction for air quality, smoke management and Fire Management Plans is in FSM 2500 - Watershed and Air Management, and FSM 5100 - Fire Management, and FSH 5109.19. – Fire Management Analysis and Planning Handbook.

DESIRED CONDITION

People visiting the National Forest have the opportunity to experience clean air and spectacular vistas in a natural setting, while recognizing that those vistas may be affected periodically by smoke from management actions or wildfires. Smoke emissions from wildland fires do not exceed the estimated historical frequency and distribution for the various vegetation types across the Forest. Ambient air quality and visibility across the Forest are within federal and state standards

Management Direction for Air Quality and Smoke Management

Type	Number	Direction Description
Goals	ASGO01	Meet federal and state ambient air quality and visibility standards and other applicable air quality direction.
	ASGO02	Manage smoke, while achieving land management objectives, to provide for desirable air quality and visibility.
Objectives	ASOB01	Comply with federal, state, and local requirements relating to the Clean Air Act. This includes, but is not limited to, participating in the respective state's Smoke Management Programs, and following State Implementation Plans.
	ASOB02	Within five years or within the timeframe required by the respective (i.e., Idaho and Utah) State Implementation Plans, develop emissions data and trend information for fire use to be stored in a centralized database. Use data to document meeting Regional Haze requirements established by the State.
	ASOB03	Use a variety of management tools, including prescribed fire and Wildland Fire Use (for Resource Benefits), to help manage vegetation to reduce potential smoke impacts from uncharacteristic wildfire.
	ASOB04	Provide educational and interpretive exhibits, displays, and programs to increase public awareness and understanding of smoke emissions from fire use and wildfire, the tradeoffs between the two, and the benefits of fuel reduction and smoke management techniques.
	ASOB05	When developing and implementing fire use projects, inform the public about potential smoke impacts to health and safety.
Standards	ASST01	Prescribed fire operations shall be conducted consistent with the state's smoke management program.
	ASST02	Adhere to the operations and procedures of the Montana/Idaho Airshed Group and the Utah Interagency Smoke Management Program to limit potential unacceptable smoke impacts. Further restrict burning activities if local conditions indicate potential unacceptable smoke impacts to ambient air quality and/or visibility.
	ASST03	Apply control measures as directed by the appropriate DEQ during air pollution episodes (e.g., no new ignitions during declared episodes).

Management Direction for Air Quality and Smoke Management

Type	Number	Direction Description
Guidelines	ASGU01	In addition to identifying applicable regulations, plans, and policies important to project design of prescribed fire activities, air quality and visibility impact evaluations should also consider other sources of emissions; identify sensitive areas; include descriptions of planned measures to reduce smoke impacts as appropriate; identify the potential risk for smoke intrusions into sensitive areas; and describe ambient air monitoring plans, when appropriate.
	ASGU02	Consider and evaluate the impacts of smoke on sensitive areas (e.g., Class I, non-attainment or maintenance areas, population centers, etc.) within an appropriate area of consideration. A 100-kilometer (approximately 62 miles) distance surrounding the project area should be the initial area of consideration. Air quality modeling should be used to support evaluations when possible. Particulate matter is currently the primary pollutant of concern for air quality evaluations related to Forest management activities for compliance with National Ambient Air Quality Standards (NAAQS).
	ASGU03	Fire Management Plans should outline a process to consider smoke impacts resulting from Wildland Fire Use and suppression activities.
	ASGU04	Annually and/or seasonally communicate with the public regarding planned amounts of prescribed burning and potential smoke impacts. Especially near population centers, communication should be aimed at minimizing concerns about health and safety related to smoke.

Soil, Water, Riparian, and Aquatic Resources

Forest Service Manual and Handbook management direction for riparian, soil, water and aquatic resources is in Forest Service Manuals 2500 - Watershed and Air Management, 2600 - Wildlife, Fish, and Sensitive Plant Habitat Management, and 3500 - Cooperative Watershed Management; and in Forest Service Handbooks: 2500, 2509.13 - Burned-Area Emergency Rehabilitation Handbook, 2509.18 - Soil Management Handbook, and 2509.22 - Soil and Water Conservation Handbook.

DESIRED CONDITION

Soil protective cover, soil organic matter, and coarse woody material are at levels that maintain or restore soil productivity and soil-hydrologic functions where conditions are at risk or degraded. Soils also have adequate physical, biological, and chemical properties to support desired vegetation growth. Riparian and aquatic ecosystems have appropriate types and amounts of vegetation. There is sufficient large woody debris appropriate for land and stream channel forms to maintain water quality, filter sediment, aid floodplain development, improves floodwater retention and groundwater recharge, and contributes to diverse habitat components. Management actions result in no long-term degradation of soil, water, riparian, and aquatic resources conditions. Instream flows are sufficient to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges, and provide for downstream uses. Wetlands and floodplains are maintained where they are properly functioning, and restored where degraded. Improving watershed conditions contribute to the de-listing of water quality limited water bodies to meet Clean Water Act requirements. Public waters are restored where water quality does not support beneficial uses and otherwise are maintained or improved.

Distribution of native and desired non-native fish and other aquatic species is maintained or is expanding into previously occupied habitat, with inter-connectivity between and within meta-populations. The amount, distribution, and characteristics of life-stage habitats are present to maintain or reach viable populations of native and desired non-native species. Habitat conditions prevent further listing of species under the Act or adding species to the Region 4 Sensitive Species list. Efforts are in place to prevent new introductions of undesirable non-native fish species and to reduce degrading effects from past introductions. Habitat provides fish populations for recreational, cultural, and commercial significance. Human activities do not prevent populations from maintaining distribution and abundance during critical life stages. Restoration activities have resulted in maintaining necessary water temperatures, reducing pollutants such as sediment, and removing human-caused barriers to fish passage to restore population and habitat connectivity where genetic contamination to native fish species from exotic species is not an issue.

Management Direction for Soil, Water, Riparian, and Aquatic Resources

Type	Number	Direction Description
Goals	**Soil Processes and Productivity**	
	SWGO01	Maintain soil productivity and ecological processes where functioning properly, and restore where currently degraded. Maintain the physical, chemical, and biological properties of soils to support desired vegetation conditions and soil-hydrologic functions and processes within watersheds.
	Hydrology and Watershed Processes	
	SWGO02	Provide for stream channel integrity, channel processes, and the sediment regime under which the riparian and aquatic ecosystems evolved.
	SWGO03	Maintain surface and ground water in streams, lakes, wetlands, and meadows to support healthy riparian and aquatic habitats; the stability and effective function of stream channels; and downstream uses.
	SWGO04	Restore and maintain flow regimes sufficient to create and sustain soil-hydrologic and water quality conditions, and riparian, aquatic and wetland habitats, and to achieve patterns of sediment, and nutrient and large woody debris routing within their inherent range of capability.
	Water Quality	
	SWGO05	Design and implement watershed management programs and plans that will restore water quality and watershed function to support beneficial uses.
	SWGO06	Meet or surpass State water quality standards by planning and designing land management activities that protect water quality.
	SWGO07	Provide water quality for stable and productive riparian and aquatic ecosystems while fully supporting appropriate beneficial uses.
	SWGO08	Manage water quality to meet requirements under the Clean Water Act and Safe Drinking Water Act, with special emphasis on de-listing water quality limited water bodies under Section 303(d) and supporting state development and implementation of TMDLs.
	SWGO09	Promote integration of planning, analysis, implementation, and monitoring efforts that support the ESA, Magnuson-Stevens Act, and Clean Water Act requirements.
	Aquatic and Riparian Habitat and Species	
	SWGO10	Provide riparian and aquatic habitat capable of supporting viable populations of native and desired non-native aquatic species.
	SWGO11	Manage human-caused disturbances to avoid or reduce degrading effects to aquatic populations, particularly during critical life stages.
	SWGO12	Provide habitat that will help keep aquatic Region 4 sensitive species from becoming listed (see Appendix E for current list of species).
	SWGO13	Provide habitat capable of supporting viable populations of aquatic Management Indicator Species (see Appendix E for current list of species).
	SWGO14	Diversity and productivity of native and desired non-native plant communities in riparian conservation areas: a) Provide amounts and distribution of large woody debris consistent with desired forest vegetation conditions described in Appendix A; b) Provide adequate summer and winter thermal regulation within the aquatic and riparian zones; and c) Achieve rates of surface erosion, bank erosion, and chemical migration characteristic of those under which the communities developed.
	SWGO15	Provide habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.
	See also Goals for TEPC Species (01, 02, 03, 04, 05, 06); Vegetation (04); Rangeland Resources (03, 05); Recreation Resources (04); and Heritage Program (03).	

Management Direction for Soil, Water, Riparian, and Aquatic Resources		
Type	**Number**	**Direction Description**
Objectives	**Soil Processes and Productivity**	
	SWOB01	Continue to maintain and update the landslide prone database to assist in identifying landslides and predicting landslide-prone areas.
	SWOB02	During fine-scale analysis, identify opportunities using fuels management activities to reduce the risk of post-wildfire watershed runoff in subwatersheds with potential threats to life and property.
	SWOB03	During fine-scale analysis, identify opportunities to restore degraded soil productivity and processes.
	Hydrology and Watershed Processes	
	SWOB04	In cooperation with affected state, tribal, and local governments, holders of water rights, and other interested parties, quantify and seek to obtain federal water rights under the appropriate state and federal laws and Forest Service policy for consumptive and instream water uses needed to carry out National Forest multiple use objectives on National Forest System lands.
	Water Quality	
	SWOB05	Cooperate with the State, Tribes, other agencies and organizations to develop and implement Total Maximum Daily Loads (TMDLs) and their implementation plans for 303d impaired water bodies influenced by National Forest System management.
	SWOB06	Work with State, Tribes, other agencies and organizations to prioritize restoration needs and to bring 303d impaired water bodies into compliance with State water quality standards in a reasonable timeframe.
	SWOB07	Work within the State's timelines to assist the State in the identification of 303d impaired water bodies, development of TMDLs, and development of TMDL Implementation Plans.
	SWOB08	Work with the State of Idaho to validate whether their listings of 303d water bodies are correct or whether the water bodies have been restored adequately so that they can be considered for de-listing.
	SWOB09	Using watershed condition indicators (refer to Appendix B), update the environmental baseline biennially when new information is available through sources such as subbasin assessments, mid- or project-scale analysis, inventories, or Forest-wide monitoring. Use this information to update the Watershed and Aquatic Recovery Strategy.
	SWOB10	Coordinate with municipalities to ensure that management actions are consistent with water quality requirements within municipal watersheds.
	Aquatic and Riparian Habitat and Species	
	SWOB11	Coordinate with state and local agencies and tribal governments annually to limit or reduce degrading effects from stocking programs on native and desired non-native fish and aquatic species.
	SWOB12	Design and implement management actions so they do not fragment habitat for native and desired non-native fish species. Restore connectivity in currently fragmented habitat where the risk of genetic contamination, predation, or competition from exotic fish species is not a concern.
	SWOB13	During fine and site/project-scale analysis, identify and prioritize opportunities for restoration of habitat linkage to promote genetic integrity and species distribution.
	SWOB14	Prioritize improvements to existing culverts, bridges, and stream crossings identified for fish passage and associated bedload and debris problems, based on the Watershed Aquatic Recovery Strategy (WARS) Map, fine-scale analyses and/or project-level priorities.
	SWOB15	Maintain and update species occurrence and habitat maps for Forest species (e.g., MIS and Region 4 Sensitive species) during fine and site/project-scale analyses.
	SWRA Restoration	

Management Direction for Soil, Water, Riparian, and Aquatic Resources		
Type	**Number**	**Direction Description**
Objectives	SWOB16	During fine-scale analysis, identify opportunities to restore degraded upland and aquatic habitat conditions in order to support productive and diverse populations of native and desired non-native aquatic species to meet social needs and tribal interests. Opportunities should focus on restoring passage for fish and other aquatic species, and restoring desired ranges of water temperature, large woody debris, streambank stability, sediment levels, water chemistry, and pool size and numbers. Refer to the Watershed Condition Indicators in Appendix B.
	SWOB17	Biennially, maintain and update the Watershed and Aquatic Recovery Strategy (WARS) using the Watershed and Aquatic Recovery Strategy prioritization process, or other appropriate methodologies.
	SWOB18	Reduce road-related effects on soil productivity, water quality, and aquatic/riparian species and their habitats. Refer to the Watershed and Aquatic Recovery Strategy (WARS) for mid-scale prioritization indicators to assist in fine and site/project scale restoration prioritization planning.
	SWOB19	Identify and capitalize on funding opportunities to assist in the restoration of aquatic habitat and watershed conditions important to the recovery of listed fish species and de-listing of 303(d) impaired water bodies. Examples of potential funding sources include the State Clean Water Act 319 funds, Federal Columbia River Power System Re-licensing funds, and funds from the Northwest Power Planning Council, public and private partnerships.
	SWOB20	As requested by the lead agency, coordinate data exchange and provide review/input into subbasin planning efforts undertaken by the State Office of Species Conservation, the Northwest Power Planning Council (NWPPC), Tribes, and local watershed advisory groups.
	See also Objectives for Rangeland Resources (03); Mineral and Geology Resources (08, 09); Lands and Special Uses (12); Facilities and Roads (04, 10, 11, 12); Recreation Resources (01, 10); Heritage Program (18); Tribal Rights and Interests (03); and Wilderness, Recommended Wilderness, and Inventoried Roadless Areas (02).	
Standards	**General**	
	SWST01	Management actions shall be designed in a manner that maintains or restores water quality to fully support beneficial uses and native and desired non-native fish species and their habitat, except as allowed under SWRA Standard #4 below. Use the MATRIX located in Appendix B to assist in determining compliance with this standard.
	Soil Processes and Productivity	
	SWST02	Management activities that may affect soil detrimental disturbance (DD) shall meet the following requirements: a) In an activity area where existing conditions of DD are below 15 percent of the area, management activities shall leave the area in a condition of 15 percent or less detrimental disturbance following completion of the activities. b) In an activity area where existing conditions of DD exceed 15 percent of the area, management activities shall include mitigation and restoration so that DD levels are moved back toward 15 percent or less following completion of the activities. To estimate soil DD, it is essential that the glossary definitions for *activity area*, *detrimental soil disturbance* and *total soil resource commitment* (TSRC) are clearly understood.
	SWST03	Management activities that may affect TSRC shall meet the following requirements: a) In an activity area where existing conditions of TSRC are below 5 percent of the area, management activities shall leave the area in a condition of 5 percent or less TSRC following completion of the activities. b) In an activity area where existing conditions of TSRC exceed 5 percent of the area, management activities shall include mitigation and restoration so that TSRC levels are moved back toward 5 percent or less following completion of the activities. To estimate TSRC, it is essential that the glossary definitions for *activity area*, *detrimental soil disturbance* and *total soil resource commitment* are clearly understood.

Management Direction for Soil, Water, Riparian, and Aquatic Resources		
Type	**Number**	**Direction Description**
Standards	**Hydrology and Watershed Processes**	
	SWST04	Management actions will neither degrade nor retard attainment of properly functioning soil, water, riparian, and aquatic desired conditions, except: a) Where outweighed by demonstrable short- or long-term benefits to watershed resource conditions; or b) Where the Forest Service has limited authority (e.g., access roads, hydropower, etc.). In these cases, the Forest Service shall work with permittee(s) to minimize the degradation of watershed resource conditions. Use the MATRIX located in Appendix B to assist in determining compliance with this standard.
	SWST05	Management actions within RCAs that are associated with valid existing rights—such as mining, water diversions, and hydro-power—shall be coordinated with licensees, permittees, or claimants in an effort to maintain or restore beneficial uses and desired habitat conditions for native and desired non-native fish.
	SWST06	In cooperation with affected state, tribal, and local governments, holders of water rights, and other interested parties, determine instream flows needed for protection of water-related resources when assessing permit or license actions such as mining claim development, hydropower development, snowmaking, or water transmission facilities. When determining the sufficient quality, quantity, and timing of flows, use the following four factors: (a) maintenance and restoration of habitat for fish, wildlife, and riparian plant communities; (b) maintenance of channel stability and capacity for passing floods; (c) maintenance of recreational opportunities such as fishing, swimming, boating, and aesthetic enjoyment; and (d) maintenance of water quality and natural temperature regimes. Make sufficient flows a condition of permit or license issuance.
	Water Quality	
	SWST07	Within legal authorities, ensure that new proposed management activities within watersheds containing 303(d) listed water bodies improve or maintain overall progress toward beneficial use attainment for pollutants that led to the listing.
	Aquatic and Riparian Habitat and Species	
	SWST08	Fish passage shall be provided at all proposed and reconstructed stream crossings of existing and potential fish-bearing streams unless protection of pure-strain native fish enclaves from competition, genetic contamination, or predation by exotic fishes is determined to be an overriding management concern.
	SWST09	In fish-bearing waters, do not authorize new surface diversions unless they provide upstream and downstream fish passage and, if needed, include either fish screens or other means to prevent fish entrapment/entrainment.
	SWST10	Trees or snags that are felled within RCAs must be left unless determined not to be necessary for achieving soil, water, riparian, and aquatic desired conditions. Felled trees or snags left in RCAs shall be left intact unless resource protection (e.g., the risk of insect infestation is unacceptable) or public safety requires bucking them into smaller pieces.
	SWST11	Do not authorize storage of fuels and other toxicants or refueling within RCAs unless there are no other alternatives. Storage of fuels and other toxicants or refueling sites within RCAs shall be approved by the responsible official and have an approved spill containment plan commensurate with the amount of fuel.
	SWST12	Site-specific analysis or field verification of broad-scale landslide-prone models shall be conducted in representative areas that are identified as landslide prone during site/project-scale analysis involving proposed management actions that may alter soil-hydrologic processes. Based on the analysis findings, design management actions to avoid the potential for triggering landslides. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B to help determine compliance with this standard.

Management Direction for Soil, Water, Riparian, and Aquatic Resources

Type	Number	Direction Description
Standards	*See also Standards for Vegetation (01); Fire Management (01, 02, 03); Timberland Resources (04, 05, 07, 08); Rangeland Resources (01, 02, 03, 04); Mineral and Geology Resources (01, 03, 04, 08, 09); Lands and Special Uses (07, 11, 12, 13, 14); Facilities and Roads (01, 02, 04, 05); Recreation Resources (02, 05); and Tribal Rights and Interests (03).*	
Guidelines	**General**	
	SWGU01	Federal, state, county, tribal, and regulatory agency priorities should be considered early in the process of subbasin review, fine- and site/project-scale analyses, and restoration priorities to help ensure priorities complement each other where possible, or at least minimize conflicts.
	SWGU02	When doing fine-scale assessments, the MATRIX in Appendix B should be used to assist in establishing reference and current conditions. Based on a comparison of current and desired conditions, identify management opportunities for watershed and aquatic restoration.
	Soil Processes and Productivity	
	SWGU03	Where proposed management actions may alter soil-hydrologic processes, representative sample of landslides and landslide-prone areas should be field-verified to identify and interpret controlling and contributing factors of slope stability. Integrate the resulting information with supporting data to provide a final stability assessment and identification of appropriate land management actions in landslide and landslide-prone areas. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.
	SWGU04	General Field Verification Procedures for Landslide and Landslide-Prone Areas: Six major groups of known characteristics should be investigated to supply information adequate to characterize unstable conditions. These are: a) Landform b) Overburden c) Geological Processes on the Hillslope d) Bedrock Lithology and Structure e) Hydrology f) Vegetation. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.
	SWGU05	After completion of ground-disturbing activities in a watershed, the minimum ground cover should be sufficient to prevent erosion from exceeding the range of soil erosion rates that are characteristic of the local soil type, landform, climate, and vegetation of the area, or the soil-loss tolerance.
	Hydrology and Watershed Processes	
	SWGU06	When assessing projects where there is a need to determine appropriate water management strategies to maintain instream flows, cooperate with affected State, Tribal, and local governments, holders of water rights, and other interested parties. These flows should incorporate: (a) summer and winter base flows to maintain or restore habitat for resident and anadromous fish species and riparian vegetation, (b) a peak flow component to maintain fish habitat, channel capacity, and riparian vegetation, and (c) a gradual rising and falling hydrograph limb during spring runoff to protect bank stability, fish habitat, and trigger fish behavioral patterns, such as migration.
	Water Quality	
	SWGU07	Projects in watersheds with 303(d) listed water bodies should be supported by the appropriate scale and level of analysis sufficient to permit an understanding of the implications of the project within the larger watershed context.

Management Direction for Soil, Water, Riparian, and Aquatic Resources		
Type	**Number**	**Direction Description**
	SWGU08	Proposed actions analyzed under NEPA should adhere to the State Nonpoint Source Management Plan to best achieve consistency with both Sections 313 and 319 of the Federal Water Pollution Control Act.
Guidelines	SWGU09	Project proposals that may affect water quality should answer the 11 questions outlined in the Idaho Nonpoint Source Management Plan (or as updated) to achieve federal consistency with the Clean Water Act as implemented by the State.
	Aquatic and Riparian Habitat and Species	
	SWGU10	Stocking of non-native fish species in high-mountain and other Forest lakes and streams should be discouraged if stocking imperils the inherent composition, structure, or function of the lake or stream ecosystems. Coordinate management of these ecosystems with Idaho Department of Fish and Game and tribal governments.
	SWGU11	Transport hazardous materials on the Forest in accordance with 49 CFR 171 in order to reduce the risk of spills of toxic materials and fuels during transport through RCAs.
	SWGU12	During site/project-scale analyses, habitat should be determined for sensitive aquatic species within or near the project area. Surveys to determine presence should be conducted for those species with suitable habitat. Document the rationale for not conducting surveys for other species in the project record.
	SWGU13	In intermittent and perennial non-fish bearing waters, new surface diversions should not be authorized unless they provide passage and habitat for native and desired non-native aquatic species other than fish. Flows that are adequate to pass fish would also be sufficient to pass other aquatic species in intermittent and perennial non-fish bearing waters.
	See also Guidelines for Fire Management (02, 03, 05, 06); Rangeland Resources (01, 02, 04, 05, 06, 07); Minerals and Geology (06, 07, 09, 10, 11); Lands and Special Uses (01, 09, 12, 13, 18); and Facilities and Roads (01, 05, 06, 07, 09, 11).	

Wildlife Resources

Forest Service Manual and Handbook management direction for wildlife resources is in FSM 2600 - Wildlife, Fish, and Sensitive Plant Habitat Management, and in FSH 2609.13 - Wildlife and Fisheries Program Management Handbook.

DESIRED CONDITION

The amount, distribution, and characteristics of source habitat are present at levels necessary to support persistence of native and desired non-native wildlife species within their respective ranges across the planning unit. For Region 4 Sensitive species, management actions retain desired source habitat conditions, or lead to restoration of those conditions. Habitat conditions contribute to the persistence of species and do not lead to listing under the ESA or as a Region 4 Sensitive Species. Human activities do not affect source environments in a manner that prevents wildlife populations from attaining desired distribution and abundance during critical life stages. Habitat conditions support sustainability of species of socio-economic and tribal interest.

Management Direction for Wildlife Resources		
Type	**Number**	**Direction Description**
Goals	**General**	
	WIGO01	Source habitats are well distributed and connected across the planning unit and support a diversity of native and desired non-native wildlife consistent with overall multiple-use objectives.
	WIGO02	Levels of human caused disturbance do not cause undesirable effects to wildlife populations during critical life stages.
	WIGO03	Source habitats within the planning unit support sustainable wildlife populations that contribute to socio-economic and tribal needs.
	Region 4 Sensitive Species	
	WIGO04	Region 4 sensitive species source habitats are well distributed and connected across the planning unit and contribute to the removal of species from the sensitive species list.
	WIGO05	Deleted, as part of 2010 Forest Plan amendment for WCS.
	WIGO06	Deleted, as part of 2010 Forest Plan amendment for WCS.
	See also Goals for TEPC Species (01, 02, 03, 04, 05, 06); Vegetation (01, 02, 05, 06, 07); Non-native Plants (04); Timberland Resources (05); Fire Management (03); Recreation Resources (04, 06); and Heritage Program (03).	
Objectives	**General**	
	WIOB01	During fine-scale analyses, identify and prioritize opportunities for restoration of source habitat linkage to promote genetic integrity and wildlife species distribution.
	WIOB02	During site/project-scale analyses, identify non-vegetated wintering and denning wildlife source habitats (caves, talus slopes, etc.) when it is determined that the proposed activity may measurably reduce the quality of those habitats.
Objectives	WIOB03	Prioritize wildlife source habitats to be restored at a mid- or Forest-scale, using information from sources such as species habitat models, and fine-scale analyses. Update priorities at least every 10 years to reflect changes in resource conditions. Incorporate priorities into the plan level Wildlife Conservation Strategy (WCS) and display on the combined Vegetative and Wildlife Habitat Restoration Strategy Map.

Management Direction for Wildlife Resources		
Type	**Number**	**Direction Description**
	WIOB04	Coordinate animal damage management with the Animal and Plant Health Inspection Service (APHIS), in compliance with USDA Wildlife Services' most current direction for southern Idaho.
	WIOB05	Identify existing and potential areas where wildlife mortality from vehicles may be a concern. Work with the state and county road agencies to reduce the potential for vehicle-caused mortality.
	WIOB06	Enhance public awareness of wildlife habitat management and species conservation through educational and interpretive programs.
	WIOB07	Deleted, as part of 2010 Forest Plan amendment for WCS.
	WIOB13	Focus source habitat maintenance and restoration activities in priority watersheds identified in the WCS and displayed on the combined *Vegetative and Wildlife Habitat Restoration Strategy Map*. Within these priority watersheds, emphasize the maintenance and restoration of old forest habitat in non-lethal and mixed-1 fire regimes. Refer to related objective, VEOB08.
	WIOB14	Coordinate research efforts associated with species of conservation concern to determine basic life history requirements with potential effects from management activities. Coordinate efforts and information with the Idaho Department of Fish and Game, universities, Forest Service Research Stations, and other federal land management agencies.
	WIOB15	Work with the Idaho Department of Fish and Game to address species and habitat needs as identified in the Idaho Comprehensive Wildlife Conservation Strategy.
	WIOB16	Reduce road-related effects on sensitive wildlife species and their habitats. Refer to the conservation principles in Appendix E and the *Vegetation and Wildlife Habitat Restoration Strategy* and *Source Environment Restoration Strategy Maps* to assist in fine and site/project scale restoration prioritization planning.
	Region 4 Sensitive Species	
	WIOB08	Continue to map locations of species occurrence and habitat for Region 4 Sensitive species during fine- and site/project scale analyses. Update appropriate Agency database modules for sensitive species occurrence and habitat on a biennial basis. Use this information to support refinements of species-habitat relations models at least every 5 years.
	WIOB09	During fine-scale analyses, prioritize opportunities for restoration of sensitive species habitat consistent with the wildlife conservation strategy and vegetation restoration priorities.
	WIOB10	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Big Game	
	WIOB11	Work with Idaho Department of Fish and Game to address their species plan objectives when Forest Service management activities may affect those objectives.
	WIOB12	Implement temporary, seasonal, or permanent area and transportation route closures through special orders to address big game vulnerability and public access needs. Coordinate closures with appropriate state agencies, other federal agencies, and tribal governments.
	See also Objectives for TEPC Species (11, 12, 13, 14); SWRA Resources (13); Vegetation (01); Rangeland Resources (03); Facilities and Roads (04, 12); Recreation Resources (19, 22, 24, 25); and Heritage Program (18).	
Standards	**General**	
	WIST01	Deleted, as part of 2010 Forest Plan amendment for WCS.

Management Direction for Wildlife Resources

Type	Number	Direction Description
	WIST08	Retain forest stands[5] that meet the definition of old forest habitat for the applicable PVG (refer to Appendix E). Management actions are permitted in such stands as long as they will continue to meet the definition of old forest habitat.[6]
	WIST09	Management actions within large or medium-size class forested stands (Appendix A definition) that have the species composition required to achieve old forest habitat for the applicable PVG (Appendix E definition) shall contribute to or not preclude[7] restoration of old forest habitat.[2]
	Region 4 Sensitive Species	
Standards	WIST02	Design and implementt projects within occupied habitats of Sensitive species to help prevent them from becoming listed. Use Forest Service-approved portions of Conservation Strategies and Agreements, as appropriate, in the management of Sensitive species habitat to keep management actions from contributing to a trend toward listing for these species.
	WIST03	Mitigate management actions within known nesting or denning sites of sensitive species if those actions would disrupt the reproductive success of those sites during the nesting or denning period. Mitigation measures shall be determined during project planning.
	WIST04	Mitigate management actions within known winter roosting sites or hibernacula (bats) of Sensitive species if those actions would measurably reduce the survival of wintering or roosting populations. Sites, periods, and mitigation measures will be determined during project planning.
	WIST05	In goshawk territories with known active nest stands, identify alternate and replacement nest stands during project-level planning when it is determined that the proposed activity is likely to degrade nest stand habitat.
	Big Game	
	WIST06	Mitigate human-caused disturbances within winter/spring ranges if disturbances cause displacement of wildlife while they are occupying those ranges.
	WIST07	Big game requirements for space and forage have priority in the management of winter range used in common by livestock and big game.
	See also Standards for TEPC Species (12, 13, 14, 15); SWRA Resources (01, 04, 06); Vegetation (01, 03); Timberland Resources (02, 03, 08); Rangeland Resources (01); Recreation Resources (05); and Mineral and Geology Resources (01).	
Guidelines	**General**	
	WIGU01	Deleted, as part of 2010 Forest Plan amendment for WCS.
	WIGU02	Inventories of bat hibernacula or maternity colonies should be typically limited to no more than once a year, to reduce disturbance. Follow approved methods for inventory or monitoring techniques.
	WIGU03	Bat passage gates that restrict human access should be evaluated and installed if needed in abandoned mines that are used by bats and are scheduled for closure.

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[5] Forest Stand—A contiguous group of trees sufficiently uniform in age class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged, and uneven-aged stands. A stand is the functional unit of silviculture reporting and record-keeping. Stand may be analogous to Activity Area. In the Intermountain Region, contiguous groups of trees smaller than 5 acres are not recorded or tracked. (Definitions, FSH 2470, 08-13-2004.)

[6] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with. This standard does not apply to PVG 10.

[7] Preclude—To put a barrier before; hence, to shut out; to hinder; to stop; to impede. (The Collaborative International Dictionary of English v. 0.44).

Management Direction for Wildlife Resources		
Type	**Number**	**Direction Description**
	WIGU04	When Forest highway[8] construction or reconstruction is proposed in habitat linkage areas, identify potential highway crossings and incorporate into project design as needed to facilitate habitat linkage needs for species of concern. Refer to Source Environment Restoration Strategy Map for latest linkage information.
	WIGU15	The Conservation Principles (CPs) found in Appendix E should be used to assist in identifying treatment priorities within watersheds, designing treatments for wildlife habitat restoration, and understanding the effects of proposed activities on wildlife habitat.
	WIGU16	Management indicator species (MIS) and their habitat should be monitored annually. Relationships between habitat changes and population trends of MIS should be evaluated periodically. Where practicable, monitoring should be done in cooperation with State fish and game agencies.
	WIGU17	Winter recreation use in high-elevation habitats characteristic of wolverine denning habitat should be monitored annually (refer to Chapter IV, Monitoring Elements). Relationships between winter recreation activities and wolverine use of the landscape should be evaluated periodically. Where practicable, monitoring should be done in cooperation with State fish and game agencies.
	WIGU18	Where possible, projects should be designed to meet both hazardous fuel reduction and wildlife habitat conservation/ restoration objectives. Standards WIST-08, WIST-09, VEST-03, and MPC specific standards concerning snag retention[9] may be waived for management activities within the wildland urban interface ("WUI") where the authorized officer determines that adherence to these standards would impair achievement of hazardous fuel reduction objectives. The authorized officer has discretion to make this determination.
	Region 4 Sensitive Species	
	WIGU05	Source habitat should be determined for Sensitive wildlife species within or near the project area during site/project scale analyses. Surveys to determine presence should be conducted for those species for which source habitat is identified.
	WIGU06	Management actions in occupied Sensitive species habitat should be modified or relocated if the effects of the actions would contribute to a trend toward ESA listing for these species.
	WIGU07	Use appropriate research to help define active, alternate, and replacement nest stands for goshawks, and configuration of post-fledging areas.
	Big Game	
Guidelines	WIGU08	Big game vulnerability to road related mortality should be evaluated during mid-, fine- or site/project-level travel management planning to help assess effects of potential travel management decisions on state population objectives.

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[8] Forest Highway—A designated forest road under the jurisdiction of, and maintained by, a public authority that is subject to the Highway Safety Act. The planning process is a cooperative effort involving the State(s), Forest Service, and the Federal Highway Administration. The location and need for improvements for these highways depend on the relative transportation needs of the various element of the National Forest System (23 CFR 660.107). The determination of relative needs involves the analysis of access alternatives associated with Forest Service programs and general public use. The basis for access needs is established in the Forest Plan. (FSM 7740.5 and 7741.)

[9] MPC 4.2, 5.1 and 6.1 standard: "For commercial salvage sales, retain at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6."

MPCs 3.1, 3.2, 4.1c standard: "Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6."

Management Direction for Wildlife Resources		
Type	**Number**	**Direction Description**
	WIGU09	Even-aged regeneration cuts should be considered to provide big-game hiding cover when the vegetation conditions in the unit meet the definition of hiding cover in the Glossary.
	WIGU10	Fencing needs for big-game passage should be determined through a field review during AMP updates. Fences on elk and deer winter/spring ranges and antelope ranges that prohibit passage should be relocated or modified to permit passage.
	WIGU11	Management actions should neither degrade or retard attainment of winter range desired conditions except where outweighed by demonstrable short- or long-term benefits to winter range or where the Forest Service has limited authority.
	WIGU12	Calving and fawning areas should be protected from project-related disturbance during big game calving or fawning. Calving/fawning areas and periods should be determined during site/project-level planning.
	WIGU13	To address big game vulnerability to mortality, components of habitat security should be identified and managed during project planning and implementation. Management requirements or mitigation measures needed to maintain these components should be determined during site/project-level planning. Consider components such as big game wallows and licks, public access, wildlife travel routes, created openings, meadows, forested stringers, and winter/spring ranges.
	WIGU14	To address big game stress and exposure during critical wintering periods, thermal cover components on winter/spring ranges should be identified and managed during project planning and implementation. Management requirements or mitigation measures needed to maintain these components should be determined during site/project-level planning. As a general guideline, at least 15 percent thermal cover should be retained on big game winter ranges where this cover presently exists. Cover should be maintained in at least 30-acre patch sizes where available. Thermal and hiding cover may or may not occur on the same acres.
	See also Guidelines for Vegetation (01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11); Rangeland Resources (02, 05, 09); Lands and Special Uses (01, 09, 13, 14); Facilities and Roads (04, 09); and Recreation Resources (09, 10).	

Vegetation

Forest Service Handbook management direction for vegetation is in FSH 2409.17 - Silvicultural Practices Handbook. Forest Service Manual and Handbook management direction for snags and coarse woody debris is in FSM 5150 – Fuels, FSM 2550 - Soil Management, and FSH 2509.18 - Soil Management Handbook. Direction for Threatened, Endangered, and Sensitive Plants is in FSM 2670 - Threatened, Endangered, and Sensitive Plants and Animals.

DESIRED CONDITION

Forested Vegetation

Forested vegetation reflects a combination of successional development, disturbance regimes, and management activities. Forested lands exhibit variable patterns of size classes, densities, structural stages, and species composition. Seral tree species such as ponderosa pine, Douglas-fir, aspen, and whitebark pine have increasing species composition in areas where fire and mechanical vegetation treatments are the primary tools. In areas where vegetation development evolves primarily as a result of plant succession rather than disturbance, late-seral/climax species composition and moderate to high canopy densities will increase. Snags and coarse woody debris are present in sufficient quantities to provide for habitat diversity and long-term soil productivity.

Grassland and Shrubland Vegetation

Grasslands and shrublands exhibit variable patterns of multiple-aged shrubs, grasses, and forbs. Shrublands are found in mosaics of canopy closures across the landscape, reflecting a combination of successional development, disturbance regimes and management activities. Some mid- to high-elevation grasslands are primarily meadow complexes that are dominated by sedges, rushes, grasses, and forbs.

Riparian Vegetation

Riparian vegetation is dominated by a variety of species, age classes, and structures including coniferous and deciduous trees, willows, alders, sedges and hydric grasses, depending on stream substrate, gradient, elevation, soil-hydrologic, and disturbance processes. Riparian areas have their own disturbance processes that influence vegetation dynamics, with an almost continual readjustment in successional stages in many areas. Riparian vegetation is also influenced by processes in the uplands, as well as by those upstream in the watershed.

Table A-2 in Appendix A lists the Potential Vegetation Groups (PVGs) for the Ecogroup. Appendix A contains more detail on these groups.

Tables A-3 through A-13 in Appendix A present the Forestwide ranges of desired conditions for vegetative attributes that should be used in the design of management activities. Sizes, numbers, and amounts may be adjusted based on new scientific information from the literature and/or studies on current and historical conditions.

Management Direction for Vegetation		
Type	**Number**	**Direction Description**
Goals	VEGO01	The diversity of plant community components, including species composition, size classes, canopy cover, structure, snags, and coarse woody debris fall within the desired range of conditions described in Appendix A and contribute to achievement of Forest Plan multiple-use objectives.
	VEGO02	Vegetative conditions reflect the range of desired ecological processes described in Appendix A, including disturbance regimes, soil-hydrological processes, nutrient cycles, and biotic interactions.
	VEGO03	Vegetation conditions reduce the frequency, extent, severity, and intensity of uncharacteristic or undesirable disturbances from wildfire, insects, and pathogens.
	VEGO04	The diversity, distribution and abundance of vegetative conditions across the planning unit support the long term sustainability of native and desired non-native wildlife species.
	VEGO05	Native plant communities are present across the Forest at levels consistent with the desired range of conditions described in Appendix A.
	VEGO06	Species identified as declining (e.g. whitebark pine, western larch, aspen) are restored to desired levels of representation across the planning unit consistent with that described in Appendix A.
	VEGO07	Elements of vegetative spatial pattern, such as amount, proportion, size, inter-patch distance, variation in patch size, and landscape connectivity are consistent with the applicable fire disturbance regime and contribute to achievement of Forest Plan multiple-use objectives.
	See also Goals for TEPC Species (01, 02, 03, 04, 05, 06); SWRA Resources (14); Wildlife Resources (02, 03, 04); Botanical Resources (01, 02, 03, 04, 05, 06); Non-native Plants (04); Fire Management (02, 03, 04, 05); Timberland Resources (01, 02, 03, 04); Rangeland Resources (02, 04); Scenic Environment (01); and Heritage Program (03).	
Objectives	VEOB01	During fine-scale analysis, prioritize areas for restoration and maintenance consistent with the *Vegetation and Wildlife Habitat Restoration Strategy Map* and associated management area objectives. Within priority areas focus treatments in: a) Forests in the non-lethal and mixed-1 fire regimes b) Aspen in both climax stands and as a seral component of coniferous stands c) Native herbaceous understory in shrub communities d) Woody riparian species e) Western larch f) Whitebark pine.
	VEOB02	When available, use monitoring data to support site/project-scale analysis and to design management actions to achieve vegetation goals and desired conditions over the long term.
	VEOB03	Utilize emerging technologies and science, and implement an adaptive management process to provide for increasing the effectiveness of vegetation monitoring.
	VEOB04	Enhance public awareness about vegetation diversity through interpretive and education programs that address species, communities, ecosystems and their processes.
	VEOB05	Promote partnerships and cooperation with state and federal agencies, tribal governments, and with other interested groups through coordination, cost sharing, and cross-training for assistance with vegetation inventory, classification, monitoring, and other activities as needed.
	VEOB06	Determine high-priority areas for vegetation management actions that restore or maintain vegetation desired attributes.

Management Direction for Vegetation		
Type	**Number**	**Direction Description**
	VEOB07	Update mid and fine-scale inventories of vegetation conditions developed during the forest plan revision process at least every 10 years to assist in identifying needs to change vegetation treatment priorities due to changed resource conditions and/or Agency management priorities.
	VEOB08	On a decadal basis, schedule and complete at least 215,000 acres of treatments designed to maintain or restore desired vegetative and associated wildlife source habitat conditions. Focus treatments in vegetative and wildlife habitat priority watersheds displayed on the combined *Vegetative and Wildlife Habitat Restoration Strategy Map.* Within these watersheds, emphasize treatments in forest stands in the non-lethal and mixed-1 fire regime able to attain the range of desired conditions for the large tree size class or old forest habitat within the short-term (≤15years).
	See also Objectives for TEPC Species (13, 14, 15, 19, 20); SWRA Resources (02, 12, 13); Wildlife Resources (03); Botanical Resources (02, 03, 05, 06, 10, 13, 14); Fire Management (02, 04, 05); Timberland Resources (01); Rangeland Resources (02, 03); Facilities and Roads (12); Recreation Resources (02, 15, 22); Heritage Program (18); and Tribal Rights and Interests (02, 03).	
Standards	VEST01	The activity area shall be used to assess snag and coarse wood conditions for vegetative management actions.
	VEST02	Vegetation management actions associated with developed recreation shall be designed to meet recreation objectives, not vegetative desired conditions described in Appendix A.
	VEST03	Retain forest stands that meet the definition of a large tree size class (Appendix A, page A-6) until forest-wide inventories demonstrate the desired quantity of large tree size class acres within the affected PVG exist across the Forest (Appendix A, Table A-4). Management actions are permitted in such stands as long as they will continue to meet the definition of a large tree size class.[10]
Standards	*See also Standards for TEPC Species (04, 05, 06, 13, 14, 15); SWRA Resources (01, 02, 03, 04, 07, 10, 12); Wildlife Resources (02, 03, 04, 05, 06, 08); Botanical Resources (01, 03, 04, 05); Non-native Plants (03, 04, 06, 10); Timberland Resources (01, 02, 04); Rangeland Resources (01); Mineral and Geology Resources (01, 03); Lands and Special Uses (03, 04); Facilities and Roads (04); Scenic Environment (01); Heritage Program (01); and Tribal Rights and Interests (01, 02, 04).*	
Guidelines	VEGU01	Deleted, as part of 2010 Forest Plan amendment for WCS.
	VEGU02	Deleted, as part of 2010 Forest Plan amendment for WCS.
	VEGU03	When coarse woody debris (CWD) in the larger size classes (>15 inches diameter) is not available for retention in an activity area, smaller size classes may be utilized to meet desired tonnage conditions described in Appendix A. However, these smaller size classes should only be utilized where the resulting fire hazard risk will remain within defined fuels management objectives. Fire hazard risk as it relates to both the activity area and adjacent areas should be considered.
	VEGU04	Broad spectrum herbicides, such as 2, 4–D, should not be used for large-scale sagebrush management if it would result in the loss of non-target forb species.
	VEGU05	Where wildfire has burned within an allotment, burned areas should be evaluated to determine if rest from livestock grazing is necessary for recovery of desired vegetation conditions and related biophysical resources.

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[10] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with. This standard does not apply to PVG 10.

Management Direction for Vegetation		
Type	**Number**	**Direction Description**
	VEGU06	When sagebrush cover types are determined to need rest from livestock grazing following a wildfire, areas should be rested for a minimum of two growing seasons. Evaluate whether additional rest is needed after two growing seasons. Base this determination on the following factors: a) The ecological status of the sagebrush community prior to the wildfire, b) How long the sagebrush community had a density or canopy closure greater than 15 percent prior to the wildfire, c) The severity and intensity of the fire, d) The amount, diversity, and recovery of forbs, grasses and palatable shrubs that are present after 2 years of rest in relation to desired conditions. In areas other than sagebrush cover types, an appropriate rest period should be determined. Base this determination on the following factors: soil conditions, the amount, diversity and recovery of forbs, grasses, and palatable shrubs in relation to the desired condition that are present after the 2 years of rest.
	VEGU07	Live and dead vegetative components should be managed in spatial patch sizes and patterns representative of the appropriate fire regime insofar as current conditions allow. Refer to Appendix A for assistance in addressing this guideline[11].
	VEGU08	Ponderosa pine and western larch trees that fit the definition of a legacy tree should be retained.[11]
	VEGU09	Sufficient live trees of the appropriate size should be retained in managed stands to recruit future snags and coarse woody debris where existing snag levels are below desired ranges. Refer to Appendix A, Tables A-5 and A-6.
	VEGU10	Management activities proposed to maintain or restore vegetative desired conditions should emphasize: • Retention of snags away from roads or other areas open to public access to reduce the potential for removal. • Retention of large snags of seral species (e.g. ponderosa pine and western larch), consistent with species composition desired conditions, to increase longevity of standing snags.
	See also Guidelines for SWRA Resources (03, 04, 05, 07, 08, 09, 12); Wildlife Resources (05, 06, 09, 11, 12, 13, 14, 15); Botanical Resources (01, 02, 03, 04, 05); Non-native Plants (03,05); Fire Management (05); Rangeland Resources (05); Mineral and Geology Resources (06, 07); Lands and Special Uses (01, 13); Facilities and Roads (09); Recreation Resources (22, 24); and Scenic Environment (02).	

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[11] This guideline shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

Botanical Resources

Forest Service Manual and Handbook management direction for Threatened, Endangered, and Sensitive plants is in FSM 2670 - Wildlife, Fish, and Sensitive Plant and Habitat Management, and FSH 2609.25 - Threatened and Endangered Plants Program Handbook. Direction on Special Designation Areas, such as Botanical Special Interest Areas, is in FSM 2370.

DESIRED CONDITION

The amount, distribution, and characteristics of life-stage habitats are present to maintain or reach viable populations of native species. Habitat conditions generally contribute to survival and recovery, and prevent listing on the Region 4 Sensitive Species List. Populations of non-native plants are reduced or eradicated in occupied and potential rare plant habitat. Desired habitat conditions are maintained or degraded habitats restored to promote pollinator success and survival. Human activities are at levels that maintain desired conditions and dynamics during key life stages of rare plants. The public understands the importance of maintaining rare and culturally important plant species.

Management Direction for Botanical Resources

Type	Number	Direction Description
Goals	BTGO01	Provide habitat capable of: a) Supporting viable populations of native plant species within the Forest, and b) Supporting plant biodiversity to meet social needs, biological diversity, and ecological and functional integrity.
	BTGO02	Emphasize conservation and recovery of Region 4 Sensitive species, Forest “Watch” plants, and other species at risk where quantity and quality of habitat needed to support viability is a concern (see Appendix C).
	BTGO03	Maintain or restore globally rare plants identified as the Natural Heritage Program G1, G2, and G3 and/or S1 and S2 species, and provide for their continued compositional and functional integrity for those species for which we have habitat (see Appendix C).
	BTGO04	Maintain habitats for native plants that provide nectar, floral diversity, and pollen throughout the season during which pollinator species are active, with emphasis on rare plant species.
	BTGO05	Maintain or restore unique habitats (e.g., unique assemblages of rare plant species, tall forb communities, etc.) throughout the Forest.
	BTGO06	Manage plant community habitats (e.g., riparian, wetland, and upland forest, shrub, and grassland habitats) to provide for: a) The desired amount, quality, and distribution of habitats, b) Reduced fragmentation within habitats, c) Juxtaposition and connectivity to other habitats, d) Ecosystem processes that shape habitat
	See also Goals for TEPC Species (01, 02, 03, 04, 05, 06); Vegetation (04, 05, 06, 07); Non-native Plants (01, 02, 04, 05); Recreation Resources (04); and Heritage Program (03).	

Management Direction for Botanical Resources		
Type	**Number**	**Direction Description**
Objectives	BTOB01	Continue to map locations of suitable occupied habitat for Region 4 Sensitive plant species, Forest Watch plants, and globally rare plant communities. Incorporate information into a GIS database and coordinate with the Idaho Conservation Data Center.
Objectives	BTOB02	During fine-scale analyses in areas containing sensitive species habitat, identify and prioritize opportunities for restoring degraded Sensitive species habitat.
	BTOB03	Continue to identify potential Botanical Special Interest Areas and recommend them for establishment. Botanical Special Interest Areas may include areas of unique habitat features, rare plant communities, or areas of high-quality cryptogrammic soil crusts with lichens, bryophytes, and fungi.
	BTOB04	Maintain annually a list of Forest Watch plants that identify species of concern (see Appendix C for list of species).
	BTOB05	Provide for the gathering of plants for Native American Indian traditional or cultural uses, as stipulated in statutes, treaties, and agreements with the U.S. Government (see Appendix C for list of species).
	BTOB06	Identify and prioritize habitat types that support economically (i.e., herbal, medicinal) and culturally important plant species to provide for gathering of plants associated with Native American Indian traditional or cultural uses (see Appendix C).
	BTOB07	Encourage participation from Forest employees, the public, and other agencies in a collaborative Celebrating Wildflowers program to promote the importance of conservation and management of native plants and plant habitats.
	BTOB08	During fine- and site/project-scale-analyses, identify and map areas of non-native plant invasions within rare plant habitat.
	BTOB09	Coordinate with research efforts for Sensitive plant species to determine habitat dynamics, seral conditions, pollination ecology, phenology, distribution, and susceptibility to impacts. Coordinate efforts and information with the Idaho Conservation Data Center, universities, Forest Service Research Stations, etc.
	BTOB10	Identify areas of high potential for cryptogamic crust restoration and/or maintenance.
	BTOB11	Enhance public awareness of the fundamental importance of plants to society through educational programs about native plants, plant conservation, biological diversity, ecological processes, and noxious weeds.
	BTOB12	As a means of proactive management, seek funding for, prioritize preparation of, and prepare Conservation Agreements and Strategies to maintain or restore habitats of Sensitive plant species
	BTOB13	Cooperate with researchers, ecologists, geneticists and other interested parties to develop seed zones or breeding zones for native plants.
	BTOB14	Collect seeds of native plants to be used in rehabilitation and restoration activities. Collect seed in accordance with seed zones or breeding zones. Develop long-term storage facilities for collected seeds such as the seed bank at the Lucky Peak Nursery.
	See also Objectives for TEPC Species (21, 22); Vegetation (02, 03, 04, 06); Non-native Plants (06, 07, 08); Rangeland Resources (03); Minerals and Geology (08); Lands and Special Uses (12); Facilities and Roads (04, 12); Heritage Program (18); and Tribal Rights and Interests (02, 03, 04).	
Standards	BTST01	Management actions that occur within occupied sensitive plant species habitat must incorporate measures to ensure habitat is maintained where it is within desired conditions, or restored where degraded.
	BTST02	Do not allow collection of sensitive plants except for research or scientific purposes, under the direction of the Forest or Regional Botanist.
	BTST03	Design and implement projects to meet the Forest Service approved portions of Conservation Strategies and Agreements for Sensitive species.
	BTST04	For projects or activities that include application of insecticides, herbicides, fungicides, or rodenticides, degrading effects on sensitive plant species will be mitigated.

Management Direction for Botanical Resources		
Type	**Number**	**Direction Description**
	BTST05	In revegetation and seeding projects in occupied sensitive plant habitat, a Forest botanist shall be consulted to ensure appropriate species are used.
Standards	*See also Standards for TEPC Species (08, 09, 10, 11); SWRA Resources (01, 11); Non-native Plants (01-12); Timberland Resources (08); Rangeland Resources (03, 04); Mineral and Geology Resources (01, 08); and Tribal Rights and Interests (01, 04).*	
Guidelines	BTGU01	For site/project-scale analysis, suitable habitat should be determined for Sensitive species within or near the project area. Conduct surveys for those species with suitable habitat to determine presence. Document the rationale for not conducting surveys for other species in the project record**.**
	BTGU02	During site/project-scale analysis and review, a Forest botanist should review insecticide or herbicide spray plans and prescribed burning plans to determine whether degrading effects to Sensitive and Forest Watch plants and their pollinators should be mitigated.
	BTGU03	When available and not cost-prohibitive, seeds and plants used for seedings and plantings in revegetation projects should originate from genetically local sources of native species. When project objectives justify the use of non-native plant materials, documentation explaining why non-natives are preferred should be part of the project planning process.
	BTGU04	In cases where plant collection permits are issued, digging or physically removing whole plants should be discouraged in favor of collecting seeds or cuttings.
	BTGU05	Coordinate with Forest botanists to consider sensitive species habitat needs when designing and implementing management activities that may affect these species or their habitats.
	See also Guidelines for TEPC Species (07); SWRA Resources (05); Vegetation (01, 04, 05, 06); Non-native Plants (01, 02, 03, 05); Fire Management (05); Rangeland Resources (05); Mineral and Geology Resources (07); Lands and Special Uses (01, 13); Facilities and Roads (09, 11); Recreation Resources (07); and Tribal Rights and Interests (02).	

Non-Native Plants

Forest Service Manual and Handbook management direction for non-native plants is in FSM 2080 - Noxious Weed Management, FSM 2100 - Environment Management, FSH 2109.14 - Pesticide Use Management and Coordination Handbook, FSH 2509.13 - Burned Area Emergency Rehabilitation Handbook, and FSH 2509.22 - Soil and Water Conservation Practices Handbook. Direction can also be found in WO Amendment 2000-95-5, Zero Code 2080; and WO Amendment 2100-94-6, Chapter 2080 - Pesticide Use Management and Coordination.

DESIRED CONDITION

Noxious weed infestations are primarily restricted to locations along roads, trails, river corridors, and airstrips. Existing noxious weed populations are not expanding in size. Weed species cover or densities are variable across the Forest. New noxious weed outbreaks may occur temporarily or continue to exist as a small nonexpanding population in areas of high susceptibility. Noxious weed populations in low susceptibility areas are small and scattered with low to moderate densities. New invader species to the forest are not becoming established. Native plants are dominant on disturbed or recently restored sites. Some areas of historic rehabilitation or vegetative manipulation are still dominated by non-native grasses or forbs.

Management Direction for Non-native Plants

Type	Number	Direction Description
Goals	NPGO01	Manage noxious weeds with an Integrated Weed Management approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities.
	NPGO02	Prevent new infestations of undesirable non-native plants or noxious weed species, with emphasis on areas of high susceptibility where those species have a strong probability for establishment and spread.
	NPGO03	Promote and participate in establishment of Coordinated Weed Management Areas. Support the State of Idaho Weed Management Strategy.
	NPGO04	Reestablish vegetation that is compatible with desired long-term vegetative conditions, Forest-wide management direction, and management area priorities.
	NPGO05	Work to reduce the risk of establishing new noxious weed populations by minimizing weed seed transport and reducing favorable establishment conditions on disturbed sites.
	See also Goals for TEPC Species (03, 04, 05, 06) and Botanical Resources (01, 04, 06).	
Objectives	NPOB01	Maintain, and use current field data to update, the Forest-wide database and map library of current status of noxious weed infestations, treatment activities, and locations of newly established infestations.
	NPOB02	Designate Coordinated Weed Management Areas on Boise National Forest System lands.
	NPOB03	Develop strategic noxious weed management plans for Coordinated Weed Management Areas. Cooperate on a regular basis with federal agencies, tribal governments, the State of Idaho, county weed organizations, state and local highway departments, and private individuals in establishing Coordinated Weed Management Area strategic priorities, and locating and treating noxious weed species.

Management Direction for Non-native Plants		
Type	**Number**	**Direction Description**
Objectives	NPOB04	Coordinate with the Idaho Department of Transportation and county officials to assist and promote cooperative efforts to reduce introduction and spread of noxious weeds.
	NPOB05	Cooperatively work with holders of special use authorizations to identify and manage noxious weed infestations within areas of use to prevent further expansion or reduce existing densities.
	NPOB06	Emphasize prevention of noxious weed establishment through education and cooperation with recreation user groups such as all-terrain vehicle (ATV), motorcycle, and stock user groups.
	NPOB07	Use Burned Area Emergency Rehabilitation or other appropriate procedures to reduce the risk of noxious weed expansion in wildland fire areas, especially those identified in the Forest-wide database and map library as being highly susceptible to invasion.
	NPOB08	Develop a Forest Noxious Weed Management Plan in coordination with county, state, and federal agencies, including USFWS and/or NMFS, within 3 years of signing the ROD for Forest Plan revision.
	See also Objectives 21 for TEPC Species and 08, 13, and 14 for Botanical Resources.	
Standards	NPST01	Only certified noxious weed-free hay, straw, or feed is allowed on National Forest System lands.
	NPST02	All seed used on National Forest System lands will be certified to be free of seeds from noxious weeds listed on the current *All States Noxious Weeds List*.
	NPST03	To prevent invasion/expansion of noxious weeds, the following provisions will be included in all special use authorizations, timber sale contracts, service contracts, or operating plans where land-disturbing activities are associated with the authorized land use (additional direction may be found in timber sale and service contract provisions and in Forest Service handbooks): a) Revegetate areas, as designated by the Forest Service, where the soil has been exposed by ground-disturbing activity. Implement other measures, as designated by the Forest Service, to supplement the influence of re-vegetation in preventing the invasion or expansion of noxious weeds. Potential areas would include: construction and development sites, underground utility corridors, skid trails, landings, firebreaks, slides, slumps, temporary roads, cut and fill slopes, and travelways of specified roads. b) Earth-disturbing equipment used on National Forest System lands--such as cats, graders, and front-loaders--shall be cleaned to remove all visible plant parts, dirt, and material that may carry noxious weed seeds. Cleaning shall occur prior to entry onto the project area and again upon leaving the project area, if the project area has noxious weed infestations. This also applies to fire suppression earth-disturbing equipment contracted after a WFSA/WFIP has been completed.
	NPST04	Contractors, with the exception of fire suppression prior to completion of WFSA/WFIP, shall be required to clean earth-disturbing, construction, and road maintenance equipment, of all sizes, to remove all plant parts, dirt, and material that may carry noxious weed seeds, prior to entry onto the Forest, or movement from one Forest project area to another.
	NPST05	During WFSA/WFIP development, identify noxious weed control and mitigation measures. Ensure their implementation through direction in the Letter of Delegation and the Incident Overhead Team briefing.
	NPST06	Materials such as hay, straw, or mulch that are used for rehabilitation and reclamation activities shall be free of noxious weed seed, and shall comply with the 1995 weed-free forage special order against use of non-certified hay, straw, or mulch. Materials that are not covered under a weed seed free certification, and that have the potential to contain noxious weed seed, shall be inspected and determined to be free of weed seed before purchase and use.

Management Direction for Non-native Plants		
Type	**Number**	**Direction Description**
Standards	NPST07	Source sites for gravel and borrow materials shall be inspected for noxious weeds before materials are processed, used, or transported from the source site into the project area or onto the National Forest.
	NPST08	Gravel or borrow material source sites with noxious weed species present shall not be used, unless effective treatment or other mitigation measures are implemented.
	NPST09	The Forest shall comply with the intent and direction established in the above provisions or clauses in a manner similar to that required of contractors or permittees.
	NPST10	Projects that may contribute to the spread or establishment of noxious weeds shall include measures to reduce the potential for spread and establishment of noxious weed infestations.
	NPST11	Integrated Weed Management shall be used to maintain or restore habitats for sensitive plants and other native species of concern where they are threatened by noxious weeds or non-native invasive plants.
	NPST12	Implement the Forest Noxious Weed Management Plan upon completion.
	See also Standards for TEPC Species (09, 10); SWRA Resources (01, 07, 12); and Botanical Resources (04, 05).	
Guidelines	NPGU01	Noxious weeds and undesirable non-native plants should be eradicated. Where it is not practical to eradicate existing infestations, infestations should be managed to prevent seed production and spread.
	NPGU02	Clean borrow and gravel sources on Forest should be maintained as noxious weed free through an inspection and treatment program. Off-Forest inspections and treatments should be coordinated with county weed agents.
	NPGU03	Identify areas with extensive noxious weed infestations where precautionary actions are necessary when planning and implementing management activities. In areas of extensive weed infestations, designated wash sites should be established as part of project planning. Wash sites should be located: (1) where they are easily accessible and useable, (2) on gravelly or well-drained soils, (3) where wash water runoff will not carry seeds away from site, (4) where wash water runoff will not directly enter streams, and (5) where they may be used repeatedly for several projects or activities within the area.
	NPGU04	Where feasible and practical, weed-free locations should be selected for incident camps, staging, cargo loading, drop points, helibases, and parking areas.
	NPGU05	Noxious weed management should determine the presence, location, and amount of noxious weed infestations. Management strategies should also identify: a) Methods and frequency for treating infestations, b) Treatment procedures and restrictions, c) Reporting requirements, and d) Follow-up or monitoring requirements.
	NPGU06	The Forest-wide database and map library of noxious weed infestations and susceptibility should be used in the development of site-specific Integrated Weed Management approaches and strategies used in Coordinated Weed Management Areas.
	See also Guidelines for TEPC Species (07); Wildlife Resources (05, 06); Botanical Resources (02, 03); Fire Management (01, 05); and Facilities and Roads (02).	

Fire Management

Forest Service Manual and Handbook direction for fire management is in FSM 5100 – Fire Management, and in Forest Service Handbooks: 5109.14 - Individual Fire Report Handbook, 5109.17 - Fire and Aviation Management Qualifications Handbook, 5109.18 - Wildfire Prevention Handbook, 5109.19 - Fire Management Analysis and Planning Handbook, 5109.31 - Wildfire Cause Determination Handbook, 5109.32a - Fireline Handbook, and 5109.34 - Interagency Fire Business Management Handbook.

DESIRED CONDITION

Fire—both prescribed and wildland—is used as a tool to achieve and maintain vegetative conditions and desired fuel levels. Fire plays a natural role where appropriate and desirable, but is actively suppressed where necessary to protect life, investments, and valuable resources. Fire operates within historical fire regimes appropriate to the vegetation type and management objectives. The selected suppression strategy is successful.

Management Direction for Fire Management

Type	Number	Direction Description
Goals	FMGO01	Firefighter and public safety is the priority in all fire management activities.
	FMGO02	Allow fire to play its natural role where appropriate and desirable to reduce the risk of uncharacteristic and undesirable wildland fires.
	FMGO03	Use fire alone or with other management activities to restore or maintain desirable plant community attributes including fuel levels, as well as ecological processes (see Vegetation Goals).
	FMGO04	Use fire alone or with other management activities to treat natural and activity fuels to a level that reduces the risk of uncharacteristic or undesirable wildland fires.
	FMGO05	Provide for protection of life, investments, and valuable resources through appropriate vegetation, fuel, and wildland fire management.
	FMGO06	Encourage and participate in partnerships with citizens or community-centered approaches to manage fire risks and hazards in wildland/urban interface areas.
	See also Goals for TEPC Species (03); Air and Smoke Management (01, 02); Wildlife Resources (02); Vegetation (01, 02, 03, 04, 05, 06, 07); Non-native Plants (05); Timberland Resources (02, 03); Rangeland Resources (02, 03); and Heritage Program (03).	
Objectives	FMOB01	Reduce fire fighter and public injuries and loss of life, and damage to communities from severe, unplanned and unwanted wildland fires by prioritizing fire fighter, public, and community safety above other concerns in fire management activities.
	FMOB02	During project planning, identify appropriate areas where prescribed fire could be used to meet management objectives. These areas may include intermingled landownership, and areas of concentrated investments, structures, or other resource concerns.
	FMOB03	Following identification of areas where wildland fire use is appropriate within management areas, aggregate common areas between management areas to fully describe the extent of wildland fire use implementation areas to be included in the Fire Management Plan. Develop the necessary implementation information for the areas and include in the Fire Management Plan.

Management Direction for Fire Management		
Type	**Number**	**Direction Description**
Objectives	FMOB04	On a decadal basis, schedule and complete at least 50,000 acres of hazardous fuel reduction and maintenance treatments within the wildland urban interface (WUI).
	FMOB05	Continue to identify high fire hazard areas in wildland/urban interface areas. Develop and prioritize vegetation treatment plans in coordination with local and tribal governments, agencies, and landowners to reduce the risk from wildland fire.
	FMOB06	Enhance public awareness of the fundamental importance of fire through educational programs about the role of fire in the ecosystem.
	FMOB07	Coordinate vegetation management activities and partnership opportunities with local land managers and owners for wildland fire suppression and use, and prescribed fire.
	FMOB08	On a decadal basis, use prescribed fire to treat at least 100,000 acres. These treatments would contribute to accomplishment of VEOB08 and FMOB04.
	See also Objectives for TEPC Species (23); Air and Smoke Management (01, 02, 03, 04, 05); SWRA Resources (12, 13, 17); Wildlife Resources (01, 09); Vegetation (01, 06); Botanical Resources (02, 08); Non-native Plants (07); Facilities and Roads (08); Recreation Resources (03, 07, 19); and Heritage Program (14).	
Standards	FMST01	Once a Wildland Fire Situation Analysis (WFSA) is approved, heavy equipment shall not be used to construct firelines within Riparian Conservation Areas (RCAs) unless: a) The line officer or designee determines that imminent safety to human life or protection of structures is an issue; OR b) The incident resource advisor determines and documents an escaped fire would cause more degradation to RCAs than would result from the disturbance of heavy equipment. In no case will the decision to use heavy equipment in RCAs be delayed when the line officer or designee determines safety or loss of human life or protection of structures is at imminent risk.
	FMST02	Once a WFSA is approved, incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities shall be located outside RCAs unless the only suitable location for such activities is determined and documented by the line officer or designee to be within an RCA. In no case will the decision to place these activities inside an RCA be delayed when the line officer or designee determines safety or loss of human life or structures is at imminent risk.
	FMST03	Once a WFSA is approved, avoid delivery of chemical retardant, foam, or additives to all surface waters within RCAs unless: a) The line officer or designee determines that imminent safety to human life or protection of structures is an issue; OR b) The incident resource advisor determines and documents an escaped fire would cause more degradation to an RCA, than would be caused by addition of chemical, foam or additive delivery to surface waters in RCAs. In no case will the decision to avoid delivery of chemical retardant, foam or additives to surface waters within RCAs be delayed when the line officer or designee determines safety or loss of human life or protection of structures is at imminent risk.
	See also Standards for TEPC Species (03, 04, 06, 08, 10, 17, 18, 19, 20, 21); Air and Smoke (01, 02, 03); SWRA Resources (01, 02, 03, 04, 07, 11, 12); Wildlife Resources (01,02, 03, 04, 05, 06); Botanical Resources (01, 03, 05); Non-native Plants (03, 04, 05, 06, 10); Lands and Special Uses (03, 04, 05); Recreation Resources (05); Scenic Environment (01, 02); Heritage Program (01); and Wild and Scenic Rivers (01).	

Management Direction for Fire Management		
Type	**Number**	**Direction Description**
Guidelines	FMGU01	An interdisciplinary team or resource advisor should be used to predetermine incident base and helibase locations. These locations should be described in the Fire Management Plans.
	FMGU02	When prescribed fire or wildland fire use areas burn more severely than prescribed or anticipated, with the potential for detrimental soil disturbance or loss of soil-hydrologic function, appropriate personnel should complete a field evaluation to determine the need for any rehabilitation measures.
	FMGU03	To minimize mechanical ground disturbance in RCAs, prescribed fire and wildland fire use should be considered viable tools to meet soil, water, riparian, and aquatic desired conditions.
	FMGU04	Consider a full range of appropriate management responses, from wildland fire use that benefits resources, to full suppression.
	FMGU05	Implementation information for wildland fire use described in the Fire Management Plan should include identification of sensitive ecological resources and social values. When it is determined that wildland fire use may degrade sensitive areas, prescriptions for wildland fire use should mitigate these effects.
	FMGU06	Direct ignition of prescribed fire in RCAs should not be used unless site/project scale effects analysis demonstrates that it would not degrade or retard attainment of soil, water, riparian, and aquatic desired conditions. Refer to SWRA Standard #4 for exceptions.
	See also Guidelines for TEPC Species (02, 07, 08); Air and Smoke Management (01, 02, 03, 04); SWRA Resources (02, 03, 05, 07, 08, 09, 11); Wildlife Resources (01, 05, 06, 11, 12, 13, 14); Vegetation (01, 02, 03); Botanical Resources (01, 02, 03, 04); Non-native Plants (03, 04); Timberland Resources (01); Rangeland Resources (03); Lands and Special Uses (06); Recreation Resources (05, 09, 22, 24); and Scenic Environment (02, 17).	

Timberland Resources

Forest Service Manual and Handbook direction for timber management is in the FSM 2400-Timber Management, and in Forest Service Handbooks: 2409.13 - Timber Resource Planning Handbook, 2409.13a - Timber Permanent Plot Handbook, 2409.15 - Timber Sale Administration Handbook, 2409.17 - Silvicultural Practices Handbook, 2509.18 - Soil Management Handbook, 2609.13 - Wildlife and Fisheries Program Management Handbook, and 2509.22 – Soil and Water Conservation Practices Handbook. Sale implementation direction can also be found in Timber Sale Contract Provisions and procurement contracts.

DESIRED CONDITION

Desired vegetation conditions for Timberland Resource are described in Appendix A and the desired condition statements for forested vegetation (see Vegetation section). Appendix A contains Forest-wide desired conditions for species composition, tree size, and canopy cover for each potential vegetation group.

Suited timberlands provide sustainable and predictable levels of forest products, both now and continuing in the future. Forest products include, but are not limited to, fuelwood, post and poles, and sawlogs.

Management Direction for Timberland Resources		
Type	**Number**	**Direction Description**
Goals	TRGO01	Manage forested vegetation to achieve: a) Conditions that are resilient and resistant to uncharacteristic fire, insect, and disease damage, and b) Conditions that contribute to desired vegetative conditions, including, distribution of tree sizes, species composition, and canopy cover.
	TRGO02	Manage suited timberlands to achieve: a) Growth rates and yields that are compatible with other resources, b) Annual harvest of expected timber volume, c) Maintenance or improvement, where possible, of genetic diversity within tree species, d) Successful reforestation through the application of appropriate and available silvicultural techniques, e) Vegetative conditions (structure, density, etc.) in plantations and surrounding stands that result in reduced hazard for loss from uncharacteristic disturbance events, and f) Sustained yield, even flow of high-quality forest products, including timber and non-timber forest products.
	TRGO03	Manage not suited timberlands to achieve: a) Forest vegetation conditions that benefit other resource objectives, and b) Utilization of forest products to the extent feasible and compatible with other uses.
	TRGO04	Provide fuelwood, post, pole, Christmas tree, and other non-sawtimber, miscellaneous forest products to help meet public demand, while also contributing to the attainment of timberland and other resource goals and objectives.

<table>
<tr><th colspan="3">Management Direction for Timberland Resources</th></tr>
<tr><th>Type</th><th>Number</th><th>Direction Description</th></tr>
<tr><td rowspan="2">Goals</td><td>TRGO05</td><td>Enhance public awareness about the value of retaining snags and coarse woody debris, the need to protect riparian areas, and the importance of preventing accelerated soil erosion through methods such as information included with personal use permits (fuelwood, Christmas trees, etc.) and interpretive displays.</td></tr>
<tr><td colspan="2"><i>See also Goals for TEPC Species (04, 05); Vegetation (01, 02, 03, 07); Fire Management (04); Rangeland Resources (02); Scenic Environment (01); and Heritage Program (03).</i></td></tr>
<tr><td rowspan="4">Objectives</td><td>TROB01</td><td>On a decadal basis:
a) Harvest timber, other than by salvage, on at least 90,000 acres,
b) Reforest at least 20,000 acres, and
c) Complete timber stand improvement activities on at least 55,000 acres.

This objective contributes to the accomplishment of VEOB08 and FMOB04.</td></tr>
<tr><td>TROB02</td><td>On a decadal basis, make available an estimated 282 million board feet of timber which will contribute to Allowable Sale Quantity (ASQ).</td></tr>
<tr><td>TROB03</td><td>Utilize wood products (e.g., fuelwood, posts, poles, house logs, etc.) generated from vegetation treatment activities, on both suited and not suited timberlands, to produce an estimated 115 million board feet of volume on a decadal basis. This volume, when combined with ASQ, is the Total Sale Program Quantity (TSPQ). On a decadal basis, the TSPQ is estimated to be 397 million board feet.</td></tr>
<tr><td colspan="2"><i>See also Objectives for TEPC Species (13, 14,15, 16, 19); SWRA Resources (12, 13); Wildlife Resources (07); Vegetation (01, 02); Rangeland Resources 02); Facilities and Roads (06); Recreation Resources (02, 19); Heritage Program (14); Tribal Rights and Interests (02, 03); and Social/Economics (01).</i></td></tr>
<tr><td rowspan="2">Standards</td><td colspan="2">Vegetation Management Practices</td></tr>
<tr><td>TRST01</td><td>Minimum stocking requirements for plantation certification for each potential vegetation group are described in the table below. A certified silviculturist may prescribe different minimum stocking requirements, which are more appropriate for site-specific conditions and stand management objectives; otherwise, the minimum stocking standards outlined in this table must be used.
<table>
<tr><th>Potential Vegetation Group</th><th>Minimum No. of Established Trees per Acre</th></tr>
<tr><td>1 – Dry Ponderosa Pine/Xeric Douglas-fir</td><td>50</td></tr>
<tr><td>2 - Warm Dry Douglas-fir/Moist Ponderosa Pine</td><td>100</td></tr>
<tr><td>3 - Cool Moist Douglas-fir</td><td>120</td></tr>
<tr><td>4 - Cool Dry Douglas-fir</td><td>75</td></tr>
<tr><td>5 - Dry Grand Fir</td><td>150</td></tr>
<tr><td>6 - Cool Moist Grand Fir</td><td>150</td></tr>
<tr><td>7 - Warm Dry Subalpine Fir</td><td>75</td></tr>
<tr><td>8 - Warm Moist Subalpine Fir</td><td>150</td></tr>
<tr><td>9 - Hydric Subalpine Fir</td><td>150</td></tr>
<tr><td>10 - Persistent Lodgepole Pine</td><td>200</td></tr>
<tr><td>11 – High Elevation Subalpine Fir</td><td>100</td></tr>
</table>
</td></tr>
</table>

Management Direction for Timberland Resources		
Type	**Number**	**Direction Description**
Standards	TRST02	Openings created by even-aged timber harvest shall be separated by stands not defined as an opening. The size of stands between created openings may vary to address site-specific resource concerns, but the minimum stand size may never be less than 5 acres. Where openings that exceed 40 acres are proposed to meet management objectives, a 60-day public notice and review by the Regional Forester shall be required.
	TRST03	An opening created by timber harvesting will, as a minimum, no longer be considered an opening when a new forest stand is established in that opening. Regenerated areas, whether planted or developed through natural regeneration, are established when they are certified.
	TRST04	Lands within Riparian Conservation Areas (RCAs), determined after field review, will be identified as not suited for timber production. Wood products harvested within RCAs will not contribute to the Allowable Sale Quantity (ASQ).
	TRST05	Field-verified high-risk landslide-prone sites are identified as not suited for timber production. Wood products harvested from high-risk landslide-prone sites will not contribute to the ASQ.
	Harvest of Miscellaneous Forest Products	
	TRST06	Off-road vehicle travel for purposes of fuelwood harvest, Christmas trees, and other miscellaneous forest products must comply with Travel Map restrictions unless specifically exempted by permit
	TRST07	No fuelwood harvest is allowed within 300 feet of perennial streams and 150 feet of intermittent streams unless management actions are designed in a manner that will not degrade riparian and related aquatic resources. Fuelwood harvest allowed within 300 feet of perennial streams and 150 feet of intermittent streams will be described in the annual fuelwood map and instructions.
	Salvage Harvesting	
	TRST08	Salvage harvest in RCAs is allowed only where the wood products salvaged will not degrade or retard attainment of riparian, aquatic, hydrological, botanical, and terrestrial wildlife habitat desired conditions.
	See also Standards for TEPC Species (04, 06, 14, 15); SWRA Resources (01, 02, 03, 04, 07, 10, 12); Wildlife Resources (01, 02, 03, 04, 05, 06); Vegetation (01); Botanical Resources (01); Non-native Plants (03, 04, 06, 10); Rangeland Resources (08); Mineral and Geology Resources (01); Scenic Environment (01, 02); Lands and Special Uses (03, 04); Heritage Program (01); Tribal Rights and Interests (01); and Wild and Scenic Rivers (01).	
Guidelines	**Conifer Plantation Protection**	
	TRGU01	Provide long-term protection of conifer plantations by any one, or a combination of the following, or similar, actions within and adjacent to plantations: a) Release and weeding to control competing vegetation, b) Thinning to control stand density, c) Brush disposal to reduce fuel loading, d) Prescribed fire (underburning) to reduce fuel loading, fuel ladders, and understory vegetation, e) Animal damage control. These and other activities should be integrated with other resource management objectives to provide protection against undesirable effects of fire, insects, and disease.
	Harvest of Miscellaneous Forest Products	
	TRGU02	Designated areas for harvesting miscellaneous forest products should be used where needed to achieve resource objectives or to reduce conflicts with other resources.
	See also Guidelines for SWRA Resources (03, 04, 05, 07, 08, 09, 12); Wildlife Resources (01, 05, 06, 09, 12, 13, 14); Vegetation (01, 02, 03); Botanical Resources (01, 02); Non-native Plants (03, 05); Recreation Resources (05, 06, 08, 22, 24); and Scenic Environment (02, 03, 04, 05, 06).	

Rangeland Resources

Forest Service Manual and Handbook management direction for rangeland resources is in FSM 2200 - Range Management, WO Amendment 2200-90-1, Chapters 10-50; Intermountain Interim Directive FSH 2209.3-99-9 - Grazing Permit Administration Handbook, Chapter 90 - Rangeland Management Decision Making; and FSH 2209.21 - Rangeland Ecosystem Analysis and Management Handbook, R4 Amendment 2209.21-93-1, Chapters 10-40.

DESIRED CONDITION

A sustainable level of forage, consistent with other resource management direction, is available for use through the Forest Service grazing permit system. Rangeland forage quality is maintained or improved in areas where vegetation management projects and range management actions occur. Riparian areas continue to be a focal point for providing vegetative diversity, landscape capability, soil productivity, wildlife habitat, proper stream channel function and water quality important to sustaining beneficial uses. Riparian areas are functioning properly and/or have improving trends in vegetative composition, age class structure and vigor. Upland range vegetation is contributing to proper hydrologic function. The composition and densities of shrubs, grasses and forbs are variable and dynamic across the landscape.

Management Direction for Rangeland Resources

Type	Number	Direction Description
Goals	RAGO01	Provide for livestock forage within existing open allotments, in a manner that is consistent with other resource management direction and uses.
	RAGO02	Manage rangelands using controlled livestock grazing, range structural and non-structural improvements, vegetative and ground rehabilitation, fire, and timber management in various combinations to meet desired conditions.
	RAGO03	Manage upland vegetation on suitable rangelands to maintain or restore hydrologic function and soil productivity of watersheds containing allotments.
	RAGO04	Manage herbaceous and shrub vegetation on suitable rangelands to meet resource objectives in an efficient manner.
	RAGO05	Manage livestock grazing within riparian areas to accommodate the maintenance or restoration of aquatic and riparian processes and functions.
	RAGO06	Coordinate livestock grazing to address conflicts with other resource uses in a manner that is consistent with Forest Plan management direction.
	See also Goal 3 for Heritage Program and Goals 01, 04, and 06 for Botanical Resources.	
Objectives	RAOB01	Coordinate the design, update and/or revision of Allotment Management Plans with adjacent landowners to maximize opportunities and minimize potential conflicts in management.
	RAOB02	Coordinate livestock grazing with timber harvest and forest regeneration activities to capitalize on management opportunities, while minimizing activity conflicts to help meet Forest Plan Vegetation and Rangeland Resource goals.
	RAOB03	During fine-scale analyses where rangeland facilities are identified as a potential concern or problem contributing to degrading resource conditions within the analysis area, identify rangeland facilities that are degrading resource conditions and prioritize opportunities to mitigate their effects or to initiate restoration of resource conditions.

Management Direction for Rangeland Resources

Type	Number	Direction Description
Objectives	*See also Objectives for TEPC Species (07, 20, 24); SWRA Resources (03); Wildlife Resources (04); Botanical Resources (02, 09, 10); Non-native Plants (05); Recreation Resources (19; Heritage Program (14); Tribal Rights and Interests (02, 03); and Social/Economics (01).*	
Standards	RAST01	Maximum forage utilization of representative areas within each pasture shall not exceed the values shown at the end of growing season. Variation in utilization standards in order to achieve specific vegetative management objectives shall occur with a site-specific or project-level decision according to direction in FSM 1922.5. a) Riparian Areas: Maximum 45 percent use or retain a minimum 4-inch stubble height of hydric greenline species, whichever occurs first. b) Upland Vegetative Cover Types: Early season or season long pastures – 40 percent use. Vegetative slow growth, after seed ripe conditions, or late season pastures – 50 percent use.
	RAST02	Livestock trailing, bedding, watering, and other handling efforts shall be limited to those areas and times that maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat.
	RAST03	New water developments, corrals, and other handling or loading facilities shall not be located within RCAs, unless it can be demonstrated that these facilities maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat.
	RAST04	Livestock salting will be prohibited in RCAs. Sheep will be salted only at bed grounds. Salt will be placed in containers and moved with the sheep.
	RAST05	Only one night/one time use of bed grounds is allowed.
	RAST06	Only open or loose sheep herding will be practiced, except where site-specific vegetation management (e.g., noxious weed control or reforestation) is needed and has been prescribed.
	RAST07	Only annual once-over sheep grazing will be allowed, with the exception of designated sheep driveways, travel routes, or where specifically authorized.
	RAST08	Bedding of sheep and salting of livestock in plantations will be prohibited until plantation trees have grown to a size that reduces their susceptibility to damage from livestock.
	RAST09	New, reconstructed, or replaced livestock water developments must provide access and escape to and from water for all types of wildlife.
	See also Standards for TEPC Species (04, 06, 08, 10, 22, 23, 24, 25, 26); SWRA Resources (01, 02, 03, 04, 07, 12); Wildlife Resources (02, 03, 07); Botanical Resources (01, 03); Minerals and Geology (01); Scenic Environment (01); Heritage Program (01); Tribal Rights and Interests (01); and Wild and Scenic Rivers (01).	

Management Direction for Rangeland Resources

Type	Number	Direction Description
Guidelines	RAGU01	The following situations should be examined when determining grazing capacities for individual or groups of allotments during project-level decisions. These guidelines are based on the assumption that typical management practices are occurring or will occur (for example, a deferred rotation grazing system): a) Generally, areas where native, desirable introduced, or introduced palatable species site productivity is less than 200 pounds per acre should not be included in the allotment grazing base. b) Landtype Associations within Capability Groups 1-5 and 10. In areas where annual precipitation is 15 inches or more, the preferred course of action is to remove sites from the grazing base that have vegetation, litter, rock, and moss cover (ground cover) less than 60 percent. In areas where annual precipitation is less than 15 inches, the preferred course of action is to remove sites that have ground cover less than 40 percent. c) Landtype Associations in Capability Group 6-9 (landtypes with a moderately high or high susceptibility to erosion). Generally, sites with soil depths less than 10 to 12 inches, and/or sites with slopes between 25-50 percent that have vegetation and litter cover less than 60 percent, and/or sites where slopes are less than 25 percent that have vegetation and litter cover less than or equal to 40 percent, should not be included in the allotment grazing base.
	RAGU02	In cattle allotments where riparian area restoration is an objective, grazing systems should be designed to incorporate the following parameters where appropriate: a) Provide residual vegetative cover (at least 6 inches of hydric vegetation) either through regrowth or rest treatments for at least 75 percent of the years in a rotation cycle. b) Reduce the duration of riparian area grazing periods where needed. Grazing period reduction may be especially needed in the fall where riparian deciduous woody species are an important riparian vegetation component. c) Design grazing periods to take advantage of favorable seasonal livestock dispersal behavior (examples: spring use of uplands, due to wet riparian conditions, late fall upland use, due to cold temperatures, poor dispersal during "hot" season). d) Incorporate sufficient growing season rest to provide good vigor, physiological needs, and regeneration of all riparian plants. e) Where deciduous trees and shrubs are important in the composition, modify the frequency of grazing periods, reduce the grazing duration, or reduce grazing intensity to levels that provide for recovery/maintenance of healthy diverse trees and shrubs.
	RAGU03	After completing vegetation treatments, livestock grazing practices (for example, salting locations, rest, temporary closure of stock water, herding, season of use, duration, and temporary electric fencing) may be altered as needed to hasten or enhance site recovery or treatment.
	RAGU04	New stock driveways and trailing routes should be located outside of RCAs. Where driveways and trailing routes must pass through RCAs, they should be located and managed to minimize the extent and severity of degrading effects to soil, water, riparian, aquatic, and botanical resources.
	RAGU05	Where rangeland facilities or practices have been identified as potentially contributing to the degradation of water quality, aquatic species or occupied sensitive or watch plant habitat, facilities and practices causing degradation should be considered for relocation, closure, or changes in management strategy, alteration, or discontinuance.
	RAGU06	Livestock use should be discouraged in progeny sites, seed orchards, and plantations that have not been certified.

Management Direction for Rangeland Resources		
Type	**Number**	**Direction Description**
Guidelines	RAGU07	To improve the cost-effectiveness of livestock pasture and improvement management, consider combining allotments or portions of allotments to increase the number of pastures available in a rotation, rather than dividing existing pastures with new fences into smaller units.
	RAGU08	Sheep should be routed to avoid slopes with loose soil conditions, active gullies, and snowbank areas that have low productivity, soil puddling, and compaction conditions.
	RAGU09	Season-long grazing practices should be discontinued where they preclude restoration of upland or riparian vegetation communities.
	RAGU10	Where recreation prescriptions are applied, adjustments to grazing management practices should be evaluated to resolve conflicts in areas of concentrated recreation use.
	See also Guidelines for TEPC Species (09); SWRA Resources (03, 05, 07, 08, 09, 12); Wildlife Resources (05, 06, 10, 11, 12, 13, 14); Vegetation (05, 06); Fire Management (05); Recreation Resources (08, 17, 22, 24); and Research Natural Areas (01).	

Mineral and Geology Resources

Forest Service Manual direction for mineral management is in FSM 2800 - Minerals and Geology, WO Amendment 2800-96-1, Zero Code; FSM 2810 - Mining Claims, WO Amendment 2800-90-1; FSM 2820 - Mineral Leases, Permits and Licenses, WO Amendment 2800-94-1; FSM 2830 - Mineral Reservations and Outstanding Mineral Rights, WO Amendment 2800-90-1; FSM 2840 - Reclamation, WO Amendment 2800-90-1; FSM 2860 - Forest Service Authorized Prospecting and Mineral Collecting, WO Amendment 2800-92-1. Direction can also be found in 36 CFR 228, Subpart A through E. When evaluating the completeness of reclamation plans, the Manual of Best Management Practices for the Mining Industry in Idaho, 1993, published by the Idaho Department of Lands, should be used as a reference for mitigating potential degrading effects to water quality.

DESIRED CONDITION

Exploration, development, and production of mineral and energy resources are conducted in an environmentally sound manner. Mineral resource inventories and evaluations are completed. Although some areas (designated Wilderness and Wild Rivers, campgrounds, administrative sites, etc.) are withdrawn from mineral exploration and development, most areas of the Forest remain open to mineral activities. Demand for locatable minerals depends upon world markets and fluctuates. Operating plans include appropriate mitigation measures, and contain bonding requirements commensurate with the costs of anticipated site reclamation. Where practicable, sites are returned to a condition consistent with management emphasis and objectives.

Management Direction for Mineral and Geology Resources

Type	Number	Direction Description
Goals	MIGO01	Facilitate orderly and environmentally sound exploration, development, and production of mineral and energy resources.
	MIGO02	Require appropriate mitigation and reclamation of environmental disturbance for all mineral exploration and development proposals. Reduce environmental effects from past mineral-related activity. Restore disturbed land to a productive condition.
	MIGO03	Eliminate or prevent occupancy that is not reasonably incident to and required for mineral operations.
	MIGO04	Integrate mineral and geology project planning and implementation in a manner that is consistent with other resource management direction.
	MIGO05	Interpret local geology and mining activities for public enjoyment and education.
	See also Goal 03 for Heritage Program and Goals 03 and 04 in TEPC Species.	
Objectives	MIOB01	Continue to inventory known abandoned mines and prepare restoration plans to address biological and physical resource concerns, chemical stability, and human health and safety.
	MIOB02	Develop and implement within one year standardized inspection, monitoring, and reporting requirements for minerals activities to provide for environmentally sound exploration, development, and production of mineral and energy resources.
	MIOB03	Develop a plan to provide for reasonable access to and occupancy of National Forest System lands for mineral-related activities.
	MIOB04	Coordinate and cooperate with other federal and state agencies having authority or expertise in mineral-related activities.

Management Direction for Mineral and Geology Resources		
Type	**Number**	**Direction Description**
Objectives	MIOB05	Identify suitable locations for the interpretation of local geology and mining activities for public enjoyment and education.
	MIOB06	Identify and provide suitable locations for the development of common variety mineral resources.
	MIOB07	Administer active mineral operations in accordance with approved plans of operation, current NEPA analysis, and adequate reclamation bonds.
	MIOB08	During fine-scale analyses in areas where mine facilities are identified as a potential concern or problem contributing to degradation of water quality, aquatic species or occupied sensitive or Watch plant habitat, evaluate and document where the contributing mine facilities are and prioritize opportunities to mitigate effects.
	MIOB09	During site/project-scale analysis, evaluate mine waste material using accepted sampling methods and analytic techniques to determine its chemical and physical stability characteristics.
	See also Objectives for TEPC Species (24); Non-native Plants (05), Recreation Resources (19); and Heritage Program (14).	
Standards	MIST01	Permits and authorizations for exploration and development of common variety minerals shall include terms and conditions for controlling operating methods in timing to prevent degrading effects to surface resources and uses.
	MIST02	Common variety mineral activities will not be conducted on land allocations such as National Recreation Trails, Research Natural Areas, and where recreation or capital improvements preclude such activities.
	MIST03	Common variety and leaseable mineral sources shall not be located and developed within RCAs. If no alternative exists, common variety and leaseable mineral sources shall be located and developed so that they do not degrade or retard attainment of other Forest Plan desired resource conditions and so that reclamation is feasible.
	MIST04	Mitigate degrading effects from locatable mining operations situated within RCAs by identifying reasonable locations for access, processing, and disposal facilities outside of RCAs, wherever possible.
	MIST05	A Certified Mineral Examiner (CME) shall review all proposed Plan of Operations in Inventoried Roadless Areas to determine if unnecessary or unreasonable resource damage will occur. If it is determined that the proposed plans are the next logical level of development, the CME shall prepare a formal Surface Use Determination Report to be used in processing and approving the Plan of Operation.
	MIST06	Require reclamation bonds for all proposed mineral activities that will potentially cause significant surface disturbance and require rehabilitation.
	MIST07	Access on and off mining claims shall be authorized where necessary for mineral development. Road construction, reconstruction, and commercial road use on and off mining claims shall be authorized through a Plan of Operations. When mine development proposals include roads, the NEPA process shall be used to analyze and evaluate proposed routes.
	MIST08	Locate new structures, support facilities, and roads outside RCAs. Where no alternative to siting facilities in RCAs exists, locate and construct the facilities in ways that avoid or minimize degrading effects to RCAs and streams, and adverse effects to TEPC species. Where no alternative to road construction in RCAs exists, keep roads to the minimum necessary for the approved mineral activity. Close, obliterate, and revegetate such roads if no longer required for mineral or other management activities.

Management Direction for Mineral and Geology Resources		
Type	**Number**	**Direction Description**
Standards	MIST09	Prohibit solid and sanitary waste facilities in RCAs. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in RCAs exists, then: a) Analyze waste material using the best conventional methods and analytic techniques to determine its chemical and physical stability characteristics. b) Locate and design waste facilities using the best conventional geochemical and geotechnical predictive tools to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, and such releases or instability would result in exceedance of established water quality standards or would degrade surface resources, prohibit such facilities in RCAs. c) Monitor waste and waste facilities to confirm predictions of chemical and physical stability, and make adjustments to operations as needed to avoid degrading effects to beneficial uses and native and desired non-native fish and their habitats. d) Reclaim and monitor waste facilities to ensure chemical and physical stability and revegetation to avoid degrading effects to beneficial uses and native and desired non-native fish and their habitats. e) Require reclamation bonds adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities.
	See also Standards for TEPC Species (06, 08, 11, 27, 28, 29, 30); SWRA Resources (01, 02, 03, 04, 07, 12); Wildlife Resources (02, 03, 04, 06); Botanical Resources (01); Non-native Plants (03, 04, 06); Scenic Environment (01); Heritage Program (01) and Wild and Scenic Rivers (01).	
Guidelines	MIGU01	Reclamation and mitigation standards that specifically address recurrent maintenance and end-of-season and interim shutdown should be part of operating plans. Reasonable expiration dates and frequency of inspections should be identified in approved plans.
	MIGU02	Long-term or final reclamation should return the land to a planned use that is consistent with the overall land use objectives of the area.
	MIGU03	Where settlement ponds, tailing dams, or impoundments are planned, each should be located, designed, constructed and inspected under the supervision of a professional engineer.
	MIGU04	Unless otherwise authorized, all garbage or refuse should be removed from National Forest System lands.
	MIGU05	New Forest Service capital investments should be avoided on lands where the potential for mineral activities occurring is high, or moderately high, within the foreseeable future.
	MIGU06	Mining development roads should be constructed and maintained to ensure adequate drainage that will mitigate degrading effects to soil, water, and other resource values through avoidance or minimization. Mitigation measures and seasonal maintenance practices for mining access and development roads should be part of the operating plan. Direction applicable to Forest Development Roads used for commercial mining uses are found in the Facilities Standards and Guidelines. Roads no longer needed should be restored, revegetated, and: a) Be closed to vehicular traffic; b) Have bridges and culverts removed; and c) Have the road surface shaped to as near a natural contour as practical and stabilized.
	MIGU07	On National Forest System lands with Reserved Public Domain Status, issuing a lease, permit, or license is not recommended where operational activities—such as surface-based access, product transportation, and ancillary production facilities—may result in irreversible or irretrievable commitment of surface resources. The denial of consent should be based upon site-specific consideration, using the appropriate evaluation criteria for the management area involved.

Management Direction for Mineral and Geology Resources		
Type	**Number**	**Direction Description**
Guidelines	MIGU08	For locatable mineral operations, degrading effects to aquatic resources and water quality should be mitigated.
	MIGU09	Monitoring plans for operation and closure should be developed to confirm predictions and ability to mitigate negative effects to biological, chemical, or physical resources. Results of inspection and monitoring should be evaluated and applied to modify plans and permits as needed to minimize negative effects to other resources.
	MIGU10	Reclamation bonds should be sufficient to ensure the full costs of reclamation, reasonable Forest Service administrative costs, restoration of productivity, and maintenance of long-term physical, chemical, and biological stability. Approved plans should include requirements for regular (annual or biennial) review of bonds.
	MIGU11	Where mine facilities or practices have been identified as potentially contributing to degradation of water quality, aquatic species or occupied sensitive and watch plant habitat, facilities and practices causing degradation should be considered for relocation, closure, changes in management strategy, alteration, or discontinuance.
	See also Guidelines for TEPC Species (01, 02); SWRA Resources (03, 05, 07, 08, 09, 11, 12); Wildlife Resources (03, 05, 06, 12, 13); Botanical Resources (01); Non-native Plants (03, 05); and Recreation Resources (08, 22, 24).	

Lands and Special Uses

Forest Service Manual and Handbook management direction for the Lands program and non-recreation special uses is in FSM 2700 - Special Uses Management, FSM 5400 - Landownership, FSM 5500 - Landownership Title Management, FSM 7150 - Surveying, and FSM 7700 - Transportation System, and in Forest Service Handbooks: 2709.11 - Special Uses Handbook, 2709.12 - Road Rights-of-Way Grants Handbook, 2709.15 - Hydroelectric Handbook, 5409.13 - Land Acquisition Handbook, 5409.17 - Rights-of-Way Acquisition Handbook, and 5509.11 - Title Claims, Sales, and Grants Handbook. See also the Recreation Resources section in this Chapter for additional direction for recreation special uses.

DESIRED CONDITION

Forest management and public needs are met through:

a) Landownership adjustments,
b) Property boundary and landline location, and
c) Issuance of Special Use authorizations.

Adjustments made in land ownership achieve resource management or protection objectives, provide needed access, or allow National Forest System lands to be managed more efficiently. Rights-of-way to access National Forest System lands are acquired to meet planned resource activities. National Forest property boundaries are located on the ground and posted. Pro-active efforts to educate and inform users and adjacent landowners result in reduced levels of unpermitted uses, encroachments, and user conflicts. Conflicts between authorized special uses and other uses and resources are mitigated or eliminated.

Management Direction for Lands and Special Uses

Type	Number	Direction Description
Goals	**Landownership Adjustments**	
	LSGO01	Identify and seek adjustments to land ownership, National Forest boundaries, and interior exclusions to effectively meet public needs, to protect and enhance important resources, to consolidate National Forest System land, and to improve management efficiency. Land adjustments reflect Forest priorities for acquisition and conveyance
	Rights-of-Way	
	LSGO02	Acquire, grant, and/or exchange for legal access to meet the needs of planned resource management activities and public and administrative access.
	Boundaries	
	LSGO03	Protect the public estate and manage the status of National Forest System lands to support resource goals.
	Special Uses	
	LSGO04	Proposed special uses of National Forest System lands—such as hydroelectric development, communication sites, water developments, and utility corridors—are considered that meet public needs, are consistent with direction for other National Forest resources, and cannot be accommodated off the National Forest.

Management Direction for Lands and Special Uses		
Type	**Number**	**Direction Description**
Goals	LSGO05	5) Special use authorizations are issued for uses that: a) Serve the public, b) Promote public health and safety, c) Protect the environment, and/or d) Are legally mandated.
		See also Goals for TEPC Species (06), Wildlife Resources (02), Mineral and Geology Resources (03), Heritage Program (03), and Tribal Rights and Interests (02).
Objectives	**Landownership Adjustments**	
	LSOB01	Use purchase, donation, conveyance, exchange, rights-of-way acquisition, transfer, interchange, and boundary adjustment to accomplish Forest Plan goals.
	LSOB02	Prepare and update, as needed, site-specific plans to guide rights-of-way acquisition, and ownership boundary marking, posting, and management.
	LSOB03	Prepare and maintain a landownership adjustment map based on Forest Plan goals and objectives.
	Rights-of-Way	
	LSOB04	Acquire and grant rights-of-way that meet resource access needs of the Forest Service, public users, and cost-share cooperators.
	LSOB05	Reduce or eliminate the current backlog of reciprocal Rights-of-Way and easement cases.
	Boundaries	
	LSOB06	Protect and maintain boundary lines between National Forest System lands and other ownerships that have been surveyed, posted, and marked to keep them visible, to protect the investment, and to deter encroachment.
	LSOB07	Maintain land status records.
	LSOB08	Identify and resolve trespass uses, title claims, and encroachment occurring on National Forest System lands, and act to reduce the likelihood of future trespass.
	Special Uses	
	LSOB09	Continue working with utilities and others to identify potential areas for additional designated utility and communication facilities.
	LSOB10	Provide for communication site designations and developments that meet public needs and are consistent with direction for National Forest resources.
	LSOB11	Work toward resolution of RS2339 claims for pre-existing ditch lines or other water transmission structures.
	LSOB12	During fine-scale analyses in areas where special use authorization facilities are identified as a potential concern or problem contributing to degradation of water quality, aquatic species or occupied sensitive or Watch plant habitat, evaluate and document where the contributing facilities are and prioritize opportunities to mitigate effects.
		See also Objectives for TEPC Species (25, 26); Non-native Plants (05); Recreation Resources (19); Heritage Program (14); and Tribal Rights and Interests (03).
Standards	**Landownership Adjustments**	
	LSST01	Land adjustments shall be consistent with Forest Plan goals and objectives, and shall consider the goals and objectives for Rights-of-Way.
	Rights-of-Way	
	LSST02	Easement acquisition shall conform to right-of-way planning and shall include existing Forest Transportation System roads and trails as well as project-related new construction. Coordinate with intermingled and adjacent landowners and local governments in developing roads or road systems that serve the needs of all parties. Obtain rights-of-way utilizing eminent domain only if necessary.

Management Direction for Lands and Special Uses		
Type	**Number**	**Direction Description**
Standards	**Boundaries**	
	LSST03	Locate and post National Forest System land boundaries before implementing management activities near or adjacent to private land or other lands not under Forest Service management.
	LSST04	Locate and post wilderness boundaries before implementing management activities that may conflict with any nearby designated wilderness.
	LSST05	Include protection measures for marked property boundaries and corners in all authorizations, contracts, agreements, plans of operations, and internal management activities where the potential for disturbing property markers exists. Damage to or loss of marked property boundaries and corners will be repaired by the appropriate party or management function.
	Special Uses	
	LSST06	Do not accept special-use authorization applications that do not meet special-uses proposal screening and application criteria, as presented in 36CFR 251.54.
	LSST07	New authorized facilities shall be located outside of RCAs wherever possible. When new facilities must be located in RCAs, they shall be developed such that degrading effects to RCAs are mitigated, through avoidance or minimization
	LSST08	Require adequate bonds or other security instruments for special-use authorizations if it is determined the use has potential for disturbance that may require rehabilitation or when needed to ensure other performance.
	LSST09	Proposals for utility and communication facilities outside designated communication sites or utility and wireless technology corridors shall be considered only after improvement of existing facilities to accommodate expanded use is analyzed and determined to be unreasonable.
	LSST10	Use authority granted under Section 4(e) of the Federal Power Act, to participate in FERC licensing processes for any project with the potential to affect National Forest System lands.
	LSST11	Use conditioning authority granted under Section 4(e) of the Federal Power Act to ensure that hydroelectric facilities that must be located within RCAs are located, operated, and maintained in a manner that mitigates degradation of Forest resources.
	LSST12	Where the authority to do so was retained, and in cooperation with affected state, tribal, and local governments, holders of water rights, and other interested parties, require that water diversion structures: a) Be monitored to limit water withdrawals to the amount of the water right and the time period of the water right; and b) Have either fish screens, or other means, to prevent fish entrapment/entrainment. Where the authority was not retained, negotiate changes to meet other Forest resource objectives wherever possible.
	LSST13	Small hydropower facilities that are granted exemptions from licensing by the FERC shall be located, operated and maintained to mitigate degradation of Forest resources.
	LSST14	Applications received before December 31, 1996 that request issuance of a permanent easement for a qualifying agricultural water system under Public Law 99-545 (commonly called the "Ditch Bill") shall be processed, subject to the conditions of the law.
	LSST15	Access to privately owned property surrounded by National Forest System lands shall be provided, subject to reasonable terms and conditions, as required by the Alaska National Interest Lands Conservation Act of December 2, 1980.
	See also Standards for TEPC Species (06, 07, 11, 31); SWRA Resources (01, 02, 03, 04, 05, 06, 07, 08, 09, 11, 12); Wildlife Resources (02, 03, 04, 05, 06); Botanical Resources (01); Non-native Plants (03, 10); Mineral and Geology Resources (01); Scenic Environment (01); Heritage Program (01); Tribal Rights and Interests (01, 02, 05, 06); and Wild and Scenic Rivers (01).	

Management Direction for Lands and Special Uses

Type	Number	Direction Description
Guidelines	**Land Acquisition**	
	LSGU01	Acquisitions of land and interest in lands should be guided by the following criteria: **Priority 1 Acquisitions:** (not listed in any order of priority) a) Lands and associated riparian ecosystems on water frontage such as lakes and major streams. b) Critical habitat lands needed for protection of TEPC fish, wildlife, or plant species. c) Other environmentally sensitive lands, such as important wetland and riparian areas. d) Lands needed for the protection of significant historical or cultural resources when these resources are threatened or when management may be enhanced by public ownership. e) Lands that enhance recreation opportunities, public access, and protection of aesthetic values. f) Lands needed for protection and management of administrative and Congressionally designated areas. g) Lands needed to reduce expenses of both the Forest Service and the public in administration and utilization. Consolidation of split estates. h) Lands with water rights that can be used to accomplish purposes for which the National Forest was created, or related resource obligations. **Priority 2 Acquisitions:** (not listed in any order of priority) a) Key tracts of an ecosystem that are not urgently needed, but will promote more effective management of the ecosystem and will meet specific needs for vegetative management, watershed management, research, public recreation, or other defined management objectives. Generally, these tracts will support consolidation objectives. b) Buffer lands needed for protection of lands acquired for purposes listed above. c) Lands needed to protect resource values by eliminating or reducing fire risks, soil erosion and occupancy trespass. **Priority 3 Acquisitions:** All other lands desirable for inclusion in the National Forest System.
	Land Conveyance	
	LSGU02	Federal land conveyances by exchange or other specific authority should be guided by the following criteria: (not listed in any order of priority) a) Lands inside or adjacent to communities or intensively developed private land, and chiefly valuable for non-National Forest System purposes. Lands that support community expansion. b) Parcels that will serve a greater public need in state, county, city, or other federal agency ownership. c) Inaccessible parcels isolated from other National Forest System lands. Parcels intermingled with private lands. d) Parcels under long-term special use permits whose use and purpose are not substantially consistent with National Forest purposes and character. Parcels having boundaries, or portions of boundaries, with inefficient configurations (projecting necks or long, narrow strips of land, etc.) Lands that support more logical and efficient management. e) Parcels eligible for disposition under the Small Tracts Act or other statutory authorities.
	Rights-of-Way	
	LSGU03	Necessary rights for county roads, state highways, and major utility improvements should be conveyed when such conveyances are in the long-term interest of management of the National Forest and in the public interest.

Management Direction for Lands and Special Uses		
Type	**Number**	**Direction Description**
Guidelines	LSGU04	Where feasible, exchange of easements, co-op agreements, and cost/share supplements should be considered as alternatives to purchase of rights-of-way.
	LSGU05	Existing Forest transportation system roads and trails, as well as project-related new construction, should be included in easement acquisition.
	Boundaries	
	LSGU06	Ownership boundary lines should be surveyed, marked, and posted to applicable Forest Service standards according to the following priorities: a) Boundary lines adjacent to or near proposed management activities. b) Boundary lines where encroachment activity by adjoining owners is suspected or known to exist. c) Boundary lines at high risk in proximity to potential or planned outside development.
	Special Uses	
	LSGU07	Formation of user associations in lieu of individual special-use permits and rights-of-way in common use facilities, uses, or areas should be encouraged. Multiple permits to the same organization should be incorporated into one permit if this facilitates permit administration.
	LSGU08	Priority for modifying existing authorizations should consider the current and potential negative effects on human health and safety and resource values that may be affected.
	LSGU09	The Federal Energy Regulatory Commission should be notified that hydroelectric proposals in watersheds with water quality concerns, important fisheries, and/or occupied TEPC plant habitat are inconsistent with Forest Plan management objectives when degrading effects cannot be effectively avoided or mitigated.
	LSGU10	Hydroelectric development that meets public needs and is consistent with direction for other National Forest resources should be considered.
	LSGU11	The FERC should be notified when projects are proposed for locations, such as in designated Wilderness, which would be inconsistent with Forest management direction and/or the National Forest reservation. It should be recommended to the FERC that preliminary permits and licenses be denied for proposals within areas recommended for Wilderness, proposed Research Natural Areas, and eligible and suitable Wild and Scenic River stream segments until appropriate studies and/or legislative processes are completed.
	LSGU12	During licensing of new and existing facilities, conditions that require flows and habitat conditions that maintain or restore riparian and aquatic resources and channel integrity should be recommended to the Federal Energy Regulatory Commission (FERC). Review and assessment of applications should be coordinated with the FERC and others. The FERC should be notified of projects that are inconsistent with the National Forest reservation.
	LSGU13	During licensing of new and existing hydroelectric facilities, conditions requiring that existing ancillary facilities be located such that degrading effects to other resources are mitigated should be recommended to the FERC. Where effective mitigation cannot be implemented, such facilities should be relocated.
	LSGU14	Proposed new and previously unpermitted small hydroelectric projects that have been exempted by FERC should be evaluated on a case-by-case basis. The evaluation should consider beneficial uses, environmental and social consequences, and resolution of conflicts with other resource objectives and activities.
	LSGU15	Access to authorized improvements for maintenance needs should be addressed as part of Special Use authorizations. Where appropriate access is not addressed in existing authorizations, the authorizations should be amended to include it.
	LSGU16	The 1993 Western Regional Utility Corridor Study, or its successors, should be used as a reference document or guide when considering land use decisions that may affect existing and/or proposed major electric power utility corridors.

Management Direction for Lands and Special Uses		
Type	**Number**	**Direction Description**
Guidelines	LSGU17	Consider requiring the posting of a bond by authorization holders to cover future project decommissioning costs associated with new structures such as dams and large buildings.
	LSGU18	Where opportunities to mitigate special use authorized facilities and practices causing degradation have been identified, consider mitigating through measures such as relocation, closure, and changes in management strategy, alteration, or discontinuance.
	See also Guidelines for TEPC Species (10, 11, 12); SWRA Resources (03, 05, 06, 07, 08, 09, 12, 13); Wildlife Resources (04, 05, 06, 11, 12, 13); Botanical Resources (01); Fire Management (05); Non-native Plants (03, 05); Mineral and Geology Resources (05, 07); Recreation Resources (05, 06, 08, 14, 22, 24); and Tribal Rights and Interests (01).	

Facilities and Roads

Forest Service Manual and Handbook management direction for facilities and roads is in Forest Service Manuals: 5460 - Right-of-Way Acquisition, 7100 - Engineering Operations, 7300 - Buildings and Other Structures, 7400 - Public Health and Pollution Control Facilities, 7500 - Water Storage and Transmission, 7600 - Electrical Engineering, and 7700 - Transportation System; and in Forest Service Handbooks: 5409.17 - Rights-of-Way Acquisition Handbook, 7309.11 - Buildings and Related Facilities Handbook, 7409.11 - Sanitary Engineering and Public Health Handbook, 7509.11 - Dams Management Handbook, 7709.55 - Transportation Planning Handbook, 7709.56 - Road Preconstruction Handbook, 7709.56b - Transportation Structures Handbook, 7709.57 - Road Construction Handbook, 7709.58 - Transportation System Maintenance Handbook, and 7709.59 - Transportation System Operations Handbook.

DESIRED CONDITION

Needed facilities are developed to the standard adequate for their intended purpose. Reconstruction and remodeling of existing facilities, and construction of new facilities, occur as facilities wear out or need to change. Facilities are safe, efficient, and meet land and resource management objectives.

The road network matches the level of management activities occurring on the Forest and supplies the transportation system needed for recreation, special uses, timber harvest, range management, minerals development, and fire protection. The transportation network is managed, through the use of a variety of tools, to reduce degrading effects to resources. Roads needed for long-term objectives are maintained to provide for user safety and resource protection. Roads not needed for long-term objectives are decommissioned and stabilized.

Management Direction for Facilities and Roads

Type	Number	Direction Description
Goals	FRGO01	Provide and maintain a safe, efficient Forest transportation system that meets resource management and access needs, while mitigating degrading resource effects.
	FRGO02	Provide and maintain safe and efficient Forest facilities.
	FRGO03	Manage the Forest telecommunication system and related facilities in accordance with the Forest Communication Plan and established national telecommunication standards.
	See also Goals for Wildlife Resources (02), Botanical Resources (06); Heritage Program (03), and Recreation Resources (01, 02, 04, 05).	
Objectives	FROB01	Analyze road system needs and associated resource effects in accordance with the established agency policy direction for roads analysis.
	FROB02	Cooperate with federal, state, and county agencies, tribal governments, and cost-share partners to achieve consistency in road design, operation, and maintenance needed to attain resource goals.
	FROB03	Identify safety hazards on Forest classified roads, establish improvement priorities, correct or mitigate the hazard.
	FROB04	During fine-scale analyses, identify opportunities to reduce road-related degrading effects to help achieve other resource objectives.

Management Direction for Facilities and Roads		
Type	**Number**	**Direction Description**
Objectives	FROB05	Coordinate transportation systems, management, and decommissioning with other federal, state and county agencies, tribal governments, permittees, contractors, cost-share cooperators, and the public to develop a shared transportation system serving the needs of all parties to the extent possible.
	FROB06	Identify roads and facilities that are not needed for land and resource management, and evaluate for disposal or decommissioning.
	FROB07	Ensure that potable water provided at any public or administrative facility is safe to protect the health and safety of the public and Forest personnel as required by law.
	FROB08	Manage a system of airfields and helispots needed for land and resource management, including appropriate public access needs.
	FROB09	Develop a Forest Facilities Master Plan depicting facility location, unit standards, existing and proposed buildings, and related improvements.
	FROB10	Inventory and assess existing classified road crossings in subwatersheds that are occupied or contain critical habitat for TEPC species. Prioritize inventories and assessments in subwatersheds outside designated and recommended wilderness and Inventoried Roadless Areas (IRA); few if any classified road crossings exist in these areas. Assess crossings to determine if they provide for fish passage, 100-year flood flow, and bedload and debris transport. Incorporate the results into the biennial updates of the Watershed and Aquatic Recovery Strategy (WARS) database.
	FROB11	In the Forest's annual program of work, prioritize and schedule improvements to existing culverts, bridges, and other stream crossings to accommodate fish passage, 100-year flood flow, and bedload and debris transport. Include accomplishments in the biennial update of the Watershed and Aquatic Recovery Strategy (WARS) database.
	FROB12	During fine-scale analyses in areas where roads and facilities are identified as a potential concern or problem contributing to degradation of water quality, aquatic and wildlife habitats or occupied sensitive or Watch plant habitat, evaluate and document where the contributing facilities are and prioritize opportunities to mitigate effects.
	See also Objectives for TEPC Species (03, 07); SWRA Resources (12, 13, 14, 18); Wildlife Resources (05, 12); Non-native Plants (03, 04); Recreation Resources (01, 05, 07); Heritage Program (14); and Wilderness, Recommended Wilderness, and Inventoried Roadless Areas (03).	
Standards	FRST01	When taking water from fish-bearing streams for road and facility construction and maintenance activities, intake hoses shall be screened with the appropriate mesh size.
	FRST02	To accommodate floods, including associated bedload and debris, new culverts, replacement culverts, and other stream crossings shall be designed to accommodate a 100-year flood recurrence interval unless site-specific analysis using calculated risk tools or another method, determines a more appropriate recurrence interval.
	FRST03	In support of road management decisions, use an interdisciplinary science-based roads analysis process such as Roads Analysis: Informing Decisions About Managing the National Forest Transportation System (USDA FS, 1999 Report FS-643).
	FRST04	Roads shall be constructed to a standard appropriate to their intended use, considering safety and concerns for resource degradation.
	FRST05	Mitigate handling of road waste material (e.g., slough, rocks) to avoid or minimize delivery of waste material to streams that would result in degradation of soil, water, riparian and aquatic resources.
Standards	*See also Standards for TEPC Species (06, 11, 32); SWRA Resources (01, 02, 03, 04, 07, 08, 11, 12); Wildlife Resources (02, 03, 04, 05, 06); Botanical Resources (01, 04); Non-native Plants (03, 04, 06, 07, 08, 09, 10); Minerals and Geology (08); Recreation Resources (02, 03, 04); Scenic Environment (01); Heritage Program (01); and Wild and Scenic Rivers (01).*	

Management Direction for Facilities and Roads		
Type	**Number**	**Direction Description**
Guidelines	FRGU01	To protect soil, water, and riparian resources, and their occupied habitat, water supply points, service areas, and other needs for road and facility construction projects should be specified in project planning and used in project implementation.
	FRGU02	In areas of existing extensive infestation, mitigation for noxious weed prevention should be incorporated into road layout, design, and project alternative evaluation.
	FRGU03	Prior to decommissioning roads, opportunities related to those roads for potential development or use as travel routes for ATVs, mountain bikes, or other alternative forms of transportation, should be considered.
	FRGU04	Roads that are not desired for public access or tribal uses, and that are no longer needed to manage the Forest or to provide access to inholdings should be considered for decomissioning and returning the lands that they occupy to desired resource management.
	FRGU05	Where practical alternatives exist, roads in RCAs that are degrading riparian-dependent resources should be evaluated for obliteration or relocation.
	FRGU06	New roads and landings should be located out of RCAs wherever possible. When new roads or landings must be located in RCAs, they should be developed such that degrading effects to RCAs are mitigated.
	FRGU07	Annually prioritize roads to receive maintenance, repairs, or improvements to protect the investment, maintain the intended serviceability, and protect other resources. Road maintenance activities should be prioritized using factors such as user safety, resource protection needs, administrative needs, user comfort, the identified traffic service level, and available funding.
	FRGU08	Classified roads in intermittent use status should be evaluated for physical closure during periods of non-use and closed as appropriate.
	FRGU09	Travel management should be used, as needed, to accomplish the following: a) Provide for the safety and welfare of the users. b) Protect threatened and endangered species and their habitat. c) Protect Forest resources, such as wildlife, soil, vegetation, and water. d) Provide a diversity of recreational experiences and reduce user conflicts. e) Protect road and trail investments. f) Comply with Forest contracts or permits, cooperative agreements, road purchase agreements, easement deeds, or other formal documents of the Government requiring that road use be controlled. g) Coordinate hunting and fishing opportunities with State agencies.
	FRGU10	When considering closure or decommissioning of roads for which an RS2477 assertion has been made by either a State or a County government, the merits of the assertion should be evaluated prior to taking any actions.
	FRGU11	Where opportunities to mitigate facilities and road management practices causing degradation have been identified, consider mitigating through measures such as relocation, closure, and changes in management strategy, alteration, or discontinuance.
	FRGU12	Historic qualities should be considered when reviewing proposed modifications to, or decommissioning of, fire lookouts and other administrative use structures.
	FRGU13	Architectural designs should follow principles and concepts outlined in the Built Environment Image Guide (BEIG).
	See also Guidelines for TEPC Species (13, 14); SWRA Resources (03, 05, 06, 07, 08,0 9, 11, 12); Wildlife Resources (04, 05, 06,08, 11, 12, 13); Botanical Resources (01, 02, 03); Non-native Plant (02, 03, 05); Mineral and Geology Resources (05, 06); Lands and Special Uses (03, 04, 05); Recreation Resources (05, 08, 09, 10, 12, 18, 19, 20); and Scenic Environment (07, 08, 09, 10, 11, 12, 13, 14, 15, 16).	

Recreation Resources

Forest Service Manual and Handbook direction for managing recreation resources is in Forest Service Manuals: 2300 - Recreation, Wilderness, and Related Resource Management, 2710 – Special Use Authorizations, and 2720 - Special Uses Administration; and in Forest Service Handbooks 2309.18 - Trails Management Handbook, and 2709.11 - Special Uses Handbook. Direction can also be found in the Region 1 - Region 4 Handbook 2509.22 - Soil and Water Conservation Practices Handbook.

DESIRED CONDITION

People visiting the National Forest find opportunities for a wide spectrum of recreation experiences. Various methods are used to manage recreation uses and facilities to mitigate degrading effects from recreation to other resources. Diverse landscapes offer a variety of settings for a wide range of activities, including primitive settings where there are opportunities for solitude, risk, and challenge, to more modified settings where there are opportunities for social interaction, comfort, and less risk.

Recreation facilities are managed to provide safe experiences and opportunities. Recreation programs and facilities meet all applicable local, state, and national standards for health and safety. Opportunities for physically challenged recreationists are maintained or expanded at developed facilities and through management of dispersed activities.

Dispersed recreation sites and uses are located and conducted in an environmentally responsible manner and managed to established standards.

Conflicts between recreationists are reduced or addressed, while a broad array of recreation opportunities are available. Collaboration among users results in decisions that reduce conflicts between recreational needs and environmental needs. Local communities, partners, and volunteers are involved and benefit from their roles in providing recreational opportunities.

A variety of environmentally responsible access is provided for recreation users.

Interpretive exhibits, displays, and programs provide learning opportunities that enhance Forest visitor’s experiences. Interpretive and educational efforts increase visitor awareness of the environmental effects of recreation use, and result in reduced degradation to other resources.

Authorized commercial developments and services meet established national standards and broaden the range of recreation opportunities and experiences provided on National Forest System lands.

Management Direction for Recreation Resources		
Type	**Number**	**Direction Description**
Goals	**General Recreation**	
	REGO01	Manage, operate, and maintain a year-round recreation program that offers a broad range of developed and dispersed recreation opportunities and experiences in a range of settings as reflected by the Recreation Opportunity Spectrum (see Appendix F for descriptions of ROS classes).
	REGO02	Plan and manage the recreation program and recreation resources to meet established standards (e.g., Meaningful Measures) to provide for health and cleanliness, safety and security, facility conditions, responsiveness to customers, environmental setting, and permit administration.
	REGO03	Address current and emerging recreation conflicts, while maintaining recreation opportunities when possible.
	REGO04	Manage recreation uses and facilities to mitigate degrading effects from recreation to other resources.
	Recreation Access	
	REGO05	Manage motorized and non-motorized travel and travel-related facilities to: a) Provide for public safety, b) Meet resource objectives and access needs, c) Mitigate road and trail damage, and d) Minimize maintenance costs and user conflicts.
	Winter Recreation	
	REGO06	Provide an array of winter recreation experiences, while mitigating conflicts between motorized and non-motorized use and wintering wildlife.
	Recreation Special Uses	
	REGO07	Ensure that recreation operations, under or being considered for special use authorizations, provide opportunities, facilities, and services that respond to a demonstrated public need while mitigating conflicts with other uses and resources, where possible.
	See also Goals for SWRA Resources (11); Wildlife Resources (02); Botanical Resources (06); Non-native Plants (01); Rangeland Resources (06); Lands and Special Uses (04, 05); Facilities and Roads (02); Heritage Program (03); and Scenic Environment (01).	
Objectives	**General Recreation**	
	REOB01	During fine-scale analyses in areas where recreation facilities are identified as a potential concern or problem contributing to degradation of water quality, aquatic species or occupied sensitive or Watch plant habitat, evaluate and document the location of the facilities causing degradation and prioritize opportunities to mitigate effects.
	REOB02	Utilize the Recreation Opportunity Spectrum (ROS) to evaluate and tailor proposed projects and activities in order to maintain desired recreation opportunities and the quality of recreation experiences
	REOB03	Update existing ROS inventories as part of project-level planning and implementation if project activities cause a change in recreation setting conditions significant enough to reclassify the affected area.
	REOB04	Maintain the necessary data to determine the individual and/or cumulative changes in ROS classes relative to the management area ROS strategy.
	REOB05	Identify and develop motorized use opportunities in locations appropriate for motorized uses through road to trail conversion, development of new trails, and other methods.
	REOB06	Continue efforts to inventory, survey, and map dispersed recreation sites to provide resource data for dispersed site management.
	REOB07	Inform the public in a timely manner about management actions affecting their recreation opportunities at appropriate locations, including roads, trails, and at developed sites.

Management Direction for Recreation Resources		
Type	**Number**	**Direction Description**
Objectives	REOB08	In cooperation with affected state, tribal, and local governments, holders of water rights, and other interested parties, maintain and acquire, under the appropriate state and federal laws and Forest Service policy, water rights for the administration of recreational activities and developments, including special use authorizations.
	REOB09	Use education and interpretation opportunities to foster dispersed camping that is at least 100 feet from trails, lakes, streams, or other occupied campsites, as terrain permits.
	REOB10	Monitor recreation resource conditions, visitor use levels, types of uses, and visitor expectations to guide recreation management actions.
	REOB11	Collaborate with other government agencies, recreation partners, volunteer organizations, and the recreation and tourism industry in recreation planning and delivery efforts to: a) Provide support to local economies, b) Promote management efficiency, and c) Improve recreation opportunities and experiences available to the public.
	REOB12	Annually update recreation databases for developed sites, dispersed areas, and trails.
	Developed Recreation	
	REOB13	Continue to improve accessibility on the Forest in compliance with all federal laws and agency guidelines.
	REOB14	Identify developed recreation sites with priority vegetation management needs, and develop comprehensive vegetation management plans to address those needs.
	REOB15	Foster and strengthen partnerships between public and private sectors to effectively and efficiently manage recreation and tourism facilities.
	REOB16	Develop ADA transition plans for developed recreation sites and begin implementation of those plans to enhance recreation opportunities and experiences.
	Recreation Access	
	REOB17	Initiate a process of phased, site-specific travel management planning as soon as practicable. Prioritize planning based on areas where the most significant user conflicts and resource concerns are occurring. Identify and address inconsistent access management of roads, trails, and areas across Forest, Ranger District, and interagency boundaries.
	REOB18	Manage cross-country travel to mitigate recreationist and big game conflicts on winter/spring ranges.
	REOB19	Mitigate degradation to Forest System trails from other resource management activities, including fire suppression, and special use activities
	REOB20	During fine-scale analyses in areas where recreational trails are identified as a potential concern or problem contributing to degradation to other resources, evaluate and document the location of the trail degradation and prioritize opportunities to mitigate effects.
	REOB21	During project planning and implementation, develop measures to mitigate degrading effects from National Forest System and non-National Forest System trails.
	Winter Recreation	
	REOB22	Provide networks of marked and designated snow machine, cross-country ski, and other winter travel routes and trailhead facilities, while meeting other resource goals and objectives.
	REOB23	Provide winter recreation user information to educate users of wildlife needs and promote backcountry safety.
	REOB24	Provide opportunities for backcountry winter recreation in areas without wintering wildlife conflicts.
	REOB25	Support winter trail management through cooperative agreements with other agencies and groups.
	Special Uses	

Management Direction for Recreation Resources		
Type	**Number**	**Direction Description**
Objectives	REOB26	When identifying the need for outfitter and guide services, and issuing and administrating outfitter and guide permits, coordinate with the Idaho Outfitters and Guide Licensing Board.
	See also Objectives for TEPC Species (27, 28, 29, 30, 31, 32); SWRA Resources (03, 12, 13); Wildlife Resources (11); Non-native Plants (05, 06); Facilities and Roads (06); Heritage Program (14, 17); and Tribal Rights (03).	
Standards	**General Recreation**	
	REST01	Where Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized ROS classes occur within designated wilderness areas, follow the wilderness management direction contained in the appropriate wilderness management plans.
	Developed Recreation	
	REST02	When new recreation facilities and trails must be located in RCAs, they shall be developed such that degrading effects to RCAs are mitigated. Where reasonable and practical location alternatives exist, new recreation facilities and trails should be located outside of RCAs.
	Recreation Access	
	REST03	Access will be managed in accordance with the existing travel management maps and amendments, or as authorized by permit, contract, or special-use authorization.
	REST04	On all lands outside of designated travel ways, motorized use shall be prohibited unless otherwise authorized.
	REST05	In emergency situations, road, trail, and area access restrictions for up to 1 year may be implemented without public participation if needed to protect resources and/or to provide for public safety.
	Recreation Special Uses	
	REST06	When a State or Federal license or permit is required for a recreation special use activity or operation on the Forest, that license or permit shall be a prerequisite to issuance of any special-use authorization.
	See also Standards for TEPC Species (06, 11, 33, 34); SWRA Resources (01, 02, 03, 04, 06, 07, 08, 10, 11, 12); Wildlife Resources (02, 03, 04, 05, 06); Vegetation (02); Botanical Resources (01, 04); Non-native Plants (01, 03 04, 06, 10); Timberland Resources (06); Mineral and Geology Resources (01, 02); Lands and Special Uses (06); Scenic Environment (01); Heritage Program (01); Tribal Rights and Interests (01, 05, 06); Wilderness, Recommended Wilderness, and IRAs (01); and Wild and Scenic Rivers (01).	
Guidelines	**General Recreation**	
	REGU01	Recreation strategies and developments should be coordinated with State and local recreation resource planning efforts.
	REGU02	Seasonal camping stay and group size limits should be established where needed to meet management goals.
	REGU03	Where the recreation demand exceeds resource capabilities or significantly changes the recreation experience available to users, alternative management strategies should be evaluated and management should be adjusted as appropriate.
	REGU04	Local Forest Service resource managers should facilitate and encourage involved user groups to resolve use conflicts among themselves. When the involved user groups accomplish resolution, the Forest Service should strongly consider recommendations and implement within the laws, regulations and policies that govern management of the National Forests. When the involved user groups do not accomplish resolution, the Forest Service should work to resolve the conflict based on the agency mission.
	REGU05	Management activities and facility development in Scenic Byway corridors with management plans should be sensitive to the goals contained within the corridor management plans.

Management Direction for Recreation Resources

Type	Number	Direction Description
Guidelines	REGU06	When proposed management actions may affect dispersed recreation sites, those potential effects should be evaluated during project-scale analysis.
	REGU07	Where recreation facilities or practices have been identified as potentially contributing to degradation of water quality or aquatic species, sensitive wildlife species or occupied sensitive and watch plant habitat, facilities and practices causing degradation should be considered for relocation, closure, changes in management strategy, alteration, or discontinuance.
	REGU08	All projects and activities should maintain or enhance the adopted ROS classes as displayed on the Forest ROS strategy maps.
	REGU09	Motorized transport is generally not consistent within Primitive and Semi-primitive Non-motorized areas. However, exceptions may include: a) Search and rescue evacuation; b) Medical treatment of individuals; c) Wildland fire suppression; d) Prescribed fire activities; e) Law enforcement activities; f) Wildlife transplant or relocation activities; g) Trail construction and maintenance; and h) Watershed restoration and/or repair of other resource damage from natural events.
	REGU10	New road construction should not occur within the summer Primitive and Semi-Primitive Non-Motorized areas.
	REGU11	During the winter season, motorized use may be allowed to set cross-country skiing tracks or skating lanes within the Semi-Primitive Non-Motorized areas.
	REGU12	Facilities identified as necessary should blend with the surrounding landscape character and the ROS setting.
	REGU13	Information and interpretive services or displays should be consistent with the ROS class.
	REGU14	Special-use permits may be issued for activities and facilities compatible with the ROS class.
	REGU15	ROS descriptions in Appendix F should be used to help guide facility development and recreation activity management within each ROS class.
	Developed Recreation	
	REGU16	During planning for new sites, or the reconstruction of existing sites, developed recreation sites should be designed to channel foot traffic towards common use areas in order to preserve ground cover and "green islands" of vegetation within the site.
	REGU17	Commercial livestock grazing should be avoided in developed recreation sites. Fence developed recreation sites within range allotments if necessary.
	REGU18	Decisions to develop recreation facilities should be based on evidence and evaluation of any of the following: a) Increased public need; b) Operating efficiency; c) The need to reduce concentration on, or conflicts at, existing sites; or d) The need to reduce resource degradation from recreation use and existing developments.
	REGU19	In developed recreation facilities, waste disposal methods should be bear-resistant.
	Recreation Access	
	REGU20	Trailhead facilities should be provided and managed commensurate with the appropriate level of use, resource effect, and local priority. These facilities may be public or private, depending on their location.

Management Direction for Recreation Resources		
Type	**Number**	**Direction Description**
Guidelines	REGU21	Funding priorities for trail maintenance should be based on: a) The five maintenance levels and traffic classes of trail use, b) Resource degradation, and/or c) Type and degree of use.
	REGU22	Damage to or loss of Forest System trails from timber harvest, livestock grazing, road construction, mining, special uses, and prescribed fire activities should be repaired or mitigated by the appropriate party.
	REGU23	State motorized grant fund investments should be consistent with Management Area ROS objectives.
	REGU24	Protection measures for National Forest System trails should be included in all timber sale contracts, annual operating plans for grazing, mining, and special use authorizations, and prescribed fire implementation documents.
	Winter Recreation	
	REGU25	Winter recreation opportunities should be managed to provide for user safety and to minimize user conflicts. Winter recreation management should recognize that some activities are not compatible in the same locations and should be separated when needed to maintain user safety and quality recreation experiences.
	REGU26	When resolving conflicts between winter recreation user groups, appropriate consideration and protection should be given to capital investments such as groomed and/or designated trails.
	Recreation Special Uses	
	REGU27	Special-use authorizations for public recreation uses should have operation plans. These plans should address adequate public service, health and safety, and resource protection.
	REGU28	When proposed services are compatible with the existing public recreation activities and when the proposed use will not degrade Forest resources, outfitter and guide special use permits may be issued. Public need should take precedence over permittee desires in any facility constructed wholly or partially with public dollars.
	REGU29	Permitted outfitter and guide operations should blend with the adopted ROS setting and/or the wilderness plan for the area in which the operation's service is to be performed.
	REGU30	The needs of both outfitted and non-outfitted users should be considered when setting use limits and/or restrictions.
	REGU31	Outfitter and guide bases of operations should be located on private lands, or, if necessary, located in conjunction with other permitted operations.
	REGU32	Historic qualities should be considered when reviewing proposed modifications of recreation residences, resorts, and other private structures under special use authorizations**.**
	See also Guidelines for TEPC Species (02); SWRA Resources (03, 05, 07, 08, 09, 10, 11, 12); Wildlife Resources (05, 06,0 8, 11, 12, 13); Vegetation (01); Botanical Resources (01, 02, 03); Non-native Plants (03, 05); Fire Management (05); Rangeland Resources (10); Mineral and Geology Resources (05); Lands and Special Uses (01, 07, 08); Facilities and Roads (03, 09); Wilderness, Recommended Wilderness, and Inventoried Roadless Areas (04, 05); and Research Natural Areas (02).	

Scenic Environment

Forest Service Manual direction for managing the scenic environment is in FSM 2380 - Landscape Management. Direction can also be found in Agriculture Handbook Number 462.

DESIRED CONDITION

The Forest provides a range of diverse landscapes. The scenic environment within the Forest ranges from landscapes displaying little or no evidence of management activities, to landscapes that have dominant visible evidence of management activities. Scenic quality is maintained or enhanced in areas of high scenic value and other highly used recreation areas.

<table>
<tr><th colspan="3">Management Direction for Scenic Environment</th></tr>
<tr><th>Type</th><th>Number</th><th>Direction Description</th></tr>
<tr><td>Goals</td><td>SCGO01</td><td>Manage the Forest’s scenic resources to maintain the recreation and visual resource values, while meeting other resource needs.</td></tr>
<tr><td rowspan="2">Objectives</td><td>SCOB01</td><td>Implement the Scenery Management System either through the Continuous Assessment and Planning process or as part of the next Forest Plan revision. Use the Visual Management System until the Scenery Management System can be implemented.</td></tr>
<tr><td>SCOB02</td><td>To facilitate the development of scenery management objectives, develop landscape character definitions, identify sense of place values, and inventory human-altered landscapes during landscape-scale assessments.</td></tr>
<tr><td rowspan="3">Standards</td><td>SCST01</td><td>All projects shall be designed to meet the adopted Visual Quality Objectives (VQOs) as identified in Management Area direction and represented on the Forest VQO map.</td></tr>
<tr><td>SCST02</td><td>Allow for short-term reductions in VQOs to accommodate Burned Area Emergency Rehabilitation (BAER) projects, emergency needs for protection of investments, and public safety needs. When reducing VQOs, attempt to meet the next-highest objective at the closest viewer distance or most relevant distance given the probable sensitive viewer.</td></tr>
<tr><td colspan="2"><i>See also Standards for Timberland Resources (02, 03) and Wild and Scenic Rivers (02).</i></td></tr>
<tr><td rowspan="5">Guidelines</td><td>SCGU01</td><td>Definitions of VQOs are those used in the Visual Management System, Agricultural Handbook Number 462. VQO abbreviations are given in the table, below. See glossary definitions for more explanation of VQOs and distance zones used below.
<table>
<tr><th colspan="2">Visual Quality Objectives</th><th colspan="2">Distance Zones</th></tr>
<tr><td>P</td><td>Preservation</td><td>fg</td><td>Foreground</td></tr>
<tr><td>R</td><td>Retention</td><td>mg</td><td>Middleground</td></tr>
<tr><td>PR</td><td>Partial Retention</td><td>bg</td><td>Background</td></tr>
<tr><td>M</td><td>Modification</td><td></td><td></td></tr>
<tr><td>MM</td><td>Maximum Modification</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>SCGU02</td><td>Duration of visual impacts from ground disturbing and vegetation removal activities to allow for herbaceous vegetative recovery of ground cover may extend to three years in fgR, fgPR, mgR, and mgPR. Consider timely initiation of reseeding in areas where natural recovery is questionable.</td></tr>
<tr><td colspan="2">Timber Harvest Activities</td></tr>
<tr><td>SCGU03</td><td>To meet fgR, visibility of stumps should be mitigated. There should be a general lack of visible ground disturbance.</td></tr>
</table>

Management Direction for Scenic Environment		
Type	**Number**	**Direction Description**
Guidelines	SCGU04	Slash and harvest residues remaining after project completion should appear to be naturally occurring downed material in fgR and mostly naturally occurring downed material in fgPR. Techniques to mitigate visibility of slash include lopping to low heights, burning, physically removing material excess to other resource needs, and dispersing concentrations.
	SCGU05	Most timber changes in mgR should be textural, with some small, simulated natural openings where openings already occur, or a limited number of small natural-appearing openings that are developed normally over two or more harvest entries.
	SCGU06	Ridgeline silhouettes in mgR, mgPR, and bgR should not have unnatural-appearing breaks along them.
	Facility Development	
	SCGU07	In fgR, roads should only be visible for a short distance from the sensitive travel way or use area. Other visible temporary excavation could occur providing the area is graded and natural-appearing contours are re-established within the same year and revegetation is initiated.
	SCGU08	There should be minimal distraction from scenic quality in fgPR and mgR from road construction, reconstruction, and other excavation management.
	SCGU09	Roads and other excavation may be visible in mgPR and bgPR, but should blend into the characteristic landscape of the surroundings.
	SCGU10	Roads and other excavation within the visual zone may dominate fgM and mgM landscapes, but their visual characteristics should be compatible with the natural surroundings.
	SCGU11	Roads and other excavation may dominate MM views. When viewed as background, the visual characteristics should be those of natural occurrences within the surrounding area. Efforts should be made to reduce sharp contrasts at any distance.
	SCGU12	When a structure or facility is created for public use, the design materials, color, and location should blend with the characteristic landscape so that visitors can enjoy the function and appearance.
	SCGU13	When a structure or facility is created for other than public use, the materials, color, and location should be chosen to reduce visual contrast of the structure.
	SCGU14	The use of natural or neutral colors and non-reflective surfaces should be considered for structures. An exception to this would be when the function of the structure is to be seen.
	SCGU15	Natural or neutral colors should be used in to help structures blend with the landscape.
	SCGU16	If the designated VQO cannot be met with overhead lines, electrical power lines of 33 KV or less should be placed underground, unless geologic structures prevent such installation.
	Fire Use	
	SCGU17	Wildland fire use and prescribed fire that emulates natural-appearing landscape character and utilizes natural fire/fuel breaks may be considered consistent with a VQO of Preservation. In some cases of wildland fire use, constructed fuel breaks may be consistent with a VQO of Preservation when they are low impact and do not negatively affect wilderness values. Such situations should be evaluated on a case-by-case basis.

Heritage Program

Forest Service Manual management direction for the Heritage Program and cultural resources is in FSM 2360. Direction can also be found in the National Heritage Strategy.

DESIRED CONDITION

People visiting the National Forest can find opportunities to explore, enjoy, and learn about cultural heritage. As visitors travel through landscapes and experience diverse environments and cultures, they can make a personal connection with the land and people and have the opportunity to reflect on the relevance of the past and the land to their daily lives. Sites identified as significant, under the National Historic Preservation Act (NHPA), are inventoried, protected, and, if warranted, nominated to the National Register of Historic Places.

Management Direction for the Heritage Program

Type	Number	Direction Description
Goals	HPGO01	Identify and manage cultural resources.
	HPGO02	Implement the National Heritage Strategy.
	HPGO03	Integrate the Heritage Program into land and resource management.
	See also Goal 01 for Tribal Rights and Interests.	
Objectives	**General**	
	HPOB01	Develop a comprehensive Cultural Resources Management Plan. Include in the Plan, as a minimum, the allocation of cultural resources for public education, research, and stewardship purposes.
	HPOB02	Update and maintain a Cultural Resources Overview for the Forest. Include in the Cultural Resources Overview, as a minimum, the following topics: a) The kinds of sites already known and their relative abundance on the Forest; b) Major prehistoric uses; c) Major ethnographic uses; d) Major historic themes; and e) The gaps in our knowledge about the prehistory and history of the Forest. Maintain associated databases, atlases, and files on the Forest.
	HPOB03	Develop and implement quality standards (e.g., Meaningful Measures) to guide management and measure Heritage Program success in achieving stewardship and public service objectives.
	HPOB04	Develop a pro-active program of cultural resource management consistent with federal guidelines for the implementation of Sections 106 and 110 of the NHPA.
	Stewardship	
	HPOB05	Maintain an ongoing inventory to locate and identify historic properties on National Forest System lands.
	HPOB06	Develop a predictive model to guide the design and completion of cultural resource inventories. Review inventory results annually to validate or refine the predictive model.
	HPOB07	Evaluate cultural resources to determine their eligibility as historic properties for listing on the National Register of Historic Places.
	HPOB08	Nominate historic properties for listing on the National Register of Historic Places when necessary for management purposes. Prepare management plans for each listed property.

Management Direction for the Heritage Program		
Type	**Number**	**Direction Description**
Objectives	HPOB09	Protect historic properties through stabilization and monitoring efforts. Monitor historic properties that may be adversely affected by management activities.
	HPOB10	Curate artifacts and records, and make them available for study by qualified researchers.
	HPOB11	Prioritize and protect the most significant historic properties. Maintain a catalogue of priority heritage assets and endangered sites.
	HPOB12	Maintain site and project records in a format consistent with corporate databases.
	HPOB13	Increase public awareness, involvement, and appreciation of outstanding heritage accomplishments through the expansion of stewardship programs.
	Public Service	
	HPOB14	Involve interested parties during the initial stages of project planning about undertakings that may affect historic properties.
	HPOB15	Expand heritage experiences and opportunities, including interpretive services, heritage tourism, environmental education, and volunteer programs such as Passport in Time to provide positive heritage experiences.
	HPOB16	Expand partnerships with individuals, local communities, and academic and private sector institutions to protect cultural resources and involve and educate the public.
	Context For Natural Resource Management	
	HPOB17	Strengthen internal linkages with recreation, interpretive services, demonstration projects, environmental education, and others to assure integrated efforts and quality products.
	HPOB18	Include information that provides a context for understanding the role of human beings in past and present ecosystems in project/site scale analyses.
	See also Objectives for Botanical Resources (05, 06) and Tribal Rights and Interests (04).	
Standards	HPST01	Review undertakings that may affect cultural resources to identify potential impacts. Compliance with Sections 106 and 110 of the NHPA shall be completed before the responsible agency official signs the project decision document.
	HPST02	Conduct cultural resource inventories in consultation with the appropriate Tribal and State Historic Preservation Offices and other individuals and organizations likely to have knowledge of historic properties in the area.
	HPST03	Treat unevaluated cultural resource sites as significant until evaluated for National Register of Historic Places eligibility.
	See also Standard 06 for Tribal Rights and Interests.	
Guidelines	HPGU01	Accurate and up-to-date site and survey information should be incorporated into appropriate databases.
	HPGU02	A management plan should be developed for each historic property nominated to the National Register of Historic Places. The plan should be drafted during the nomination process.
	HPGU03	The National Heritage Strategy should be used to guide decisions on issues related to the Heritage Program.
	See also Guidelines for Fire Management (05), Facilities and Roads (12), and Recreation Resources (32).	

Tribal Rights and Interests

Forest Service Manual management direction for tribal rights and interests is in FSM 1563 – Tribal Governments. Additional direction related to government-to-government relationships can be found in FS-600, Forest Service National Resource Book on American Indian and Alaska Native Relations. Direction for Special Designation Areas, such as Cultural Special Interest Areas, is in FSM 2360 – Special Interest Areas.

DESIRED CONDITION

Tribes continue to have interest and reliance on ecosystems even as their cultures change, employing both traditional and contemporary ways of relating to their homelands and interest areas (lands where they traditionally ranged to sustain their way of life). Lands within the Forest help sustain American Indians' way of life, cultural integrity, social cohesion, and economic well-being.

Federal agencies take a more proactive role on the tribes' behalf, especially in areas of treaty interest, rights, traditional and cultural resources, and ecosystem integrity. Federal agencies provide opportunities for traditional American Indian land uses and resources. The presence of healthy habitats is fundamental to the achievement of both useable and harvestable levels of resources significant to American Indians, as well as to ecosystem integrity.

Management Direction for the Tribal Rights and Interests

Type	Number	Direction Description
Goals	TRGO01	Enhance relationships with American Indian tribes in order to better understand and incorporate tribal cultural resources, values, needs, interests, and expectations in Forest management and allow cooperative activities where there are shared goals.
	TRGO02	Facilitate the exercise of tribal rights to meet federal trust responsibilities (see Appendix H).
	See also Goals for Wildlife Resources (03), Botanical Resources (01, 03), and Heritage Program (01).	
Objectives	TROB01	Meet annually with designated tribal representatives to coordinate tribal uses of National Forest System lands as provided for through existing tribal rights with the U.S. Government
	TROB02	Consider areas and resources important to American Indian tribal cultures when planning management activities or development proposals and resolve adverse effects to those sites.
	TROB03	Work with designated tribal representatives during project planning to develop protection or mitigation measures for resources important to the tribes.
	TROB04	Coordinate with tribes to identify Traditional Cultural Properties and recommend for establishment Cultural Special Interest Areas. Traditional Cultural Properties and Cultural Special Interest Areas may include areas of important cultural and spiritual use, reservoirs of cultural plants or resources, or important cultural features.
	TROB05	Establish a consistent and acceptable approach to effective government-to-government consultation that provides for tribal participation and facilitates the integration of tribal interests and concerns into the planning process to inform decisions.
	TROB06	Continue operating under, and update as needed, the Memorandum of Understanding with the Nez Perce Tribe.

Management Direction for the Tribal Rights and Interests		
Type	**Number**	**Direction Description**
	See also Objectives for TEPC Species (18); SWRA Resources (05, 06, 11, 17, 20); Wildlife Resources (12); Vegetation (05); Botanical Resources (05, 06); Facilities and Roads (02, 05); and Heritage Program (02, 04, 14).	
Standards	TRST01	Affected tribes shall be consulted prior to or during initial scoping of site-specific project proposals in order to identify tribal interests
	TRST02	Affected tribes shall be consulted on land ownership adjustments (exchange, consolidation, or disposal) of Forest Service administered lands.
	TRST03	Consult with potentially affected tribes during mid-, fine- and site/project scale analyses to coordinate recovery and restoration efforts. Where possible, assessments should be compatible with resources and places identified by other intergovernmental entities.
	TRST04	During project planning, affected tribes shall be consulted regarding opportunities for restoration, enhancement, and maintenance of native plant communities that are of interest to tribes when proposed activities may affect those plant communities.
	TRST05	Decisions for environmental documents shall demonstrate how tribal interests raised during consultation or scoping were considered.
	TRST06	Management decisions affecting cultural resources important to tribes shall consider Indian values and perspectives, as mandated by Sections 106 and 110 of the NHPA.
	See also Standards 01 and 02 for Heritage Program.	
Guidelines	TRGU01	Notify Tribes of land tenure adjustment opportunities within their ceded lands/territories.
	TRGU02	Consider opportunities for protection or enhancement of culturally significant plants that are known to occupy the project area and the Tribes have identified during project scoping or consultation.
	TRGU03	Fisheries supplementation, research, and monitoring activities designed to maintain or restore Wild and Scenic River values (ORVs) should be coordinated with potentially affected tribes.
	See also Guidelines for SWRA Resources (01, 10); Fire Management (05); Lands and Special Uses (01); and Facilities and Roads (04).	

Wilderness, Recommended Wilderness, and Inventoried Roadless Areas

Forest Service Manual and Handbook direction for managing wilderness resources is in FSM 2320 - Wilderness Management, and FSH 2309.18 - Trails Management Handbook. More detailed direction is in the wilderness area-specific management plans.

DESIRED CONDITION

Wilderness

People visiting wilderness within the National Forest can find outstanding opportunities for primitive and unconfined recreation, including exploration, solitude, risk, and challenge. The area is primarily affected by the forces of nature, with man's imprint substantially unnoticeable.

Recommended Wilderness

People visiting recommended wilderness within the National Forest can find outstanding opportunities for primitive and unconfined recreation, including exploration, solitude, risk, and challenge. The area is primarily affected by the forces of nature with man's imprint substantially unnoticeable. The unique wilderness character of the area is preserved until Congress acts on the Forest Service recommendation.

Inventoried Roadless Areas

IRAs contribute to providing a range of uses and opportunities and do not contain classified roads. Some IRAs exhibit many values associated with undeveloped landscapes.

Management Direction for Wilderness, Recommended Wilderness, and Inventoried Roadless Areas

Type	Number	Direction Description
Goals	**Wilderness**	
	WRGO01	Protect wilderness values as defined in the 1964 Wilderness Act. Improve opportunities and experiences through the development of individual wilderness management plans, partnerships with permittees and user groups, and interpretive and educational opportunities.
	Recommended Wilderness	
	WRGO02	Manage recommended wilderness to protect wilderness values as defined in the Wilderness Act. Activities permitted in recommended wilderness do not compromise wilderness values nor reduce the area's potential for wilderness designation.
	Inventoried Roadless Areas	
	WRGO03	Update Inventoried Roadless Area boundaries as appropriate to reflect new development or more accurate information.
	See also Goal 03 for Heritage Program.	

Management Direction for Wilderness, Recommended Wilderness, and Inventoried Roadless Areas		
Type	**Number**	**Direction Description**
Objectives	**Wilderness**	
	WROB01	Manage designated wilderness in accordance with the current management plan for the Frank Church--River of No Return Wilderness.
	WROB02	Manage high mountain lakes within designated wilderness to be consistent with policies for fish and wildlife management in National Forest and Bureau of Land Management wilderness (Forest Service, BLM, and IAFWA, August 1986). Jointly develop management agreements with the Idaho State Fish and Game Department for such areas.
	Inventoried Roadless Areas	
	WROB03	Evaluate any cases where classified roads exist within IRAs to determine whether the road's status or IRA boundary adjustments are appropriate, and make any needed adjustments.
Standards	**Recommended Wilderness**	
	WRST01	Changes to existing recreational settings (mapped ROS classes) are limited to only those that maintain or restore wilderness characteristics.
	See also Standard 04 for Lands and Special Use, and Standard 01 for Recreation Resources.	
Guidelines	**General**	
	WRGU01	Use public education and interpretation programs to foster wilderness values, and to maintain environmental qualities and primitive recreation experiences.
	Wilderness	
	WRGU02	Interim management direction, covering the period of time prior to having an approved wilderness management plan in place, should be established once recommended wilderness areas are designated as wilderness.
	Recommended Wilderness	
	WRGU03	Non-conforming uses in recommended wilderness should not be promoted.
	WRGU04	State Off-Road Motor Vehicle capital investment funds should not be solicited or used in recommended wilderness.
	WRGU05	Mechanical transport in recommended wilderness areas where it currently exists may be allowed to continue unless: a) It degrades wilderness values, b) Resource damage occurs, or c) User conflicts result.
	Inventoried Roadless Areas	
	WRGU06	Boundaries of IRAs should be reviewed and adjusted as appropriate during project-level planning for proposed development projects within or adjacent to such areas. Consider potential additions, as well as subtracting developments, when making reviews and adjustments.
	See also Guidelines for Fire Management (05); Lands and Special Uses (01, 11); and Recreation Resources (29).	

Wild and Scenic Rivers

Forest Service Handbook direction for managing eligible, suitable, and designated Wild and Scenic Rivers is in FSH 1909.12 - Land and Resource Management Planning, Chapter 8.2.

The following direction applies to eligible, suitable, and designated river areas until a river management plan is implemented. River areas include the entire length of an eligible, suitable, or designated river and the adjacent river corridor extending 1/4 mile on either side of the high water mark. Wild and Scenic River segments are portions of the river delineated for evaluation and planning purposes.

DESIRED CONDITION

River segments and their corridors that are eligible, suitable, or designated as Wild and Scenic Rivers are managed to retain their free-flowing status, classification, and outstandingly remarkable values for scenery, wildlife, cultural, fish, geology, hydrology, and ecological/ botanical resources. Opportunities are provided so the public can understand the uniqueness of eligible, suitable, and designated Wild and Scenic Rivers. The South Fork Salmon River is congressionally designated as Wild and Scenic Rivers.

Management Direction for Wild and Scenic Rivers

Type	Number	Direction Description
Goals	WSGO01	Manage river segments that are eligible or suitable for potential addition to the National Wild and Scenic Rivers System to meet the requirement of the Wild and Scenic River Act.
Objectives	WSOB01	Emphasize the following in managing eligible and suitable Wild and Scenic Rivers: a) Maintaining or enhancing the outstandingly remarkable values; b) Maintaining the free-flowing character; c) Maintaining or enhancing values compatible with the assigned classification; and d) Accommodating public use and enjoyment consistent with retaining the river's natural values.
Standards	WSST01	When management actions are proposed that may compromise the outstandingly remarkable value, classification, or free-flowing character of an eligible Wild and Scenic River segment, a suitability study must be completed for that eligible river segment prior to initiating the actions.
	WSST02	Assign VQOs to the classifications of eligible, suitable, and designated Wild and Scenic River corridors as follows: a) Preservation to a Wild classification, b) Retention to a Scenic classification, c) Partial Retention to a Recreational classification.
Guidelines	WSGU01	Suitability studies for eligible segments on the Forest should be coordinated with: a) Idaho Department of Water Resources where the State's Comprehensive Water Plans involve National Forest System lands. b) Bureau of Land Management for each study where eligible segments occur in both jurisdictions. The lead agency should be determined before the study begins. c) Other national forests where eligible segments occur in both jurisdictions. The lead Forest should be determined before the study begins.
	See also Guidelines for Fire Management (05); Lands and Special Uses (11); and Tribal Rights and Interests (03).	

Research Natural Areas

Detailed information concerning the values of each RNA can be found in the individual RNA establishment records. Any site-specific direction for the RNAs will be included in the development of the RNA management plans (see Objective 01, below).

DESIRED CONDITION

Research Natural Areas (RNAs) are areas where ecological processes generally prevail. They remain largely undisturbed by human uses or activities, and provide quality opportunities for non-manipulative scientific research, monitoring, observation, and study. The RNA network provides examples of representative forest habitats, shrublands, wetlands, riparian systems, grasslands, geologic formations, wildlife habitats, and aquatic communities. Management plans have been developed and implemented for all areas.

Management Direction for Research Natural Areas

Type	Number	Direction Description
Goals	RNGO01	Maintain values for which the RNAs were established, as identified in the establishment records.
	RNGO02	Look for opportunities to establish additional RNAs in high priority areas.
Objectives	RNOB01	Develop and implement management plans for established RNAs.
	RNOB02	Consider recommending additional RNAs based on high priority needs as identified by, *The Representativeness Assessment of Research Natural Areas on National Forest System Lands in Idaho*.
Guidelines	RNGU01	Commercial livestock grazing in RNAs should be avoided unless specifically provided for in the establishment records.
	RNGU02	Potential degradation from motorized use should be considered when developing RNA Management Plans and Travel Management Planning.
	See also Guidelines for Fire Management (05) and Lands and Special Uses (11).	

Social and Economic

Forest Service Manual and Handbook direction for social and economic resources is found in FSM 1700 - Civil Rights, FSM 1970 - Economic and Social Analysis, FSH 1709.11 - Civil Rights Handbook, and FSH 1909.17 - Economic and Social Analysis Handbook.

DESIRED CONDITION

Sustainable and predictable levels of goods and services are provided for local communities. Firewood, post and poles, sawlogs, forage, developed and dispersed recreation, and other goods and services are made available to the public consistent with management direction. Local economic development goals are considered along with sustainable resource outputs when developing land management objectives.

There is increased coordination among federal, state, county, and tribal governments, and a high level of collaboration with a broad range of stakeholders, where appropriate and feasible. This coordination and collaboration results in a better understanding of the tradeoffs between resource protection, commodity production, and other Forest uses.

Management Direction for Social and Economic

Type	Number	Direction Description
Goals	SEGO01	Promote collaboration among federal, state, county and tribal governments in land management planning, implementation, and monitoring efforts to coordinate activities and improve the effectiveness in delivery of government services.
	SEGO02	Promote cooperation among stakeholders by involving them in planning, implementing, and monitoring Forest land management activities to better understand the trade-offs needed to make informed decisions.
	SEGO03	Develop sustainable land uses and management strategies that contribute to economic development goals.
	See also Goals for Timberland Resources (02, 03, 04); Rangeland Resources (01); and Lands and Special Uses (02).	
Objectives	SEOB01	Provide a predictable supply of Forest goods and services within sustainable limits of the ecosystem that help meet public demand.
	SEOB02	Provide opportunities for cooperation by enhancing public involvement efforts in Forest activities through the media, stakeholder workshops, personal contacts, and other methods.
	See also Objectives for Timberland Resources (01, 02, 03); Facilities and Roads (02, 05); Heritage Program (15); and Guidelines for Facilities and Roads (10) and Recreation Resources (01).	

MANAGEMENT AREA DESCRIPTION AND DIRECTION

This introductory section is a user's guide for the Management Area descriptions and direction that follow. The Management Areas describe current resource conditions, management emphasis, goals, objectives, standards, and guidelines for the major resource programs within the area. Program areas are organized similar to Forest-wide direction, beginning with biophysical resources, and followed by socio-economic resources. In some cases a program area may not have any additional direction at the Management Area level beyond that already provided at the Forest-wide level.

To provide more effective and efficient management, the Forest has been divided into smaller units called Management Areas that are organized around a combination of watershed and administrative boundaries. The Management Area Description and Direction section describes each of these areas in detail, highlights resource areas of importance or concern within each area, and prescribes more specific management direction to address specific concerns that were not covered in the more general Forest-wide direction. Each Management Area is divided into two separate but connected subsections: (1) Management Area Description, and (2) Management Area Direction. The intent and content of these subsections are described in detail below.

Management Area Descriptions

The Management Area description summarizes the current conditions for important features and resources within each area. The purpose of this description is to familiarize the reader with the area and its special characteristics and concerns. These concerns also set the stage for management area direction that follows.

Each description begins with a general depiction of the area's size and location, and then discusses the main access routes to and within the area, and special features associated with the area. Then specific resources are described, starting with biophysical resources and finishing with social and economic resources.

Many of the biophysical resources (Soils, Water, Riparian and Aquatic, Vegetation, Wildlife) have their conditions rated in terms of how well they are currently functioning. These ratings are the result of recent Properly Functioning Condition (PFC) assessments that the Revision Team conducted with Forest personnel who were most familiar with the areas. District specialists were asked to rank conditions for their resources in relation to how much "risk" those resources were facing if a large disturbance event (wildfire, disease, rain-on-snow, etc.) were to occur. "Risk" for this exercise was assessed on a sliding scale of how resilient those resources would be to disturbance. The Revision Team assumed that if the resource conditions were well within their historical range of variability, the resources should be resilient and resistant to disturbance. If conditions were outside of the historical range, the resources would generally be less resilient and resistant, and therefore at greater risk to uncharacteristic change from a disturbance.

Resource conditions rated at high risk are characterized as "not functioning properly" in the assessments. Resources rated at moderately high to low risk are characterized as "functioning at risk." Resources rated at very low or no risk are characterized as "functioning properly." These PFC assessments were conducted at a variety of mid- and fine-scales and were based on available information from existing broad-, mid- and fine-scale assessments, as well as local experience and knowledge. The assessments are both qualitative and quantitative. Their main purpose was to provide a relative comparison of resource conditions from which specific management concerns and priorities might emerge. For instance, the Revision Team assumed that where resource conditions are "not functioning properly," additional management area direction to restore (or begin restoring) those conditions within the planning period should be considered. Resource conditions "functioning at risk" might also need direction to help restore them, especially if those resources themselves were already considered at risk, such as listed species or 303(d) water bodies. Conversely, resource conditions "functioning properly" might only need a maintenance management strategy, or might not require attention until future planning periods. These strategies were based on the fact that the Forest can only accomplish so much during any planning period, so Forest managers must focus on addressing the most pressing needs first.

Air Quality was described by airsheds developed for Smoke Management Program operations. For more information on these airsheds, see the Air Quality and Smoke Management section, Chapter 3, Forest Plan Revision Final EIS. The management area descriptions summarize existing conditions using information available from a variety of sources. Descriptions include:

- Key sensitive areas that need to be considered during fire use planning and implementation;
- The closest ambient air and visibility monitoring data sources;
- County emissions data (1995-1999) for PM 10 and PM 2.5, including annual amounts and trends; and
- Amount of agricultural-related burning by county.

The descriptions can be used to help support fire use planning and implementation at the project level. Each management area has a list of the airsheds and counties that the area lies within or intersects, and a description of current conditions. Information contained in the descriptions will need to be supplemented over time as new data becomes available. Project planners will need to periodically re-evaluate current conditions and trends rather than rely on the summaries in the management areas. In particular, for projects that include Class I areas within 100 kilometers, data regarding seasonal patterns and trends will change and become more available over time due to information updates from the Regional Haze Monitoring Network.

Historical fire regimes and the vegetative conditions that contribute to uncharacteristic wildfire hazard were evaluated at the mid-scale. Historical fire regimes were assigned to the forested Potential Vegetation Groups or non-forested cover types based on scientific literature and expert knowledge of the vegetation groups. Hazard ratings were developed also using available scientific literature and expert input. The ratings represent departure between the effects of the historical and current fire regimes on vegetation, which in turn affects other ecosystem components and processes. The areas with the greatest departure are those in the historically non-lethal fire regimes where conditions are such that a fire occurring in the assessed conditions would be lethal. The areas with the lowest departure are in the historically lethal fire regimes.

The National Fire Plan (Schmidt et al. 2002) historical fire regimes correspond to the historical fire regimes developed for the assessment as follows:

National Fire Plan Historical Fire Regimes	Forest Plan Corresponding Fire Regimes
I (0-35 year frequency, low)	PVGs 1, 2, and 5 (nonlethal or nonlethal-mixed1)
II (O-35 year frequency, stand replacement)	Communities where sagebrush is dominant or co-dominant (mixed1 or mixed2)
III (35-100+ year frequency, mixed	PVGs 3, 4, 6, 7, and 11 (mixed2 or mixed1-mixed2)
IV (35-100+ year frequency, stand replacement)	Climax aspen and pinyon-juniper stands (lethal)
V (200+ year frequency, stand replacement)	PVGs 8, 9, 10 (lethal)

The hazard ratings developed for the mid-scale assessment were defined as low, moderate, high, and extreme. The Condition Classes for the National Fire Plan and the hazard ratings described in the Forest Plan were developed using the same concept of departure. The Condition Classes correspond to the hazard ratings developed for the assessment as follows:

Condition Class 1 = low departure

Condition Class 2 = moderate departure

Condition Class 3 = high and extreme departure

Each Management Area displays the percent of total Management Area acres assigned to the various historical fire regimes and hazard (departure) ratings.

Management Area Direction

Management Area direction is designed to tier to Forest-wide direction, and to meet Forest-wide goals and desired conditions. However, Management Area direction is intended to be more specific than Forest-wide direction, addressing specific concerns related to each program area, and setting the stage for specific actions that can be implemented to resolve those concerns.

Management Areas use the same types of direction—goals, objectives, standards, and guidelines—that are defined in the Introduction to Chapter III. The distribution of this direction is somewhat different, however, at the Management Area level. Much of the Management Area direction is expressed as *objectives* to be implemented at this level in order to achieve Forest-wide goals and desired conditions.

Time frames for achieving Management Area objectives are essentially the same as for Forest-wide objectives—10 to 15 years (the planning period) unless otherwise stated. More specific time frames are not typically used because accomplishment can be delayed by funding, litigation, environmental changes, and other influences beyond the Forest's control.

Standards and guidelines do appear in Management Areas to address two areas that Forest-wide direction cannot address specifically. First, they are used to provide more explicit protection or guidance than can be provided through Forest-wide direction. This more explicit direction is based on the site-specific needs or concerns of the area. Put another way, Forest-wide standards and guidelines generally apply to all Management Areas on the Forest; however, this direction may be refined or expanded at the Management Area level to address specific concerns unique to that Management Area.

The second type of standards and guidelines relates to Management Area Prescription Categories (MPCs) found within a Management Area. Each emphasis provided by an MPC carries with it varying degrees of constraints on the types and intensity of management practices that can be used to maintain or restore conditions that best align with the MPC emphasis. These constraints result from a common set of standards and guidelines that apply, regardless of the Management Area in which the MPC is applied. Application of this common set of MPC standards and guidelines helps ensure that management emphasis for the MPC is generally attained, regardless of location. Refer to the more detailed discussion of MPCs below.

MPC Maps and Tables

Each Management Area has a map that precedes the area description. This map is designed to provide reference points for the reader. It displays the area boundaries and includes relevant communities, water bodies, and other features within or near the area. It also shows the Management Prescription Categories (MPCs) that have been assigned to each area. These prescriptions are also summarized by percentage in a table that begins each Management Area description. The purpose of the MPC map and table is to give the reader a quick and general impression of the management emphasis for each area. MPCs are described in detail below.

Management Prescription Categories

Management prescriptions are defined as, "Management practices and intensity selected and scheduled for application on a specific area to attain multiple use and other goals and objectives" (36 CFR 219.3). MPCs are broad categories of management prescriptions that indicate the general management emphasis prescribed for a given area. They are based on Forest Service definitions developed at the national level, and represent management emphasis themes, ranging from Wilderness (1.0) to Concentrated Development (8.0). The national MPCs have been customized during Forest Plan revision to better fit the needs and issues of the Forest.

MPCs were assigned by subwatershed where possible. Although they are intended to show general management emphasis within a subwatershed, they do not necessarily define emphasis for every single acre within that subwatershed. As with most rule sets, there are exceptions within MPCs. For example, some administrative areas—such as Wilderness, Wild and Scenic River corridors, Research Natural Areas, and National Recreation Areas—cut across subwatershed boundaries, and these areas are managed according to the laws or policies governing their establishment. Also, there are many distinctive areas that may have different management requirements than the overall MPC emphasis/direction for the subwatershed. Examples include administrative and recreation sites, designated communications sites or utility corridors, mining sites, plantations, Riparian Conservation Areas, and cultural or historic sites.

MPC management emphasis is further defined by Forest-wide and Management Area direction. For instance, almost all MPCs could feature vegetation management to some degree. The type and intensity of vegetation management that may occur in a given MPC area is reflected in its common set of standards and guidelines (described below by MPC), and may be further refined within an individual area to reflect that unique Management Area needs or concerns.

Each MPC emphasis is described below. Following the emphasis description, the standards and guidelines for management practices and intensity that apply to each MPC are stated. Except where noted, these MPC standards and guidelines have also been incorporated into the management direction of each Management Area in which the MPC occurs.

1.1 – Existing Wilderness

This prescription applies to areas designated by Congress as Wilderness. The main management objective is preserving wilderness attributes, including natural appearance, ecological integrity, opportunities for solitude, opportunities for primitive recreation, and identified special features. The area is managed to allow ecological processes to prevail, with little or no evidence of human development. Current wilderness management plans and approved fire management plans provide specific direction for management activities.

MPC 1.1 Standards	
Standard	Management actions shall be designed and implemented in accordance with the Frank Church--River of No Return Wilderness Management Plan.
Standard	Mechanical vegetation treatments, including salvage harvest, are prohibited.
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
Standard	Fire suppression strategies and tactics shall be in accordance with the Frank Church - River of No Return Wilderness Management Plan.

1.2 – Recommended Wilderness

This prescription applies to areas the Forest Service recommends for Wilderness designation. The primary management objective is to maintain wilderness attributes until Congress decides to designate the areas as wilderness or release them to some other form of management. Although these areas do not fall under the authority of the Wilderness Act, they are managed to maintain wilderness attributes where feasible, and to generally allow ecological processes to prevail.

MPC 1.2 Standards and Guideline	
Standard	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
Standard	Mechanical vegetation treatments, including salvage harvest, are prohibited.
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
Standard	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute, or treaty.
Standard	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize the impacts of suppression activities on wilderness values.

2.1 – Wild and Scenic Rivers and Their Corridors

This prescription applies to areas that have been Congressionally designated [1] as Wild, Scenic, or Recreational Rivers and their associated land corridors, which extend an average of 0.25 mile from each bank. Wild and Scenic Rivers and their corridors are managed to protect their free-flowing waters, outstandingly remarkable values (ORVs), and their classification status. A "Wild" classification is the most primitive or least developed. These rivers have essentially undeveloped corridors and are generally inaccessible except by trail. "Scenic" river corridors may have some development, and are accessible in places by roads. "Recreational" rivers are readily accessible by roads and often have development within their corridors.

MPC 2.1 Guidelines	
Guideline	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as Outstandingly Remarkable Values (ORVs) are maintained within the river corridor.
Guideline	Prescribed fire and wildland fire use may be used in any river corridor as long as ORVs are maintained within the corridor.
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.

2.2 – Research Natural Areas

This prescription applies to areas that have been administratively established as Research Natural Areas and that provide unique opportunities for research. Existing and proposed Research Natural Areas are managed to protect the unique values for which they were established. Management plans are developed for each area to provide guidance and protection of values.

MPC 2.2 Standards and Guideline	
Standard	Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize fire suppression strategies and tactics that minimize impacts to values for which the RNA was established.

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[1] Eligible or suitable rivers are provided similar emphasis as designated rivers, but were not assigned to this MPC. Management direction for eligible or suitable rivers, including the MPC guidelines below, is included in the Management Area where the rivers are located, and in Forest-wide direction for Wild and Scenic Rivers.

2.4 – Boise Basin Experimental Forest

The Boise Basin Experimental Forest (8,740 acres) is administered by the USDA Forest Service, Rocky Mountain Research Station, headquartered in Fort Collins, Colorado. This forest was originally established in the 1930s to conduct silvicultural and other related research in the ponderosa pine type. It includes the Bannock Creek Research Natural Area (445 acres), which was set aside to represent mixed conifer vegetation in the management area. The RNA has also been identified as a potential National Natural Landmark. Activities on the Experimental Forest are generally for research purposes. Other activities may occur if they do not negatively affect past, ongoing, or planned research. Timberlands within the Boise Basin Experimental Forest are identified as not suited for timber production. The Forest is withdrawn from mineral entry.

MPC 2.4 Standards and Guidelines	
Standard	All activities on the Experimental Forest shall be coordinated with the Scientist-in-Charge of the Boise Basin Experimental Forest (Rocky Mountain Research Station)
Standard	Livestock grazing is prohibited unless prescribed as a management tool to achieve research objectives.
Standard	Wildland fire use is prohibited.
Guideline	Vegetation management actions, using both prescribed fire and mechanical treatment methods, may occur as part of planned research activities, or to achieve other Forest Plan objectives, provided that research objectives are not compromised.
Guideline	Salvage harvest may occur as part of planned research activities.
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression should emphasize fire strategies and tactics that minimize impacts to experimental areas and other investments.

3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial and Hydrologic Resources

This prescription is designed to minimize temporary-term risks and avoid short- and long-term risks from management actions to soil/hydrologic conditions and aquatic and terrestrial habitats. The objective of 3.1 is to keep management-related impacts from degrading existing conditions for TEPCS fish, wildlife, and botanical species, or 303(d) impaired water bodies. Low levels of management activities occur, and these activities are expected to have minimal and temporary degrading effects to soils, water quality, riparian areas, and aquatic and terrestrial habitats. Other uses and activities, such as salvage harvest or Wildland Fire Use, may occur and may have some temporary effects, provided they do not retard attainment of short- and long-term objectives for aquatic and terrestrial habitat, or soil/hydrologic resources. Tools associated with this prescription—such as special order restrictions, operating plan adjustments, and prescribed fire—are typically of low intensity and designed to maintain existing conditions, primarily through ecological processes.

MPC 3.1 Standards and Guideline	
Standard	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years). Degrade and degradation are defined in the glossary.

MPC 3.1 Standards and Guideline	
Standard	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
Standard	Mechanical vegetative treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
Standard	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources

This prescription is designed to minimize temporary and short-term risks and avoid long-term risks from management actions to soil/hydrologic conditions and aquatic and terrestrial habitats. The objective of this prescription is to actively restore or maintain conditions for TEPCS fish, wildlife, and botanical species, or 303(d) impaired water bodies through a combination of management activities and natural processes. Management activities used to achieve this objective include watershed restoration, noxious weed treatments, and vegetative treatments that include prescribed fire, wildland fire use, and mechanical. Restoration is focused on those components of the ecosystem that are not functioning properly, or are outside the range of desired conditions, while maintenance helps to preserve those components that are functioning properly.

MPC 3.2 Standards and Guideline	
Standard	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term time periods, and must be designed to avoid resource degradation in the long term (greater than 15 years).

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC 3.2 Standards and Guideline	
Standard	Vegetative restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
Standard	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

4.1a – Undeveloped Recreation: Maintain Inventoried Roadless Areas

This prescription applies to lands where dispersed and undeveloped recreation uses are the primary emphasis. Providing dispersed recreation opportunities in an inventoried roadless area is the primary objective. Both motorized and non-motorized recreation opportunities may be provided. Other resource uses are allowed to the extent that they do not compromise the roadless and undeveloped character of the IRA. The area has a predominantly natural-appearing environment, with slight evidence of the sights and sounds of people. Species habitat and recreational uses are generally compatible, although recreation uses may be adjusted to protect TEPCS species.

MPC 4.1a Standards and Guideline	
Standard	Management actions—including wildland fire use, prescribed fire, and special use authorizations—must be designed and implemented in a manner that does not adversely compromise the area's roadless and undeveloped character in the temporary, short term, and long term. "Adversely compromise" means an action that results in the reduction of roadless or undeveloped acres within any specific IRA. Exceptions to this standard are actions in the 4.1a road standard, below.
Standard	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the roadless or undeveloped character of the area.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with

4.1c – Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities

This prescription applies to lands where dispersed recreation uses are the primary emphasis. Providing dispersed recreation opportunities in an unroaded landscape is the predominant objective. Both motorized and non-motorized recreation opportunities may be provided. Other resource uses are allowed to the extent that they do not compromise ROS settings. The area has a predominantly natural-appearing environment, with slight evidence of the sights and sounds of people. Species habitat and recreational uses are generally compatible, although recreation uses may be adjusted to protect TEPCS species.

MPC 4.1c Standards and Guideline	
Standard	Management actions—including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standards, below.
Standard	Within Inventoried Roadless Areas (IRAs), road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
Standard[4]	Outside IRAs, road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To provide transportation systems that support accomplishment of Management Area ROS objectives.
Standard	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[5]
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape.

4.2 – Roaded Recreation Emphasis

This prescription applies to lands where dispersed and developed recreation uses are the primary emphasis. A wide range of recreational activities and developments occurs. Facilities are maintained, and both motorized and non-motorized recreation opportunities may be provided. Multiple uses such as timber harvest and grazing are allowed to the extent that they do not compromise recreation resource objectives. Human use and presence are generally obvious. The area has a predominantly natural-appearing environment, with moderate evidence of the sights and sounds of people. Generally, a mix of mechanical and fire activities are used to treat vegetation to achieve desired conditions for recreation settings and developments, and to reduce the risk of uncharacteristic vegetative damage or loss from insects, diseases, and fire.

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[4] 4.1c allocations in most Management Areas occur completely within IRAs, and therefore those Management Areas do not include this standard.

[5] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC 4.2 Standard and Guideline	
Standard	Vegetation management actions—including wildland fire use, prescribed fire, and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.
Standard	For commercial salvage sales, retain at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[6]
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.
Guideline	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).

5.1 – Restoration and Maintenance Emphasis within Forested Landscapes

This prescription applies to lands that are predominantly (> 50 percent) forested. Emphasis is on restoring or maintaining vegetation within desired conditions in order to provide a diversity of habitats, reduced risk from disturbance events, and sustainable resources for human use. Commodity production is an outcome of restoring or maintaining the resilience/resistance of forested vegetation to disturbance events; achievement of timber growth and yield is not the primary purpose. The full range of treatment activities may be used. Restoration occurs through management activities and succession. Combinations of mechanical and fire treatments are used to restore forested areas while maintaining or improving resources such as soils, water quality, fish and wildlife habitat, and recreation settings. The risk of temporary and short-term degradation to the environment is minimized, but impacts may occur within acceptable limits as resources are managed to achieve long-term goals and objectives.

MPC 5.1 Guidelines	
Standard	For commercial salvage sales, retain at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[6]
Guideline	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
Guideline	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.

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[6] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC 5.1 Guidelines	
Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
Guideline	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
Guideline	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.

5.2 – Commodity Production Emphasis within Forested Landscapes

This MPC, and its associated standards and guidelines, was deleted by the 2010 Forest Plan amendment (USDA FS, 2010a).

6.1 – Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes

This prescription applies to lands that are predominantly (> 50 percent) shrubland and grassland. Emphasis is on restoring and maintaining vegetation within desired conditions in order to provide a diversity of habitats, reduced risk from disturbance events, and sustainable resources for human use. The full range of treatment activities may be used. Restoration occurs through management activities and succession. Combinations of mechanical and fire treatments are used to restore shrubland and grassland areas while maintaining or improving resources such as soils, water quality, fish and wildlife habitat, and recreation settings. The risk of temporary and short-term degrading effects to the environment are minimized, but impacts may occur within acceptable limits as resources are managed to achieve long-term goals and objectives.

MPC 6.1 Guidelines	
Standard	For commercial salvage sales, retain at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[8]
Guideline	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
Guideline	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.

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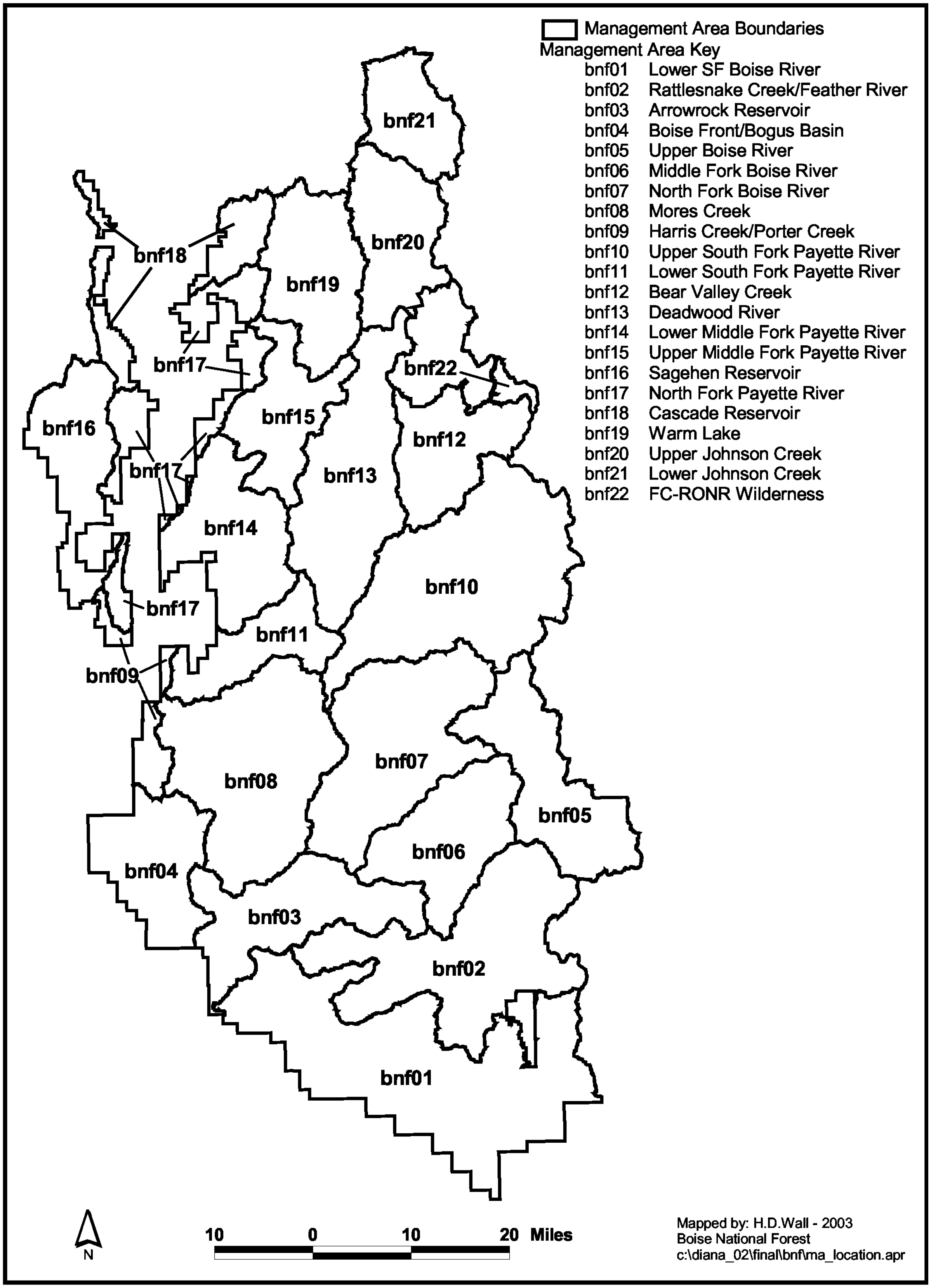
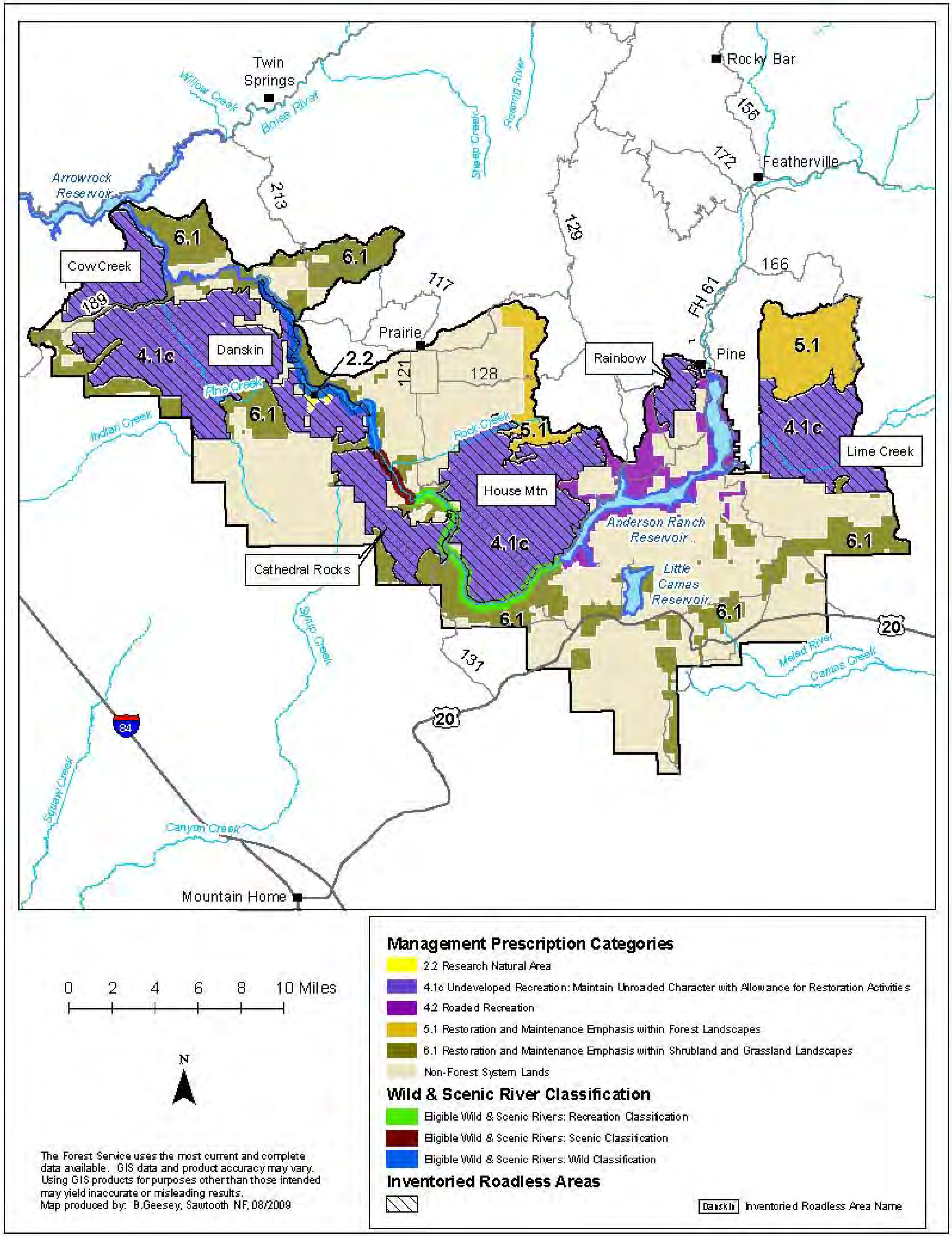
[8] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

Guideline	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
Guideline	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
Guideline	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.

The following map shows the general location of all the Boise National Forest Management Areas. Following the map is a description and direction for each individual management area.

Boise National Forest - Management Area - Location Map





Management Area 01. Lower South Fork Boise River Location Map

Management Area 1
Lower South Fork Boise River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 1 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	Trace
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	51
4.2 – Roaded Recreation Emphasis	9
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	9
6.1 – Restoration and Maintenance Emphasis within Shrubland & Grassland Landscapes	31

General Location and Description - Management Area 1 is located at the southern end of the Boise National Forest, about 15-50 miles southeast of Boise, Idaho (see map, opposite page). Administered by the Mountain Home Ranger District, the management area is in Elmore County and extends from Arrowrock Reservoir in the west to the Sawtooth National Forest boundary in the east (see area map, opposite). The management area is an estimated 291,100 acres, of which the Forest Service manages 59 percent, 31 percent are privately owned, and 10 percent are State of Idaho lands. The area is bordered by Boise National Forest to the north, Sawtooth National Forest to the east, and a mix of private and BLM lands to the south and west. The primary uses or activities in this management area have been dispersed and developed recreation, livestock grazing, and timber management.

Access - The main access to the area is by paved State Highway 20 from Interstate 84 to Forest Road 13 to Anderson Ranch Reservoir and Forest Road 113. Other access routes include Forest Roads 189 along the South Fork Boise River, Forest Road 160 to Little Camas Reservoir, and Forest Highway 61 from State Highway 20 to Anderson Ranch Reservoir. These are well-maintained gravel roads. The density of classified roads for the management area is an estimated 1.2 miles per square mile. Total road density for area subwatersheds ranges between 0 and 2.1 miles per square mile. The area has one of the highest trail densities on the entire Forest, with over 210 miles of motorized trails occurring in the Danskin Mountains alone.

Special Features - One eligible Wild and Scenic River, the South Fork Boise River, falls within this management area. The South Fork Boise River has three segments. The southernmost segment, beginning just below Anderson Ranch Reservoir, has a Recreational classification, and is 13.1 miles long, with an estimated river corridor of 4,200 acres. The middle segment has a Scenic classification, and is 3.1 miles long, with a river corridor of 1,000 acres. The northernmost segment is classified as Wild, and is 12.3 miles long, with a river corridor of 9,130 acres. The river is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, geologic, and hydrologic values.

The Raspberry Gulch Research Natural Area (640 acres) is a narrow, deep canyon that contains cliff and canyon vegetation, and a rare habitat type of ponderosa pine with an understory of needle-and-thread grass. The rural communities of Pine and Prairie are in this management area. The Anderson Ranch and Little Camas Reservoirs attract heavy recreation use. An estimated 30 percent of the management area is inventoried as roadless, including all of the Danskin, House Mountain, and Cathedral Rocks Roadless Areas, and portions of the Cow Creek, Rainbow, and Lime Creek Roadless Areas. Due primarily to salvage harvest, the Lime Creek IRA was reduced to roughly half its original inventoried size in the last decade.

Air Quality - Portions of this management area lie within Montana/Idaho Airsheds ID-21, 22, and 24 and within Elmore County. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located within these airsheds in Boise, Idaho City, and Mountain Home to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in Elmore County improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the county was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was moderately low (an estimated 5,000 acres) within the county. Point sources contributed minor amounts to the annual total PM 2.5 emissions within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet at the South Fork Boise River to 7,700 feet atop House Mountain. Management Area 1 falls within portions of multiple subsections, including the Prairie Lowlands, Middle Fork Boise Canyon and Streamcut Lands, and House Mountain. The main geomorphic landforms associated with the subsections are volcanic flow lands, deeply entrenched canyonlands, and granitic troughs and headlands. The land is characterized by gentle to steep slopes that are weakly to strongly dissected by streams. Slopes average from 5 to 60 percent in the lowlands, 15 to 45 percent in the canyonlands, and 35 to 65 percent in the troughs and headlands. The surface geology is primarily volcanic basalts south of the South Fork Boise River, and Idaho batholith granitics to the north. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high, with the majority being moderate (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). There are localized impacts from roads, livestock grazing, timber harvest, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of all or part of five watersheds that drain into the South Fork Boise River Subbasin, and small portions of ten watersheds that drain south into the C J Strike Reservoir and Camas Creek Subbasins. The watersheds in the South Fork Boise River Subbasin are: Anderson Ranch Reservoir, Little Camas Creek, Rock-Cayuse Willow Creek, Lower South Fork Boise River, and Lime Creek. The main streams in the area are the South Fork Boise River and the following tributaries: Lime Creek, Fall Creek, Little Camas Creek, Rock Creek, and Willow Creek. There are no natural lakes in this area, but there are three large reservoirs: Anderson Ranch, Little Camas, and Arrowrock. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below).

There are localized impacts, which include accelerated sediment and thermal changes due to water diversions, roads, timber harvest, livestock grazing, wildfire, and recreation. Eleven of the 24 subwatersheds in this area are listed as impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Little Canyon Creek, Big Fiddler-Soup, Long Gulch, Black Canyon-Trail, Pierce-Mennecke, Cayuse-Rough, Anderson Ranch Reservoir, Lower Willow, Upper Willow, Indian Creek, and Wood Creek. There is one TMDL-assigned subwatershed associated with this management area; Indian Creek. The pollutant of concern for most subwatersheds is sediment.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
8	12	4	1	22	1	2	19	3	11	1	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Bull trout are known to mostly occur within the South Fork Boise River, which they use as a migration corridor between Anderson Ranch Reservoir and headwater streams. Native redband trout also occur in several MA streams, but their abundance is not well known. The South Fork Boise River is managed as a "blue ribbon" rainbow trout stream, and Anderson Ranch Reservoir is managed as a kokanee salmon fishery. Several non-native species have been introduced to area streams and reservoirs for sport fishing. Aquatic habitat is functioning at risk in some areas due to elevated water temperatures, habitat fragmentation, and accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid and upper elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of seral lodgepole pine and aspen. Aspen can also occur as a climax community.

An estimated 68 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Bitterbrush, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (13 percent), Cool Dry Douglas-fir (3 percent), Cool Moist Douglas-fir (8 percent), and Dry Ponderosa Pine/Xeric Douglas-fir (8 percent). A large amount of forested vegetation has recently been burned by lethal wildfires. Aspen is an important component in all of the forested groups.

The Mountain Big Sagebrush, Bitterbrush, and Perennial Grass Slopes groups are not functioning properly, and the Montane Shrub group is functioning at risk due to impacts from the 1992 Foothills Fire and the introduction of non-native species. Structure and composition have been substantially altered. Native shrubs and grasses have been replaced in many areas by noxious weeds and introduced grasses and forbs (cheatgrass, wheatgrass, rush skeletonweed, sweet clover, orchard grass).

The Warm Dry Douglas-fir/Moist Ponderosa Pine and Dry Ponderosa Pine/Xeric Douglas-fir groups are not functioning properly. Many stands that burned in 1992 experienced high mortality because decades of fire exclusion had resulted in high stand densities and fuel loadings that had moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands. Recent insect outbreaks have increased tree mortality and the risk of uncharacteristic large wildfire. The Cool Dry Douglas-fir and Cool Moist Douglas-fir groups have similar conditions but to a lesser extent, and therefore they are only functioning at risk. These groups also have increasing insect and mistletoe infestations, and lack young structural stages and seral ponderosa pine and aspen. Aspen stands are not functioning properly in some areas due to fire exclusion that has resulted in old stands without structural diversity, which are not regenerating. Many stands are succumbing to insects and disease, and are being replaced by conifers or sagebrush. All the watersheds in the management area are a high priority for aspen restoration.

Riparian vegetation is at not functioning properly in some areas due to impacts from roads, livestock grazing, wildfires, and private land uses. Composition has changed in many riparian areas because of disturbance, lowered water tables, and introduced plant species. Non-native plants have increased, and *carex* and other wetlands species have decreased. Native cottonwoods and broadleaf shrubs have also decreased, and are not regenerating in many areas.

Botanical Resources – Bugleg goldenweed is a Region 4 sensitive species that occurs in this management area. Least Phacelia, a Region 4 Sensitive species, may have potential habitat in this area. Additionally, Wilcox's primrose and hooked stylocline are proposed Region 4 sensitive species that occur in this area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses, slickspot peppergrass, and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slickspot peppergrass is a rare annual or biennial species that may be found in sagebrush-steppe habitats ranging from around 2,200 to 5,300 feet. Slender moonwort, a Candidate species, is a diminutive fern (generally less than 1 inch in height) that may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Leafy spurge, spotted knapweed, rush skeletonweed, Dalmatian toadflax, and Scotch thistle are noxious weeds that occur in the area, particularly along the main road corridors. Yellow starthistle and purple loosestrife are not currently present but have a high potential of occurring. Cheatgrass is not a noxious weed, but is a non-native plant that is replacing native plants and increasing fire hazard in the area. An estimated 73 percent of the area is highly susceptible to invasion by noxious weed and exotic plant species. The main weeds of concern are leafy spurge and spotted knapweed, which currently occur in small, scattered populations throughout the area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Big Fiddler-Soap	Yes	Yes	No	Yes	No
Long Gulch	Yes	Yes	No	No	No
Black Canyon-Trail	Yes	Yes	No	Yes	No
Pierce-Mennecke	Yes	Yes	No	No	Yes
Anderson Ranch Reservoir	Yes	No	No	No	No
Upper Willow Creek	Yes	Yes	No	Yes	No
Lower Willow Creek	Yes	Yes	No	Yes	No
Wood Creek	Yes	Yes	No	Yes	No
Indian Creek	Yes	Yes	No	Yes	No
Long Tom Reservoir	No	Yes	No	No	Yes
Lower Lime	No	Yes	No	No	Yes
Cayuse-Rough	No	Yes	No	No	Yes
Wildhorse-Camas Prairie	No	No	No	No	Yes
Syrup Creek	No	No	No	No	Yes
Moores Creek	No	No	No	No	Yes

Wildlife Resources—The wide range of elevations and vegetation types in the management area provide a variety of wildlife habitats. Anderson Ranch Reservoir has wintering and nesting habitat for bald eagles. The South Fork Boise River corridor has wintering habitat for bald eagles and potential nesting habitat for peregrine falcons. Much of the lower-elevation grasslands and shrublands are important winter range for elk and deer, as well as foraging habitat for mountain quail, sage grouse, and introduced turkey and chukar. Mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. Higher-elevation forests provide nesting and foraging habitat for many migratory landbirds, as well as summer range for mammals such as elk, black bear, and mountain lion. Yellow-billed cuckoo habitat may be present in cottonwood stands in the lower portions of the South Fork Boise River.

Two Idaho Department of Fish and Game focal areas overlay portions of this Management Area: Anderson Ranch and Boise River. Overall, terrestrial habitat is not functioning properly because recent wildfires have reduced snags and large woody debris below desired levels, and have substantially altered vegetation structure and composition. A high percentage of timber and shrub stands have been replaced by perennial grasses, many of them non-native, which have in turn increased the risk of high fire frequency. These changes have resulted in corresponding changes in wildlife species abundance and distribution. Mountain quail and sage grouse habitat has been significantly reduced because of recent wildfires.

Recreation Resources - Relatively low elevation and proximity to Mountain Home and Boise make this area a year-round recreation area. There are many developed recreation sites, most of which are centered in the Anderson Ranch Reservoir area. This reservoir is heavily used for water-oriented recreation, including fishing, boating, and water-skiing. The Forest Service has developed campgrounds, boat ramps and information centers, and there are also privately owned food, lodging, gas, and marina services. Dispersed recreation such as hunting, hiking, sight-seeing, snowmobiling, skiing, off-road vehicle use, and camping occurs throughout Management Area 1, and there are many dispersed camp sites. The South Fork Boise River corridor is used for fishing, rafting, kayaking, and canoeing. Key recreation areas and travel corridors have objectives designed to protect visual quality. Almost all roads and trails in the area are open to some type of motorized vehicle use. A portion of the Idaho Centennial Trail lies within this management area. Public access through private lands is a concern in areas of extensive inholdings. The management area is located partially within Idaho Fish and Game Management Units 39, 43, 44, and 45. There is a recreational special use authorization for the Fall Creek Lodge and Marina.

Cultural Resources – Cultural themes in this area include Prehistoric archeology, Ranching, Transportation, Reclamation, Forest Service History, and Civilian Conservation Corps (CCC). This management area contains the highest density of prehistoric sites known on the Forest. Danskin Rock Shelter, for example, is extraordinary for the depth of cultural deposits and the rock art on its walls. Euro-American settlement in the area was a consequence of Oregon Trail emigration on Goodale's Cutoff during the 1850s. By the 1860s, ranches along the cutoff supplied emigrants and miners in the South Boise Mining District with fresh meat and produce. Other ranches were established after Congress passed the 1906 Forest Homestead Act and 1916 Stockraising Homestead Act. In 1930, Congress authorized the Arrowrock Addition that expanded the Forest boundary. During the 1930s Depression, CCC crews made road and facility improvements in the area. The Lester Creek Guard Station contains National Register eligible structures dating to the CCC era, and the compound was used as the Pine Ranger Station from 1909 to 1935. Danskin Peak Lookout was built in 1940, and is the only lookout from this period on the Forest. Anderson Ranch Dam, built in 1950, is managed by the Bureau of Reclamation.

Timberland Resources—Of the estimated 41,100 tentatively suited acres in this management area, 15,800 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 3 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 4.2, 5.1, and 6.1, as shown on the map displaying the MPCs for this management area. Lands in MPCs 2.2 and 4.1c have been identified as not suited for timber production. Fuelwood, post and poles, Christmas trees, and other miscellaneous forest products are currently collected in designated areas.

Rangeland Resources - The management area contains all or portions of nine cattle allotments. Management Area 1 provides an estimated 40,900 acres of capable rangeland. These acres represent about 10 percent of the capable rangeland on the Forest. This area features a fairly high level of structural range improvements.

Mineral Resources - The area is open to mineral activities and prospecting. Historic mining has occurred for gold, silver, and copper. The locatable mineral potential is generally moderate, as is the leasable mineral potential for geothermal resources. The potential for other leasable minerals is low. The potential for common variety mineral materials (mostly decorative stone and basalt gravel) is moderate to high south of the South Fork Boise River and unknown north of the river.

Fire Management—Prescribed fire has been used to improve winter range and livestock forage conditions, and to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years there were approximately 105 fire starts. Of all the management areas on the Boise, this one had the fewest starts relative to its size but proportionally more were human-caused fires than in other management areas. About 40 percent of the total starts are human-caused. Approximately 62 percent of the management area has burned over the past 20 years, the majority of which occurred from the 1992 Foothills Fire. This fire, which started from lightning, was mostly high intensity.

Pine and Prairie are National Fire Plan communities, and the area around these communities, areas along Fall Creek, and surrounding Little Camas Reservoir are considered wildland-urban interface due to private development adjacent to the Forest. Black Canyon-Trail, Rock Creek, Deer Creek, and Anderson Ranch Reservoir subwatersheds are considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 1 percent lethal, 35 percent mixed1 or 2, and 64 percent non-lethal. An estimated 15 percent of the regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 41 percent of the area is in moderately departed conditions—9 percent in the mixed1/mixed2 fire regimes, and 32 percent in the non-lethal regimes. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special use authorizations include a designated utility corridor containing the Anderson Ranch-Mountain Home power transmission line, operations along Anderson Ranch Road, and utility corridors to private inholdings. A designated communications site is located on Danskin Peak. Opportunities exist to consolidate National Forest lands through exchange with other landowners in the area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	0101	Manage the South Fork Boise River eligible river corridor to its assigned classification standards, and preserve its Outstandingly Remarkable Values (ORVs) and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	0168	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6. [1]
	Vegetation Guideline	0102	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0103	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0104	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	0105	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Fire Standard	0106	Prescribed fire may only be used to maintain vegetative values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	0107	Road construction and reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	0108	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.

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MPC Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0109	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standards, below.
	Vegetation Standard	0169	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6. [2]
	Road Standard	0110	Within Inventoried Roadless Areas (IRAs), road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Road Standard	0111	Outside IRAs, road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To provide transportation systems that support accomplishment of Management Area Recreation Resource Opportunity Spectrum objectives.
	Fire Guideline	0112	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 4.2 Roaded Recreation Emphasis	Vegetation Standard	0170	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[2]
	Vegetation Guideline	0113	Vegetation management actions—including prescribed fire and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.
	Vegetation Guideline	0171	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0114	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0172	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3][3]
	Vegetation Guideline	0115	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0173	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0116	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0117	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0174	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0118	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0119	Deleted, as part of 2010 Forest Plan amendment for WCS.

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[3] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC Resource Area	Direction	Number	Management Direction Description
MPC 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	Vegetation Standard	0175	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	0120	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0176	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0121	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0122	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0177	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
Soil, Water, Riparian, and Aquatic Resources	Objective	0123	Improve water retention and restore wetland vegetation in riparian areas by re-introducing beaver in Wood Creek, Willow Creek and other suitable habitat.
	Objective	0124	Maintain habitat to support the "blue ribbon" rainbow trout fishery in the South Fork Boise River.
	Objective	0125	Manage to provide for a migration corridor for bull trout in the South Fork Boise River.
	Objective	0126	For the Deer Creek Watershed, coordinate with the local highway district to address fish passage issues.
	Guideline	0127	Coordinate improvement of soil-hydrologic function with private landowners in management area watersheds that the State of Idaho has listed as being impaired.

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[4] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

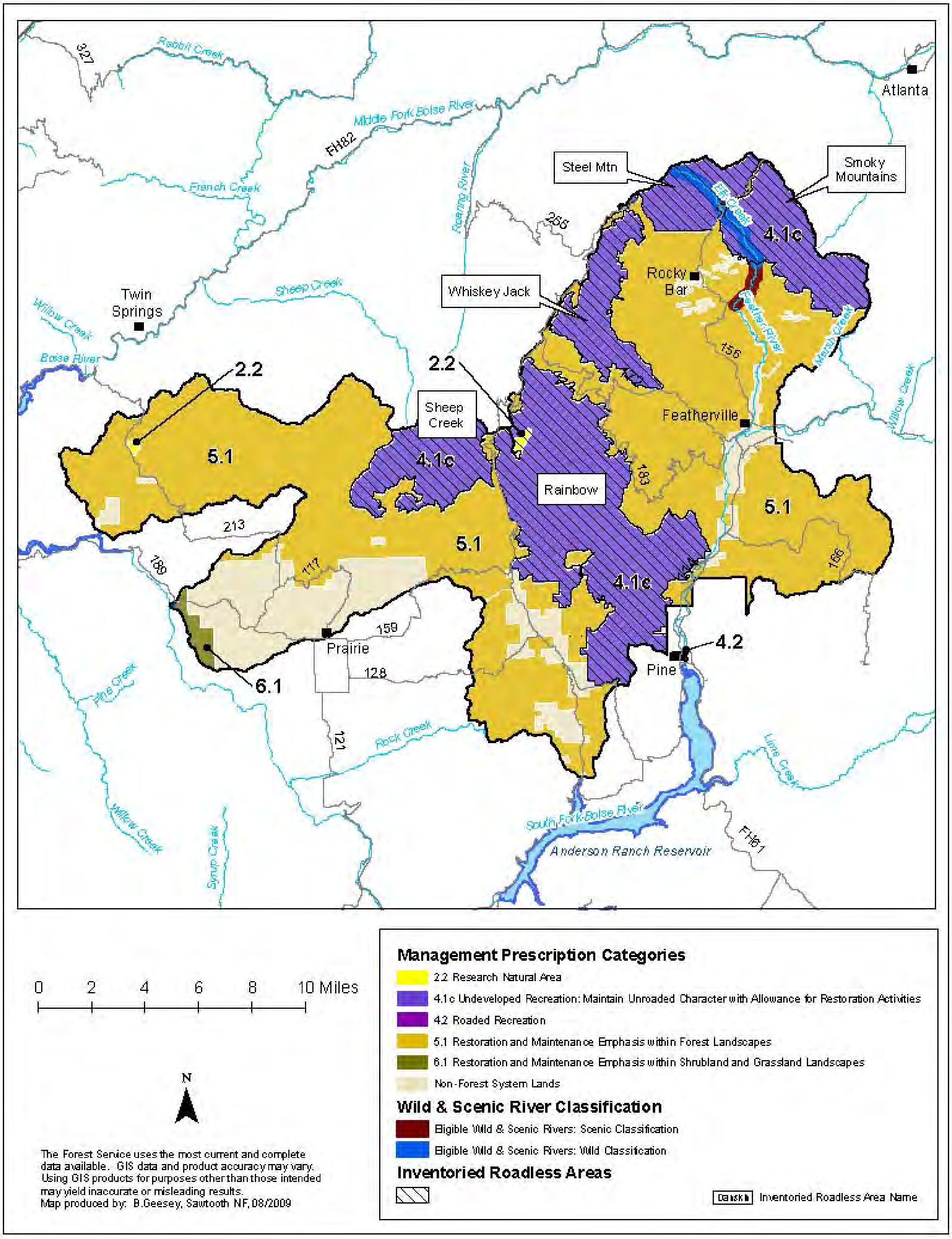
MPC Resource Area	Direction	Number	Management Direction Description
Soil, Water, Riparian, and Aquatic Resources	Guideline	0128	For the Deer Creek subwatershed, bull trout fish passage should be a high priority. Culverts should be inventoried and modified as needed to ensure fish passage occurs during required times of the year.
	Guideline	0129	Coordinate beaver re-introduction efforts with Idaho Department of Fish and Game.
Vegetation	Objective	0130	Rely on natural regeneration as the primary means of recovering forested, shrubland, and grassland vegetation in areas affected by the 1992 Foothills Fire.
	Objective	0131	Initiate restoration of decadent aspen stands where they currently exist by stimulating regeneration and reducing conifer density in all the watersheds in the management area.
	Objective	0132	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	0133	Within the 1992 Foothills Fire area, maintain existing and newly established shrub stands in the Mountain Big Sagebrush and Bitterbrush vegetation groups to improve shrub diversity.
Botanical Resources	Objective	0134	Maintain or restore known populations and occupied habitats of Threatened, Endangered, Proposed, Candidate, or Region 4 Sensitive (TEPCS) species, such as bugleg goldenweed, Wilcox's primrose, and hooked stylocline, to contribute to the long-term viability of these species.
	Objective	0135	Emphasize reducing rush skeletonweed, leafy spurge, and spotted knapweed within rare plant occupied and potential habitat.
Non-native Plants	Objective	0136	Contain and control the spread of noxious weeds, with emphasis on leafy spurge and spotted knapweed along the South Fork Boise River corridor.
	Objective	0137	Minimize the establishment and spread of rush skeletonweed and cheatgrass.
	Objective	0138	Prevent establishment of yellow starthistle and purple loosestrife.
Wildlife Resources	Objective	0139	Maintain or restore bald eagle wintering habitat along the South Fork Boise River corridor.
	Guideline	0140	Management actions in sage grouse habitat should be designed to meet the desired conditions for sagebrush described in Appendix A. Where greater than 40 percent of the sage grouse habitat in the management area has less than 10 percent canopy cover, management actions should be designed to maintain or restore canopy cover conditions.
Recreation Resources	Objective	0141	Provide for public recreation use on the South Fork Boise River to maintain river-related recreation opportunities.
	Objective	0142	Improve developed sites around Anderson Ranch Reservoir, emphasizing Curlew Campground and launch site, and paving the parking area at Elk Creek boat ramp to enhance recreation experiences and to reduce impacts on other resources.
	Objective	0143	Manage the Danskin Motorized Trail Area for a variety of users to provide a range of recreation opportunities and experiences.
	Objective	0144	Reconstruct trails in the Danskin-Willow Creek area as needed to reduce resource impacts and to improve recreation experiences and visitor safety.

<table>
<tr><th>MPC Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="5">Recreation Resources</td><td>Objective</td><td>0145</td><td>Provide toilet facilities along the South Fork of the Boise River below Anderson Ranch Dam to reduce resource impacts from dispersed recreation use.</td></tr>
<tr><td>Objective</td><td>0146</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>5%</td><td>1%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>38%</td><td>78%</td></tr>
<tr><td>Roaded Natural</td><td>24%</td><td>17%</td></tr>
<tr><td>Roaded Modified</td><td>33%</td><td>3%</td></tr>
<tr><td>Non Forest Service Lands</td><td>1%</td><td>1%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Objective</td><td>0147</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from off-road ATV/motorbike use in the Pierce-Mennecke, Long Tom Reservoir, Lower Lime Creek, Cayuse-Rough, Wildhorse-Camas Prairie, Syrup Creek, and Moores Creek subwatersheds. Consider annual weed inspection and treatment of trailheads and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0148</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Big Fiddler-Soap, Black Canyon-Trail, Upper Willow Creek, Lower Willow Creek, Wood Creek, and Indian Creek subwatersheds. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Standard</td><td>0149</td><td>Do not issue special use permits for commercial whitewater rafting or fly-fishing outfitters and guides in order to maintain the current river-related recreation experiences.</td></tr>
<tr><td rowspan="4">Cultural Resources</td><td>Objective</td><td>0150</td><td>Maintain the National Register status of Danskin Rockshelter, Moores Spring, and other eligible properties. Monitor the conditions of properties in the area eligible for the National Register of Historic Places (NRHP).</td></tr>
<tr><td>Objective</td><td>0151</td><td>Inventory acquired lands in the management area for historic properties, specifically tracts on Granite Creek.</td></tr>
<tr><td>Objective</td><td>0152</td><td>Inventory historic properties contributing to the High Prairie Archaeological District.</td></tr>
<tr><td>Objective</td><td>0153</td><td>Nominate Danskin Rockshelter, Moores Spring, the High Prairie Archaeological District, and Danskin Peak Lookout to the NRHP. Develop management plans for Moores Spring, Danskin Rockshelter, and Danskin Peak Lookout.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>0154</td><td>Deleted, as part of 2010 Forest Plan amendment for WCS.</td></tr>
</table>

MPC Resource Area	Direction	Number	Management Direction Description
Rangeland Resources	Objective	0155	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Big Fiddler-Soap, Long Gulch, Black Canyon-Trail, Pierce-Mennecke, Upper Willow Creek, Lower Willow Creek, Wood Creek, Indian Creek, Long Tom Reservoir, Lower Lime Creek, and Cayuse-Rough subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
	Guideline	0156	When constructing new fences or reconstructing existing fences, design or relocate to avoid potential sage grouse mortality near leks.
	Guideline	0157	Whenever possible, modify developed springs and other water sources to restore free-flowing water and wet meadows in sage grouse habitat.
Fire Management	Objective	0158	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans (CWPPs) that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0159	Limit the use of prescribed fire in existing and newly established stands of mountain big sagebrush and bitterbrush within the 1992 Foothills Fire area in order to restore canopy closure, and restore or maintain shrub diversity.
	Objective	0160	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
Lands and Special Uses	Objective	0161	Use land exchange opportunities to acquire scattered parcels of private inholdings to improve Forest management efficiency.
	Objective	0162	Dispose of scattered National Forest lands south of Anderson Ranch Reservoir, except those lands around Camas Reservoir, to improve Forest management efficiency.
	Objective	0163	Continue to cooperate on cost-share agreements for road use with State agencies to efficiently provide for access needs.
	Guideline	0164	Vegetation management activities within the Bonneville Power Administration (BPA) utility corridor should be coordinated with the BPA and should also be consistent with the most recent programmatic vegetation management direction for BPA corridors.
Facilities and Roads	Objective	0165	Evaluate and improve, as necessary, the facilities at the Lester Creek Work Center.

MPC Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	0166	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Big Fiddler-Soap, Long Gulch, Black Canyon-Trail, Pierce-Mennecke, Anderson Ranch Reservoir, Upper Willow Creek, Lower Willow Creek, Wood Creek, and Indian Creek subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	0167	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
South Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Arrowrock Reservoir	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 113	1	R	R	PR	R	PR	PR	R	PR	M
Anderson Ranch Reservoir and recreation sites	1	R	R	PR	R	PR	PR	R	PR	M
State Highway 20	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 134	1	R	R	PR	R	PR	PR	R	PR	M
Forest Highway 61	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 189	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 128	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 160	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 123	2	PR	PR	M	PR	M	M	PR	M	MM
Camas Reservoir and recreation sites	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 021, 039, 193, 194, 195	2	PR	M	M	M	M	M	M	M	MM
Danskin Trails 300, 317, 400, 410, 500	2	PR	PR	M	PR	M	M	PR	M	MM



Management Area 02. Rattlesnake Creek/Feather River Location Map

Management Area 2
Rattlesnake Creek/Feather River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 2 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	Trace
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	33
4.2 – Roaded Recreation Emphasis	Trace
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	66
6.1 – Restoration and Maintenance Emphasis within Shrubland & Grassland Landscapes	1

General Location and Description - Management Area 2 is located north of the South Fork Boise River, in the southern portion of the Boise National Forest, about 15-45 miles east of Boise, Idaho (see map, opposite page). Administered by the Mountain Home Ranger District, the management area is in Elmore County and extends from Arrowrock Reservoir in the west to Featherville in the east (see area map, opposite). The management area is an estimated 198,900 acres, of which 88 percent are managed by the Forest Service, 10 percent are privately owned, and 2 percent are State of Idaho lands. The area is bordered by Boise National Forest to the south, west, and north, and Sawtooth National Forest to the east. The primary uses or activities in this management area have been timber management, dispersed recreation, livestock grazing, and mining.

Access - The main access to the area is by State Highway 20 from Interstate 84 to Forest Road 134 to Anderson Ranch Reservoir and Forest Road 113. Other access routes include Forest Roads 156 along the South Fork Boise River and 123/129 up Fall Creek. The density of classified roads for the management area is an estimated 2.0 miles per square mile. Total road density for area subwatersheds ranges between 0.7 and 4.4 miles per square mile. The roadless portions of the area are accessed by trails.

Special Features - Two eligible Wild and Scenic Rivers fall within the management area, Elk Creek and the South Fork Boise River. Elk Creek has two segments in this management area with classifications of Scenic and Wild. The Scenic segment is an estimated 5.1 miles, with a river corridor of 1,642 acres. The Wild segment is 2.2 miles, with a river corridor of 717 acres. Elk Creek is considered eligible for Wild and Scenic River status because of its outstandingly remarkable cultural resource values.

The South Fork Boise River has one segment, with a Recreational classification, which is 0.2 mile, with a river corridor of 70 acres. The South Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable recreational, geologic, hydrologic, and cultural resource values.

The Elk Creek Enclosure RNA (110 acres) contains undisturbed grassland vegetation, and the Trinity Mountain RNA (190 acres) contains undisturbed alpine vegetation. The rural communities of Pine, Featherville, and Prairie are in this management area. The Trinity Lakes area attracts heavy backcountry recreation use. An estimated 29 percent of the area is inventoried as roadless, including all of the Whiskey-Jack Roadless Area, and portions of the Rainbow, Smoky Mountains, Sheep Creek, Lost Man Creek and Steel Mountain Roadless Areas.

Air Quality - This management area lies within Montana/Idaho Airshed ID-21 and in Elmore County. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located within these airsheds in Boise, Idaho City, and Mountain Home to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in Elmore County improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the county was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was moderately low (an estimated 5,000 acres) within the county. Point sources contributed minor amounts to the annual total PM 2.5 emissions within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet at the South Fork Boise River to 9,451 feet atop Trinity Mountain. Management Area 2 falls within portions of multiple subsections, including the Trinity Mountains, Middle Fork Boise Canyon and Streamcut Lands, and Cayuse Point. The main geomorphic landforms associated with the subsections are glaciated uplands, deeply entrenched canyonlands, and strongly dissected fluvial lands. Slope gradients average between 25 to 65 percent in the uplands, 15 to 45 percent in the canyonlands, and 30 to 60 percent in the fluvial lands. The surface geology is predominantly Idaho batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from moderate to low, with the majority being moderate (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). There are localized impacts from roads, livestock grazing, timber harvest, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of the Feather-Grouse and Fall Creek Watersheds, and part of the Lower South Fork Boise River Watershed. The entire area drains into the South Fork Boise River Subbasin. The main streams in the area are the South Fork Boise River and its tributaries: Fall Creek, Smith Creek, Rattlesnake Creek, Trinity Creek, and Feather River. There are a number of high alpine lakes in the vicinity of Trinity Mountain. Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). Localized impacts include thermal changes due to water diversions, and accelerated sediment from roads, timber management, livestock grazing, and recreation. Seven of the 15 subwatersheds in this area have water bodies that were listed as impaired in 1998 under Section 303(d) of the Clean Water Act. These subwatersheds are Lower

Rattlesnake, Upper Rattlesnake, Lower Smith, Upper Smith, Feather River, Bear Creek, and Elk Creek. Sediment was the pollutant of concern in all seven subwatersheds. There are currently no TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
4	11	0	0	7	8	0	8	7	7	0	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Bull trout occur in the Upper Rattlesnake Creek, Feather River, Bear Creek, Elk Creek, and Wagontown-Schoolhouse subwatersheds, with a strong local population found in the Elk Creek subwatershed. Habitat is currently fragmented. Redband trout are only found in the Wagontown-Schoolhouse subwatershed. The South Fork Boise River is managed as a blue ribbon rainbow trout stream, and Rainbow Basin is managed as a high-quality, alpine lake backcountry fishery. Introduced brook trout occur in Smith and Fall Creeks. Other non-native fish species have been introduced to area streams and reservoirs for sport fishing. Aquatic habitat is functioning at risk in some areas due to elevated water temperatures, habitat fragmentation, and accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts described above. The Bear Creek and Elk Creek subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands and shrublands and ponderosa pine and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 26 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (18 percent), Cool Dry Douglas-fir (6 percent), Cool Moist Douglas-fir (19 percent), Dry Ponderosa Pine/Xeric Douglas-fir (16 percent), and Warm Dry Subalpine Fir (7 percent). Aspen is an important component in all of the forested groups.

The Mountain Big Sagebrush and Montane Shrub groups are functioning at risk due to fire exclusion that has resulted in many stands with old age structure, dense canopies, and low levels of herbaceous ground cover. Perennial Grass Slopes are not functioning properly because native species have been replaced in many areas by noxious weeds and introduced grasses and forbs (cheatgrass, wheatgrass, rush skeletonweed, sweet clover, orchard grass).

The Warm Dry Douglas-fir/Moist Ponderosa Pine and Dry Ponderosa Pine/Xeric Douglas-fir groups are not functioning properly. Stands that have recently burned have experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands. Recent insect outbreaks have increased tree mortality and the risk of uncharacteristic large wildfire. The Cool Dry Douglas-fir and Cool Moist Douglas-fir groups have similar conditions but to a lesser extent, and therefore, they are only functioning at risk at present. These groups also have increasing insect and mistletoe infestations, and lack young structural stages and seral ponderosa pine and aspen. The Warm Dry Subalpine Fir group and aspen are functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Some aspen stands are being replaced by conifers or sagebrush. All the watersheds in the management area are a high priority for aspen restoration.

Riparian vegetation is functioning at risk due to localized impacts from roads, livestock grazing, and fire exclusion. Composition has changed in many riparian areas because of lowered water tables and introduced plant species. Non-native plants have increased, and *carex* and other wetland species have decreased. Native cottonwoods and broadleaf shrubs have also decreased, and are not regenerating in many areas.

Botanical Resources – Current Region 4 Sensitive species known in this management area include Idaho douglasia and giant helleborine orchid. There are also known populations of Kellogg's bitterroot, a Region 4 proposed Sensitive species, and Wilcox's primrose, a proposed Region 4 Watch species, and tall swamp onion, a proposed Forest Watch species. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Rush skeletonweed, spotted knapweed, leafy spurge, and Dalmatian toadflax occur in the area, particularly along the main road corridors. An estimated 49 percent of the area is highly susceptible to invasion by noxious weed and exotic plant species. The main weeds of concern are rush skeletonweed and leafy spurge, which currently occur in scattered populations throughout the management area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Lower Rattlesnake Creek	Yes	Yes	Yes	Yes	No
Upper Rattlesnake Creek	Yes	No	No	No	No
Lower Smith Creek	Yes	Yes	Yes	No	Yes
Lower Fall Creek	No	Yes	Yes	No	No
Middle Fall Creek	No	No	Yes	No	No
Wagontown-Schoolhouse	Yes	Yes	Yes	Yes	No
Feather River	Yes	No	Yes	No	No
Bear Creek	Yes	No	No	No	No
Elk Creek	Yes	No	No	No	No
Dog-Nichols	No	No	No	Yes	No

Wildlife Resources—The wide range of elevations and vegetation types in the management area provide a variety of wildlife habitats. The South Fork Boise River corridor has wintering and nesting habitat for bald eagles and potential nesting habitat for peregrine falcons. Much of the low-elevation grasslands and shrublands are important winter range for elk and deer, as well as foraging habitat for mountain quail, sage grouse, and introduced turkey, gray partridge, and chukar. Low and mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation forests provide nesting and foraging habitat for many migratory landbirds, as well as summer range for mammals such as elk, black bear, and mountain lion. Yellow-billed cuckoo habitat may be present in cottonwood stands in the lower portions of the South Fork Boise River. Two Idaho Comprehensive Wildlife Conservation Strategy focal areas overlay portions of this Management Area: Anderson Ranch and Boise River.

High road densities in this management area are influencing use of habitat by wildlife species that are negatively affected by road-associated factors. Overall, terrestrial habitat is functioning at risk because, in managed areas, timber harvest and roads have increased fragmentation and have reduced snags, large trees, and large woody debris below historical levels. In unmanaged areas, stand densities and fuel loadings are likely above or at the high end of their historical levels, reducing habitat for species such as flammulated owl and white-headed woodpecker, and increasing the risk of lethal wildfire.

The Fall Creek (5th code HUC 1705011304) and Feather-Grouse (5th code HUC 1705011305) watersheds have been identified as important to the sustainability of Forest sensitive species and other native wildlife utilizing large tree and old forest habitat with low canopy conditions, and are identified as short-term high-priority areas for maintenance and restoration treatments. These two watersheds have also been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. Consequently, they are identified as short-term high priority areas for subsequent site-specific investigations at a finer scale.

Recreation Resources - Dispersed recreation such as hunting, fishing, hiking, sightseeing, snowmobiling, skiing, off-road vehicle use, and camping occurs throughout Management Area 2, and there are many dispersed campsites. The Trinity Lakes area has four developed campgrounds, and the adjacent Rainbow Basin area is heavily used for backcountry recreation. The South Fork Boise River corridor is used for fishing, rafting, kayaking, and canoeing. Key recreation areas and travel corridors have objectives designed to protect visual quality. Almost all roads and trails in the area are open to some type of motorized vehicle use. The management area is located partially within Idaho Fish and Game Management Units 39 and 43.

Cultural Resources - Cultural themes in this area include Mining, Ethnic Heritage, Ranching, Transportation, Timber Industry, Forest Service History, and the CCC. This management area contains the South Boise Historic Mining District, which is listed on the National Register of Historic Places. In 1863, miners discovered gold on Feather River and its tributaries, leading to the establishment of Rocky Bar and Featherville. Sites associated with Chinese miners are in the area. In 1864, Julius Newberg built the South Boise Wagon Road, linking the mining camps with ranches along Goodale’s Cutoff. Today, Forest Highway 61 follows portions of the old toll road. Historic properties associated with logging and homesteading are also located in the area. In 1906, the Forest Service established the Trinity Lakes Guard Station in conjunction with a nearby lookout on Trinity Mountain. In 1934, CCC crews replaced the guard station buildings with new structures and built campgrounds in the area.

Timberland Resources—Of the estimated 98,300 tentatively suited acres in this management area, 52,200 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 10 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 4.2, 5.1and 6.1, as shown on the map displaying the MPCs for this management area. Lands in MPCs 2.2 and 4.1c have been identified as not suited for timber production. This area has had a moderate to high level of past timber management. Portions of this area were also selectively harvested for mine timbers, construction lumber, and fuelwood for historic mining communities. Fuelwood, post, poles, Christmas trees, and other forest products are currently collected in designated areas.

Rangeland Resources - The management area contains all or portions of seven cattle and two sheep allotments. Management Area 2 provides an estimated 54,200 acres of capable rangeland. These acres represent about 14 percent of the capable rangeland on the Forest. This area features a fairly high level of structural range improvements.

Mineral Resources - The area is open to mineral activities and prospecting. Historic mining has occurred for gold, silver, and copper. The locatable mineral potential is high in areas of past activity, such as the Rocky Bar and South Boise Mining Districts. The leasable mineral potential for geothermal resources is moderate. The potential for other leasable and locatable minerals is low. The potential for common variety mineral materials (mostly decorative stone and basalt gravel) is high in the mining districts, and unknown elsewhere.

Fire Management—Prescribed fire has been used to improve winter range and livestock forage conditions and to reduce activity-generated and natural fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years there have been approximately 229 fire starts in the management area, the majority of which were lightning-caused. Total acres burned have been relatively low given the number of starts. Large wildfires, including the 1992 Foothills Fire have burned about 21 percent of the management area in the last 20 years. These fires were, for the most part, high intensity lethal wildfires.

Pine, Prairie, Featherville and Rocky Bar are National Fire Plan communities, and the area around these communities as well as the corridor between Pine and Featherville are considered wildland-urban interface areas due to private development adjacent to the Forest. Lower Smith Creek, Lower Fall Creek, Dog-Nichols, Grouse Creek, Wagontown-Schoolhouse, Upper Smith Creek, and Feather River subwatersheds are considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 11 percent lethal, 45 percent mixed1 or 2, and 44 percent non-lethal. An estimated 14 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 39 percent of the area is in moderately departed conditions—15 percent in the mixed1/mixed2 fire regimes, and 24 percent in the non-lethal regimes. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - There are several utility corridors to private inholdings and communities. Opportunities exist to consolidate National Forest System lands through exchange with other landowners in the area. The Featherville, Trinity, and Dog Mountain designated communication sites are located within the management area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	0201	Manage the South Fork Boise River and Elk Creek eligible river corridors to their assigned Wild and Scenic River classification standards, and preserve their ORVs and free-flowing status until the rivers undergo a suitability study and the study finds them suitable for designation by Congress, or releases them from further consideration as Wild and Scenic Rivers.
	Vegetation Standard	0258	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	0202	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0203	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0204	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	0205	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	0206	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	0207	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0208	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	0259	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	0209	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0210	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 4.2 Roaded Recreation	Vegetation Standard	0260	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Vegetation Guideline	0211	Vegetation management actions—including prescribed fire and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.
	Vegetation Guideline	0261	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0212	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[3] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0262	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Road Standard	0213	New roads and landings shall be located outside of RCAs in the MPC 5.1 portion of the Elk Creek subwatershed unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are already in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	0214	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0263	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0215	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0216	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.

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[4] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	0264	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0217	Deleted, as part of 2010 Forest Plan amendment.
	Fire Guideline	0218	Deleted, as part of 2010 Forest Plan amendment for WCS.
MPC 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	Vegetation Standard	0265	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[5]
	Vegetation Guideline	0219	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0266	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0220	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0221	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0267	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.

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[5] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
Soil, Water, Riparian, and Aquatic Resources	Objective	0222	Restore water quality within the Feather River and Trinity Creek drainages by reducing accelerated sediment delivery from existing roads. Prioritize restoration where road-related sedimentation to bull trout spawning and rearing habitats can be quickly reduced, and benefits to water quality and aquatic species can be maximized.
	Objective	0223	Manage for strong local populations of bull trout in the Elk Creek and Bear Creek subwatersheds through active habitat restoration by reducing mining and road-related impacts to water quality and fish habitat.
	Objective	0224	Restore migration connectivity for bull trout and redband trout in the Feather River and Trinity Creek drainages by removing migration barriers in the existing roads.
	Objective	0225	Develop a schedule to inventory existing culverts to determine if they currently provide fish passage and prevent fish entrainment. Prioritize completion of the Feather River, Lower Trinity Creek, Upper Trinity Creek, and Dog-Nichols subwatershed inventories.
	Guideline	0226	For the Feather River, Lower Trinity Creek, Upper Trinity Creek, and Dog-Nichols subwatersheds, bull trout fish passage should be a high priority. Culverts should be inventoried and modified as needed to ensure fish passage occurs during required times of the year.
Vegetation	Objective	0227	Deleted, as part of the 2010 Forest Plan amendment for WCS.
	Objective	0228	Restore decadent aspen stands by stimulating regeneration and reducing conifer density in all watersheds in the management area. Restore historical disturbance regimes for aspen.
Botanical Resources	Objective	0229	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, giant helleborine orchid, and Kellogg's bitterroot, to contribute to the long-term viability of these species.
	Objective	0230	Emphasize reducing leafy spurge and rush skeletonweed within rare plant occupied and potential habitat.
	Standard	0231	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	0232	Contain and control the spread of multiple noxious weeds, particularly rush skeletonweed and leafy spurge, and prevent establishment of new noxious weed species.
Wildlife Resources	Objective	0233	Maintain or restore bald eagle wintering habitat along the South Fork Boise River corridor.
	Objective	0268	Focus source habitat restoration activities within the Fall Creek (5th code HUC 1705011304) and Feather-Grouse (5th code HUC 1705011305) watersheds in areas field-verified to have good to excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E*).

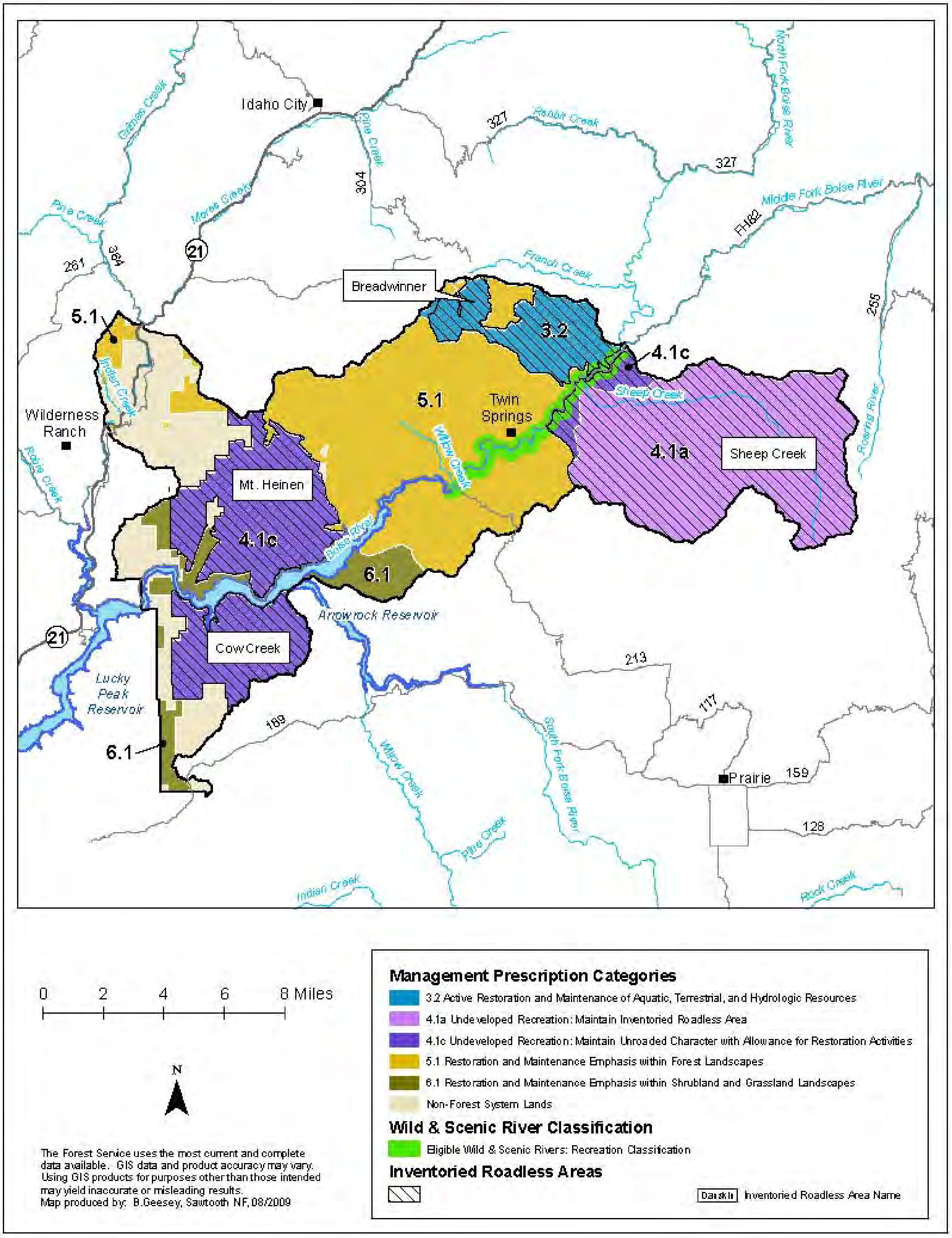
<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="3">Wildlife Resources</td><td>Objective</td><td>0269</td><td>Reduce open road densities within the Fall Creek (5th code HUC 1705011304) and Feather-Grouse (5th code HUC 1705011305) watersheds where it is determined that they limit use of source habitats by wildlife species identified as TEPC and R4 Regionally Sensitive. (<i>Refer to Conservation Principles 5 and 6 in Appendix E.</i>).</td></tr>
<tr><td>Objective</td><td>0270</td><td>Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Fall Creek (5th code HUC 1705011304) and Feather-Grouse (5th code HUC 1705011305) priority watersheds. (<i>Refer to Conservation Principle 6 in Appendix E.</i>).</td></tr>
<tr><td>Guideline</td><td>0271</td><td>Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Fall Creek (5th code HUC 1705011304) and Feather-Grouse (5th code HUC 1705011305) watersheds should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals.(<i>Refer to Conservation Principles 1, 4, and 5 in Appendix E.</i>).</td></tr>
<tr><td rowspan="6">Recreation Resources</td><td>Objective</td><td>0234</td><td>Inventory and analyze recreation opportunities in the Trinity/Rainbow Lakes area to determine future recreation management needs.</td></tr>
<tr><td>Objective</td><td>0235</td><td>Relocate or reconstruct trails such as Camp Creek, Crosscut, and Dismal Swamp that are not meeting resource objectives or are causing visitor safety concerns.</td></tr>
<tr><td>Objective</td><td>0236</td><td>Facilitate and participate in the development of a scenic byway corridor management plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.</td></tr>
<tr><td>Objective</td><td>0237</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from off-road ATV/motorbike use in the Lower Smith Creek subwatershed. Consider annual weed inspection and treatment of trailheads and other high-use areas; and posting educational notices in these areas to inform the public of areas that are susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0238</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Lower Rattlesnake Creek, Dog-Nichols, and Wagontown-Schoolhouse subwatersheds. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0239</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>13%</td><td>20%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>12%</td><td>78%</td></tr>
<tr><td>Roaded Natural</td><td>21%</td><td>2%</td></tr>
<tr><td>Roaded Modified</td><td>54%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Recreation Resources	Standard	0240	Within the Rainbow Lakes area, prohibit recreation pack and saddle stock on designated trails and adjacent to lakes to protect sensitive resources and provide a range of recreation opportunities and experiences.
Cultural Resources	Objective	0241	Maintain the National Register status of eligible properties including Trinity Lakes Guard Station, which is on the Forest's cabin rental program, and the South Boise Historic Mining District, which is listed on the NRHP.
	Objective	0242	Inventory Smith Prairie and acquired lands on Fall Creek and its tributaries for historic properties.
	Objective	0243	Monitor the conditions of NRHP eligible properties in the area to be aware of potential damage or loss of important historic properties.
	Objective	0244	Nominate Trinity Lakes Guard Station to the NRHP, and develop a maintenance plan to protect its historic character.
	Objective	0245	Develop a management plan for the South Boise Historic Mining District that includes revising the NRHP listing to identify contributing properties.
Timberland Resources	Objective	0246	Evaluate and implement, where needed, Timber Stand Improvement (TSI) treatments in regenerated stands in the Foothills Fire and Star Gulch Fire areas.
	Objective	0247	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Lower Rattlesnake Creek, Lower Smith Creek, Lower Fall Creek, Middle Fall Creek, Wagontown-Schoolhouse, and Feather River subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fireline construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	0248	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Lower Rattlesnake Creek, Lower Smith Creek, Lower Fall Creek, Middle Fall Creek, Wagontown-Schoolhouse, and Feather River subwatersheds.
Rangeland Resources	Objective	0249	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Lower Rattlesnake, Lower Smith Creek, Lower Fall Creek, and Wagontown-Schoolhouse subwatersheds. Methods to consider include changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
	Standard	0250	Prohibit all livestock grazing in the Rainbow Basin Lakes area to protect sensitive resources and provide a range of recreation opportunities and experiences.

MPC/Resource Area	Direction	Number	Management Direction Description
Fire Management	Objective	0251	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0252	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Objective	0253	Evaluate opportunities to demonstrate and teach techniques in fire ecology within the Cottonwood Demonstration Area set aside in the 1995 Record of Decision for the Boise River Wildfire Recovery Project. As part of this evaluation, determine the need to maintain the special status of the area and define area uses expected in the future.
	Guideline	0254	Coordinate with adjacent land managers to develop compatible wildland fire suppression strategies.
Facilities and Roads	Objective	0255	Explore opportunities to manage the Cottonwood Guard/Work Station through a concession authorization to reduce maintenance costs.
	Objective	0256	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Lower Rattlesnake Creek, Upper Rattlesnake Creek, Lower Smith Creek, Wagontown-Schoolhouse, Feather River, Bear Creek, and Elk Creek subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	0257	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
South Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Rainbow Lakes developed sites & trails	1	R	R	PR	R	PR	PR	R	PR	M
Forest Roads 114, 129, 172, 173, 7000	1	R	R	PR	R	PR	PR	R	PR	M
Elks Flat, Dog Creek Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Roads 113, 125, 126, 128, 156	2	PR	PR	M	PR	M	M	PR	M	MM
Ice Springs Campground	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 037, 055, 089, 123, 126, 127, 128, 129, 156, 165, 173, 176, 177, 191, 200, 270	2	PR	PR	M	PR	M	M	PR	M	MM
Trinity Lookout	2	PR	PR	M	PR	M	M	PR	M	MM

Smith Creek Falls



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 03. Arrowrock Reservoir Location Map

Management Area 3
Arrowrock Reservoir

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 3 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial & Hydrologic Resources	6
4.1a - Undeveloped Recreation: Maintain Inventoried Roadless Areas	27
4.1c – Undeveloped Rec.: Maintain Unroaded Character with Allowance for Restoration	22
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	37
6.1 – Restoration and Maintenance Emphasis within Shrubland & Grassland Landscapes	8

General Location and Description - Management Area 3 is located in the Arrowrock Reservoir and Boise Front areas of the Boise National Forest, about 5-25 miles east of Boise, Idaho (see map, opposite page). Administered by the Mountain Home and Idaho City Ranger Districts, the management area is in Elmore and Ada Counties and extends from the Boise Front area in the west to the Sheep Creek drainage in the east. The management area is an estimated 117,600 acres, of which the Forest Service manages 88 percent, 10 percent are privately owned, and 2 percent are State of Idaho lands. The area is bordered primarily by Boise National Forest, with some State lands. The primary uses or activities in this area have been developed and dispersed recreation, livestock grazing, timber management, and mining.

Access - The main access to the area is by State Highway 21 from Boise to Mores Creek, and by the paved Bogus Basin Road from Boise to Boise Ridge. Other access routes include Forest Roads 268 along Arrowrock Reservoir and the Middle Fork Boise River, 261 from Arrowrock Reservoir up Robie Creek, and 377 from Arrowrock Reservoir up Cottonwood Creek. The density of classified roads in the management area is an estimated 0.6 miles per square mile, which includes several county and private roads not under Forest Service jurisdiction. Total road density for area subwatersheds ranges between 0 and 2.6 miles per square mile. Although some areas are fairly well developed, there are several roadless areas as well. Most area trails are in the Sheep Creek drainage.

Approximately the first 6 miles of the Middle Fork of the Boise River Road (Forest Highway 82) to the base of Arrowrock Dam are scheduled to be improved from a gravel surface road to a paved road. This road provides access to Arrowrock Reservoir and beyond to the town of Atlanta and southeastern portions of the Forest.

Special Features - Two eligible Wild and Scenic Rivers fall within the management area, the Middle Fork Boise River and the North Fork Boise River. The portion of the Middle Fork Boise River in the area has a Recreational classification. It is 10.9 miles long, with an estimated river corridor of 3,485 acres, and considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, botanical, and cultural resource values. The portion of the

North Fork Boise River found in the area has a Wild Classification. It is less than one tenth of a mile long, and is considered eligible because of its outstandingly remarkable scenic value.

The Idaho State-designated Ponderosa Pine Scenic Byway (Highway 21) lies partly within this area. It has been nominated as a National Scenic Byway. The William H. Pogue National Recreation Trail is in this area. The management area is in close proximity to the City of Boise and also has a high percentage of intermingled land ownership, including residential subdivisions in the Mores Creek area. The Arrowrock and Lucky Peak Reservoirs attract heavy recreation use. An estimated 48 percent of the management area is inventoried as roadless, including portions of the Mount Heinen, Breadwinner, Sheep Creek, and Cow Creek Roadless Areas.

Air Quality - This area lies within Montana/Idaho Airshed ID-21 and within Boise and Elmore Counties. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located in Boise, Idaho City, and Mountain Home to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the counties was fugitive dust from unpaved roads, and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Boise County (less than 100 acres) and moderately low (an estimated 5,000 acres) in Elmore County. Elmore County had point sources contributing minor amounts to the annual total PM 2.5 emissions within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet at Lucky Peak Reservoir to 8,500 feet in the upper Sheep Creek drainage. Management Area 3 falls within portions of multiple subsections, including Mores Flat, Middle Fork Boise Canyon and Streamcut Lands, Boise Foothills and Squaw Butte, and Boise Ridge-Payette Canyonlands. The main geomorphic landforms associated with the subsections are volcanic flow lands, fluvial canyonlands, and fluvial side slopes. Slope gradients average from 5 to 30 percent in the volcanic flow lands, 45 to 65 percent in the fluvial canyonlands, and 5 to 35 percent in the fluvial side slopes. The surface geology is primarily volcanic basalts south of the South Fork Boise River, and Idaho batholith granitics to the north. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from moderate to high (see table below). Subwatershed Geomorphic Integrity ratings vary from high (functioning appropriately) to low (not functioning appropriately), with the majority being moderate (functioning at risk). There are localized impacts from roads, livestock grazing, timber harvest, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of all or part of the Sheep-Logging, Arrowrock Reservoir, and Lower Mores Creek Watersheds in the South Fork Boise River Subbasin, and Boise-Cottonwood and Dry-Spring Valley Watersheds in the Lower Boise River Subbasin. The main streams in the area are the Middle Fork Boise River, Sheep Creek, Mores Creek, Cottonwood Creek, Clear Creek, and Robie Creek. Two large reservoirs--Arrowrock and Lucky Peak--are in the area, as well as a couple small natural lakes in the upper reaches of Sheep Creek. The Deer-Grouse and Sheep-Charcoal subwatersheds are part of the state-regulated public water systems (United Water of Idaho, Inc.) for portions of the city of Boise.

Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to low (not functioning appropriately), with the majority being moderate (functioning at risk). Localized impacts include accelerated sediment from roads, timber harvest, livestock grazing, wildfire, and recreation. Only one of the 11 subwatersheds in this area was listed in 1998 as having an impaired water body under Section 303(d) of the Clean Water Act—the Blacks Creek subwatershed. Pollutants of concern were sediment, nutrients, and dissolved oxygen. Blacks Creek also has a TMDL assigned, although there are less than a thousand acres of this subwatershed on National Forest System lands.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
6	5	0	1	8	2	1	9	1	1	1	2

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Threatened bull trout occur in many streams within the Upper Sheep Creek, Lambing-Trail, Badger-Slide, Logging-Haga, Deer-Grouse, and Lower Sheep subwatersheds. A strong local population of bull trout occurs in upper Sheep Creek. Redband trout occur in some of the area drainages. The Middle Fork Boise River is managed as a high value fishery, and Arrowrock Reservoir is managed for a high-quality angling experience. Several non-native fish species have been introduced to area streams and reservoirs for sport fishing. Aquatic habitat is functioning at risk in some areas due to elevated water temperatures, habitat fragmentation, and accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid and upper elevations are dominated by shrubs and forests of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Aspen can also occur as a climax community.

An estimated 55 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Bitterbrush, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (19 percent), Cool Dry Douglas-fir (6 percent), Cool Moist Douglas-fir (4 percent), and Dry Ponderosa Pine/Xeric Douglas-fir (8 percent). Aspen is an important component in all of the forested groups. A large amount of forested vegetation has recently burned in lethal wildfires.

The Mountain Big Sagebrush and Perennial Grass Slopes groups are not functioning properly, and the Montane Shrub and Bitterbrush groups are functioning at risk due to impacts from the 1992 Foothills Fire and the introduction of non-native species. Structure and composition have been substantially altered. Native shrubs and grasses have been replaced in many areas by noxious weeds and introduced grasses and forbs (cheatgrass, wheatgrass, rush skeletonweed, sweet clover, orchard grass).

The Warm Dry Douglas-fir/Moist Ponderosa Pine and Dry Ponderosa Pine/Xeric Douglas-fir groups are not functioning properly in some areas. Many stands that burned in 1992 experienced high mortality because decades of fire exclusion had resulted in high stand densities and fuel loadings that had moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands. Recent insect outbreaks have increased tree mortality and the risk of uncharacteristic large wildfire. The Cool Dry Douglas-fir and Cool Moist Douglas-fir groups have similar conditions but to a lesser extent, and therefore they are functioning at risk. These groups also have increasing insect and mistletoe infestations, and lack young structural stages and seral ponderosa pine and aspen. Aspen stands are functioning at risk due to fire exclusion that has resulted in old stands without structural diversity, which are not regenerating. Many stands are succumbing to insects and disease, and are being replaced by conifers or sagebrush. All the watersheds in this Management Area are high priority for aspen restoration.

Riparian vegetation is functioning at risk due to localized impacts from roads, livestock grazing, wildfires, and private land uses. Composition has changed in many riparian areas because of disturbance, lowered water tables, and introduced plant species. Non-native plants have increased, and *carex* and other wetland species have decreased. Native cottonwoods and broadleaf shrubs have also decreased, and are not regenerating in many areas.

Botanical Resources – Giant helleborine orchid, a Region 4 Sensitive species, and Kellogg’s bitterroot, a proposed Sensitive species are known from this management area. There are also known populations of Wilcox’s primrose, a proposed Region 4 Watch species. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies’-tresses, slickspot peppergrass, and slender moonwort may exist. Ute ladies’-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slickspot peppergrass, a Candidate species, may be found in sagebrush-steppe habitats ranging from around 2,200 to 5,300 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Rush skeletonweed, spotted knapweed, Dalmatian toadflax, leafy spurge, and St. Johnswort occur in the area, particularly along the main road corridors. An estimated 70 percent of the area is highly susceptible to invasion by noxious weed and exotic plant species. The main weeds of concern are leafy spurge and spotted knapweed, which currently occur in small, scattered populations, particularly along the Middle Fork Boise River corridor.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a “yes” in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Deer-Grouse	Yes	Yes	No	No	No
Lambing-Trail	Yes	Yes	Yes	No	No
Smith-Dunnigan	Yes	No	No	No	No
Badger-Slide	No	Yes	No	No	No
Logging-Haga	No	Yes	No	No	No
Lower Sheep Creek	No	No	No	Yes	No

Wildlife Resources—The wide range of elevations and vegetation types in the management area provide a variety of wildlife habitats. Arrowrock Reservoir and the Middle Fork Boise River have wintering and nesting habitat for bald eagles, and nesting habitat for osprey. Much of the low-elevation grasslands and shrublands are important winter range for elk and deer, as well as foraging habitat for mountain quail, and introduced turkey and chukar. Mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation forests provide nesting and foraging habitat for many migratory land birds, as well as summer range for mammals such as elk, deer, and mountain lion. Yellow-billed cuckoo habitat may be present in cottonwood stands in the lower portions of the South Fork Boise River. The Idaho Comprehensive Wildlife Conservation Strategy Boise River Focal Area overlays most of this Management Area.

Overall, terrestrial habitat is functioning at risk because recent wildfires have reduced snags and large woody debris below historic levels, and have altered vegetation structure and composition. Some timber stands, shrubs, and bitterbrush have been replaced by perennial grasses, many of them non-native, which have in turn increased the risk of high fire frequency. Winter range has been reduced in both quality and quantity due to extensive wildfires.

Recreation Resources - Relatively low elevation, paved access, several major recreation attractions, and proximity to Boise and the Treasure Valley make this a year-round recreation area. The Forest maintains a boat-launching ramp at Arrowrock Reservoir, and three developed campgrounds just to the north. This reservoir and Lucky Peak are heavily used for water-oriented recreation, including fishing, boating, and water-skiing. Dispersed recreation such as hunting, hiking, mountain biking, sightseeing, snowmobiling, and skiing occurs throughout Management Area 3, but especially in the Boise Front and Boise Ridge areas. The Middle Fork Boise River corridor is used for fishing, rafting, kayaking, and canoeing. Key recreation areas and travel corridors have objectives designed to protect visual quality. Roads and trails in the area provide both motorized and non-motorized recreational opportunities. Public access through private lands is a concern and limitation in areas of extensive inholdings. The management area is located partially within Idaho Fish and Game Management Unit 39.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Mining, Ranching, Transportation, Forest Service History, CCC, and Recreation. Sites associated with transportation and reclamation are the most prominent features of the landscape in this area of the Forest. The Middle Fork Boise River Road connecting the Atlanta Mining District with Boise was constructed at different intervals between 1876 and 1907. Twin Springs was the site of 1870s placer mining and later, massive hydraulic operations. The Bureau of Reclamation built Arrowrock Dam, which is listed on the National Register of Historic Places, in 1915.

Within a couple of years the reservoir was a popular recreation destination. The CCC reconstructed the Middle Fork Road during the 1930s, and replaced structures at Cottonwood Guard Station, established in 1908. This management area also contains prehistoric sites including hunting blinds, and historic sites associated with mining, ranching, and logging. Lucky Peak Nursery, established in 1960, cultivates tree seedlings and shrubs for national forests and other federal agencies.

Timberland Resources—Of the estimated 36,700 tentatively suited acres in this management area, 10,500 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 2 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 4.2, 5.1, and 6.1, as shown on the map displaying the MPCs for this management area. Lands in MPCs 2.2, 3.1, 3.2, and 4.1c have been identified as not suited for timber production. The area around the Arrowrock Reservoir is mostly non-forested land and is not managed for timber production. The level of past timber production in the area varies from low in roadless areas to fairly high in roaded areas. Fuelwood, posts and poles, Christmas trees, and other forest products are collected in designated areas.

Rangeland Resources - The management area contains all or portions of seven cattle allotments and one sheep allotment. Management Area 3 provides an estimated 16,400 acres of capable grazing land. These acres represent about 4 percent of the capable rangeland on the Forest. This area features a fairly high level of structural range improvements.

Mineral Resources - The area is open to mineral activities and prospecting. Past and current mining activities include recreational dredging (Middle Fork Boise River), placer, and small-scale hardrock operations. The locatable mineral potential is generally moderate, as is the leasable mineral potential for geothermal resources. The potential for other leasable minerals and common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to improve winter range and livestock forage conditions and to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years there were approximately 86 fire starts, most of which were lightning-caused. Large wildfires (Foothills, Star Gulch, Dunnigan, Grouse Creek) have burned an estimated 70 percent of the management area in the last 20 years. All but one of these large fires (Star Gulch) was caused by lightning. These fires have been, for the most part, high intensity lethal wildfires.

There are no National Fire Plan communities within this area, but the area around Twin Springs and the western portion of the Management Area near Highway 21 are considered wildland-urban interface areas due to private development adjacent to the Forest. These areas and Upper Thorn Creek are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be 40 percent mixed1 or 2, and 60 percent non-lethal. An estimated 9 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 46 percent of the area is in moderately departed conditions—13 percent in the mixed1/mixed2 fire regimes, and 33 percent in the non-lethal regimes. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special-use permits are issued for several utility corridors to private inholdings. The Grape Mountain designated communication site is in this area. Opportunities exist to consolidate National Forest System lands through exchange with other landowners in the area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
EligibleWild and Scenic Rivers	General Standard	0301	Manage the Middle Fork Boise River and North Fork Boise River eligible river corridors to their assigned classification standards, and preserve their ORVs and free-flowing status until the rivers undergo a suitability study and the study finds them suitable for designation by Congress or releases them from further consideration as Wild and Scenic Rivers.
	Vegetation Standard	0352	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6. [1]
	Vegetation Guideline	0302	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0303	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0304	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 3.2 Active Aquatic, Terrestrial, Watershed Emphasis	General Standard	0305	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Aquatic, Terrestrial, Watershed Emphasis	Vegetation Standard	0306	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	0353	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	0307	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	0308	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 4.1a Undeveloped Recreation: Maintain Inventoried Roadless Areas	General Standard	0309	Management actions—including prescribed fire and special use authorizations—must be designed and implemented in a manner that does not adversely compromise the area's roadless and undeveloped character in the temporary, short term, and long term. "Adversely compromise" means an action that results in the reduction of roadless or undeveloped acres within any specific IRA. Exceptions to this standard are actions in the 4.1a Roads standard, below.
	Road Standard	0310	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0311	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the roadless or undeveloped character of the area.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0312	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that is consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	0354	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	0313	Within IRAs, road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0314	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0355	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	0356	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Road Standard	0315	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Road Guideline	0357	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
	Vegetation Guideline	0316	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Fire Guideline	0317	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0318	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0319	Deleted, as part of 2010 Forest Plan amendment for WCS.
MPC 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	Vegetation Standard	0358	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[5]
	Road Standard	0320	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Vegetation Guideline	0321	The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0359	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).

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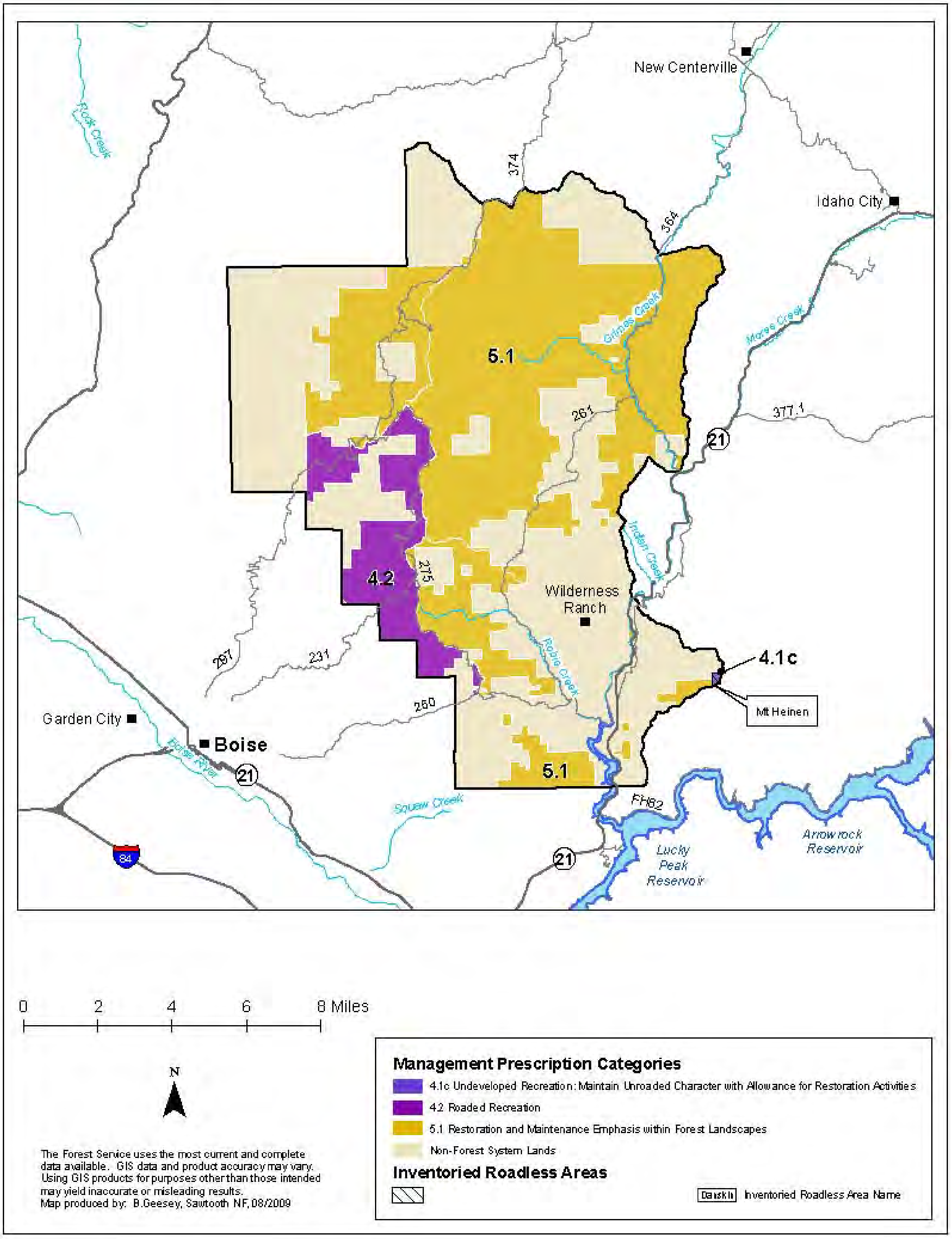
[5] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	Road Guideline	0360	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
	Fire Guideline	0322	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
Soil, Water, Riparian, and Aquatic Resources	Objective	0323	Maintain, or initiate restoration of, focal bull trout habitat within the Sheep Creek drainage.
	Objective	0324	Work the state and other federal agencies to initiate actions needed to re-establish bull trout in the Lucky Peak core area.
	Objective	0325	Develop a schedule to inventory existing culverts to determine if they currently provide fish passage and prevent fish entrainment. Prioritize completion of the Deer Creek and Cottonwood Creek inventories.
Vegetation	Objective	0326	Deleted, as part of the 2010 Forest Plan amendment for WCS.
	Objective	0327	Initiate restoration of decadent aspen stands where they currently exist by stimulating regeneration and reducing conifer density in all the watersheds in the management area.
Botanical Resources	Objective	0328	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Kellogg's bitterroot and giant helleborine orchid, to contribute to the long-term viability of these species.
	Objective	0329	Emphasize reducing rush skeletonweed and spotted knapweed within rare plant occupied and potential habitat.
Non-native Plants	Objective	0330	Use contain and control weed management strategies to treat noxious weeds and introduced species. The long-term goal is to have native species replace non-native plants through natural succession where feasible. Contain and control the spread of leafy spurge and spotted knapweed along the Middle Fork Boise River corridor.
Wildlife Resources	Objective	0331	Maintain or restore bald eagle wintering and nesting habitat along the Middle Fork Boise River corridor and Arrowrock Reservoir.
Recreation Resources	Objective	0332	Evaluate and implement opportunities to improve dispersed and developed recreation experiences, especially around Arrowrock Reservoir.
	Objective	0333	Reconstruct trails in the Sheep Creek drainage and on Lava Mountain to reduce resource impacts, improve recreation opportunities, and improve visitor safety.
	Objective	0334	Facilitate and participate in the development of a scenic byway corridor management plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="2">Recreation Resources</td><td>Objective</td><td>0335</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Lower Sheep Creek subwatershed. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0336</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>24%</td><td>23%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>39%</td><td>61%</td></tr>
<tr><td>Roaded Natural</td><td>20%</td><td>16%</td></tr>
<tr><td>Roaded Modified</td><td>17%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="4">Cultural Resources</td><td>Objective</td><td>0337</td><td>Maintain the National Register status of Cottonwood Guard Station and other eligible properties.</td></tr>
<tr><td>Objective</td><td>0338</td><td>Conduct a sample inventory to identify historic properties in the management area.</td></tr>
<tr><td>Objective</td><td>0339</td><td>Monitor the conditions of National Register eligible properties, including prehistoric sites at Lucky Peak Nursery.</td></tr>
<tr><td>Objective</td><td>0340</td><td>Nominate Cottonwood Guard Station to the NRHP, develop a management plan to protect its historic character, and investigate third party use of the facility.</td></tr>
<tr><td rowspan="4">Timberland Resources</td><td>Objective</td><td>0341</td><td>Manage stand density through thinning and other appropriate silvicultural treatments on suited timberlands to promote growth, to provide timber products, and to reduce hazards from uncharacteristic fire, insects, and diseases. Use thinning also to reduce the spread and intensification of dwarf mistletoe.</td></tr>
<tr><td>Objective</td><td>0342</td><td>Evaluate and implement, where needed, TSI treatments in regenerated stands in the Foothills Fire and Star Gulch Fire areas.</td></tr>
<tr><td>Objective</td><td>0343</td><td>Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Lambing-Trail subwatershed. Consider such methods as designated skid trails, winter skidding, minimal fireline construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.</td></tr>
<tr><td>Guideline</td><td>0344</td><td>Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Lambing-Trail subwatershed.</td></tr>
<tr><td>Rangeland Resources</td><td>Objective</td><td>0345</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Deer-Grouse, Lambing-Trail, Badger-Slide, and Logging-Haga subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Fire Management	Objective	0346	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0347	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Guideline	0348	Coordinate with adjacent land managers to develop compatible wildland fire suppression strategies.
Facilities and Roads	Objective	0349	Continue to coordinate with the Atlanta Highway District on the Middle Fork Boise River Road (268) to maintain road management efficiency.
	Objective	0350	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Deer-Grouse, Lambing-Trail, and Smith-Dunnigan subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	0351	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Arrowrock Reservoir	1	R	R	PR	R	PR	PR	R	PR	M
Middle Fork Boise River Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Trail 189	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 268	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 377	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 203	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 113	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 122, 123, 126 127, 128, 129	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trail 130	2	M	M	M	M	M	M	M	M	M



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 04. Boise Front/Bogus Basin Location Map

Management Area 4
Boise Front/Bogus Basin

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 4 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	Trace
4.2 – Roaded Recreation Emphasis	14
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	86

General Location and Description - Management Area 4 is located in the Boise Front and Bogus Basin areas of the Boise National Forest, about 5-10 miles northeast of Boise, Idaho. Administered by the Mountain Home and Idaho City Ranger Districts, the area is in Boise and Ada Counties, extending from the Forest boundary above Boise up to Shafer Butte and east to Warm Springs Ridge (see map, opposite page). The management area is an estimated 93,000 acres, of which the Forest Service manages about 52 percent, 44 percent are privately owned, and 4 percent are State of Idaho lands. The area is bordered by Boise National Forest to the north and east, and by a mix of BLM and private lands to the south and west. The primary uses and activities in this management area have been developed and dispersed recreation, watershed protection, and livestock grazing.

Access - Access to the area is by Bogus Basin Road from Boise to Boise Ridge, by Forest Road 260 from Boise up Cottonwood Creek, by State Highway 21 from Boise to Forest Road 261 from Lucky Peak Reservoir up Robie Creek, and by County Road 364 in the Grimes Creek drainage. The density of roads in the management area is an estimated 1.6 miles per square mile, which includes some county and private roads not under Forest Service jurisdiction. Total road density for area subwatersheds ranges between 0.7 and 2.8 miles per square mile. There are relatively few system trails in the area, but there are several user-defined non-system motorized and non-motorized trails.

Special Features - Management Area 4 contains the Bogus Basin Mountain Resort and the Shafer Butte Recreation Area, and a small portion of Lucky Peak Reservoir. Lucky Peak Nursery is located just off Forest Service land next to the reservoir. The Idaho State-designated Ponderosa Pine Scenic Byway (Highway 21) lies partly within this management area. It has been nominated as a National Scenic Byway. This management area is the closest in proximity to the City of Boise and also has a high percentage of intermingled land ownership, including residential subdivisions in the Robie Creek, Grimes Creek, Macks Creek and Clear Creek areas. A small portion of the Mt. Heinen Roadless Area lies in Management Area 4.

Air Quality - Portions of this management area lie within Montana/Idaho Airsheds ID-15, 21, and 22, and in Boise and Ada Counties. A portion of the former Northern Ada County PM and CO non-attainment area lies within the area. While Northern Ada County is in attainment and has developed "Maintenance Plans" for PM 10 and CO, the area has experienced problems for ozone and PM 2.5. Particulate matter is the primary pollutant of concern related to Forest management. Ambient air monitors are located within these airsheds to obtain current background levels, trends, and seasonal patterns of particulate matter. Ambient air monitors are located in Garden Valley, Idaho City, as well as Boise and surrounding cities. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter within Boise was fugitive dust from unpaved roads and agricultural activities such as tilling. Ada County had numerous sources contributing to emission of particulate matter related to urbanization. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Boise County (less than 100 acres) and low (an estimated 4,000 acres) within Ada County. There were no point sources within these counties.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet at Lucky Peak Reservoir to 7,582 feet atop Shafer Butte. The main geomorphic landforms in the area are fluvial and depositional lands. The land is characterized by moderately steep slopes that are moderately to strongly dissected by streams. The dominant slope range is 30 to 60 percent. The surface geology is a mix of volcanic and granitics parent materials. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high, with the majority being high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below). There are localized impacts from roads and subdivision development, livestock grazing practices, timber management activities, and recreation development and use. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of all or part of the Arrowrock Reservoir and Lower Mores Creek Watersheds in the South Fork Boise River Subbasin, Harris Creek Watershed in the Payette River Subbasin, and Boise-Cottonwood and Dry-Spring Valley Watersheds in the Lower Boise River Subbasin. The main streams in the area are Mores Creek, Cottonwood Creek, Shafer Creek, Grimes Creek, Pine Creek, Macks Creek, and Robie Creek. No lakes occur in the area, though the area is bounded in the southeast corner by an arm of Lucky Peak Reservoir. A large number of wells and septic systems are present within and adjacent to the area. Shafer Creek, Sheep-Charcoal, Voquelin-Deer, and Robie Creek subwatersheds are part of state-regulated public water systems (United Water of Idaho, Inc) for portions of the city of Boise, and (Bogus Basin Recreational Association) for Bogus Basin.

Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk), with the majority being moderate (see table below). Localized areas have impacts from accelerated sediment from roads, stream channel modification, user-defined trails, and dispersed recreation camping activities. Two of the 11 subwatersheds in this MA were listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Cottonwood Creek and Macks Creek. The pollutant of concern is sediment for Macks Creek, and unknown for Cottonwood Creek. The Cottonwood Creek, Dry Creek, Miller-Hulls Gulch subwatersheds currently have assigned TMDLs.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
7	3	1	2	5	4	2	9	0	2	3	4

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Threatened bull trout are not currently known to occur in this area, although they are known to occur downstream in Lucky Peak Reservoir and within Mores Creek. Redband trout are currently known to occur in the Sheep-Charcoal and Vaquelin-Deer subwatersheds. Several non-native fish species have been introduced to area streams and Lucky Peak Reservoir for sport fishing. Aquatic habitat is functioning at risk in localized areas due to habitat fragmentation and accelerated sediment. Native redband trout are at risk due to the presence of non-native species and habitat impacts described above.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid and upper elevations are dominated by shrubs and forest communities of ponderosa pine and Douglas-fir, with pockets of lodgepole pine and aspen.

An estimated 17 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Bitterbrush, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (52 percent), Cool Dry Douglas-fir (8 percent), and Cool Moist Douglas-fir (15 percent).

The Montane Shrub group is functioning properly. The Mountain Big Sagebrush, Bitterbrush and the Perennial Grass Slopes groups are functioning at risk due to altered structure and composition, and the introduction of non-native species. Native shrubs and grasses have been replaced in many areas by noxious weeds and introduced grasses and forbs (e.g., cheatgrass, wheatgrass, rush skeletonweed, sweet clover, and orchard grass).

The Warm Dry Douglas-fir/Moist Ponderosa Pine group is functioning at risk in localized areas that have not received density management. These stands have relatively high stand densities and fuel loadings that have moved them from a non-lethal to a lethal fire regime. Recent insect outbreaks have increased tree mortality and the risk of uncharacteristic large wildfire. The Cool Dry Douglas-fir and Cool Moist Douglas-fir groups have similar conditions but to a lesser extent, and therefore the risk is not as high. These groups also have increasing insect and mistletoe infestations, and lack young structural stages and seral ponderosa pine. The Harris

Creek (5th code HUC 1705012216) and Lower Grimes Creek (5th code HUC 1705011203) watersheds are high priorities for active management to restore the large tree size class.

Riparian vegetation is functioning at risk due to localized impacts from roads, livestock grazing, wildfires, and private land uses. Composition has changed in many riparian areas because of disturbance, lowered water tables, and introduced plant species. Non-native plants have increased, and *carex* and other wetlands species have decreased. Native cottonwoods and broadleaf shrubs have also decreased, and are not regenerating in many areas.

Botanical Resources – No Region 4 Sensitive species are known to occur in this management area. Giant helleborine orchid is known from adjacent management areas and could potentially occur in this area. There are known populations of Wilcox's primrose, a proposed Region 4 Watch species, close to the Forest boundary. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses, slickspot peppergrass, and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slickspot peppergrass, a Candidate species, may be found in sagebrush-steppe habitats ranging from around 2,200 to 5,300 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - A number of noxious weeds and exotic plants occur in the area, particularly along the main road corridors. The main plants of concern are rush skeletonweed and cheatgrass, which occur in scattered populations throughout the management area. An estimated 87 percent of the management area is highly susceptible to invasion by noxious weeds and exotic species. A cooperative agreement between local counties and the Forest Service has been established for implementing a noxious weed control and prevention program.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Voquelin-Deer	Yes	Yes	Yes	No	No
Shafer Creek	No	Yes	Yes	No	No
Macks Creek	Yes	No	Yes	No	Yes
Dagger Creek	Yes	No	Yes	Yes	No
Robie Creek	Yes	No	Yes	No	No
Pine Creek	Yes	No	Yes	No	No
Clear Creek	Yes	No	Yes	No	No
Dry Creek	Yes	No	No	No	No

Wildlife Resources—Lucky Peak Reservoir has wintering and nesting habitat for bald eagles, and nesting habitat for osprey. Much of the low-elevation grasslands and shrublands are vitally important winter range for elk and deer due to the proximity of Boise and adjacent subdivision developments adjacent and within the area. These grasslands/shrublands are also habitat for mountain quail and sage grouse, and introduced turkey, gray partridge, and chukar. Mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. Area forests provide nesting and foraging habitat for many migratory landbirds, as well as summer range for mammals such as elk, deer, and mountain lion. Overall, terrestrial habitat is functioning at risk due primarily to the urban interface that has disrupted migration corridors and changed habitat use for deer and elk.

Recreation Resources - Paved access, proximity to Boise and the Treasure Valley, and year-round recreational attractions combine to make this management area the most heavily used recreation area on the Forest. Downhill skiing, cross-country skiing, hiking, driving for pleasure, mountain biking, motorcycling, snowmobiling, and ATV riding are all popular uses. Lucky Peak is heavily used for water-oriented recreation, including fishing, boating, and water-skiing. The Hulls Gulch Trail on the Boise Front is a National Recreation Trail. Much of the area is considered visually sensitive. Roads and trails in the area provide both motorized and non-motorized recreational opportunities. Public access through private lands is a concern and limitation in some areas due to extensive inholdings. The management area is located within Idaho Fish and Game Management Unit 39. There is a recreational special use authorization for the Bogus Basin Mountain Resort.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Mining, Ranching, Timber Industry, Forest Service History, CCC, and Recreation. This management area contains sites associated with American Indians, miners, and ranchers. Beginning in the 1860s, ranchers trailed cattle through the area from Boise River settlements to mines in Boise Basin. After 1900, commercial export logging became the dominant industry. Boise-Payette Lumber Company owned much of the land. In 1915, the company built the Intermountain Railroad from Grimes Creek to Barber Mill, located on the outskirts of Boise. During the 1930s, the lumber company managed private CCC camps in the area at Holcomb and at Shafer Butte. The CCC troops at Shafer Butte built the road used today by recreationists to reach Bogus Basin Ski Resort, which opened in the 1950s. In 1934, Congress authorized the Boise Basin Addition to the Forest. The addition expanded the Forest's boundaries to encompass the lands comprising this management area.

Timberland Resources—Of the estimated 35,800 tentatively suited acres in this management area, 28,000 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 5 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 4.2, and 5.1, as shown on the map displaying the MPCs for this management area. Lands in MPC 4.1c have been identified as not suited for timber production. Much of this area received a high level of timber harvest activities in the past century due to proximity of the railroads and access to the Boise area sawmills. This management area includes the Holcomb Seed Orchard, developed and maintained to produce seeds of desirable genetic quality. The fuelwood, posts and poles, and Christmas tree permit programs currently receive a lot of public use and interest due to the close proximity of Boise.

Rangeland Resources - The management area contains all or portions of two cattle allotments and one sheep allotment. Management Area 4 provides an estimated 3,200 acres of capable rangeland. These acres represent less than 1 percent of the capable rangeland on the Forest. This area features a fairly high level of structural range improvements.

Mineral Resources - The area is open to mineral activities and prospecting. Past and current mining activities include placer, and small-scale hardrock operations. The locatable mineral potential is generally moderate, as is the leasable mineral potential for geothermal resources. The potential for other leasable minerals and common variety mineral materials is unknown.

Fire Management—Wildfire starts (human and lightning-caused) are frequent in this area, though most are successfully suppressed during the initial attack phase. Prescribed fire has been used to improve winter range and livestock forage conditions, and to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. During the past 20 years there were approximately 100 fire starts. Of the management areas on the forest, this one had the second highest rate of human-caused fires at about 40 percent of the total starts. Large fires in the last 20 years include the 1996 8th Street Fire, which burned an estimated 10 percent of the management area at mixed severity.

A large proportion of the Management Area is considered wildland-urban interface including Wilderness Ranch, which is a National Fire Plan community, other subdivisions along Highway 21, and residential developments along the Bogus Basin road and near the Bogus Basin Ski Area. These subwatersheds, along with Cottonwood and Millers-Hulls Gulch, are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be 29 percent mixed1 or 2, and 71 percent non-lethal. An estimated 42 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 31 percent of the area is in moderately departed conditions—8 percent in the mixed1/mixed2 fire regimes, and 23 percent in the non-lethal regimes. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special use authorizations in the area are issued for Shafer Butte, Deer Point, Doe Point, and Lower Deer Point designated communication sites, and several utility corridors to private inholdings. The area also includes a small portion of the Brownlee-Boise Bench 3 and 4 transmission line and designated utility corridor. Opportunities exist to consolidate National Forest lands through exchange with other landowners in the area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration	General Standard	0401	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c roads standard, below.
	Vegetation Standard	0462	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Road Standard	0402	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0403	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 4.2 Roaded Recreation Emphasis	Vegetation Standard	0463	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[2]
	Vegetation Guideline	0404	Vegetation management actions—including prescribed fire and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.
	Vegetation Guideline	0464	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0405	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0465	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Vegetation Guideline	0406	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0466	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0407	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0408	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0467	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0409	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0410	Deleted, as part of 2010 Forest Plan amendment for WCS.
Air Quality and Smoke Management	Guideline	0411	Involve state and local air pollution regulators early in planning process and project development when proposed management activities could increase criteria pollutants, especially particulate matter and carbon monoxide, due to the proximity of non-attainment or maintenance areas. Apply smoke management strategies including emissions reduction techniques, as appropriate so attainment status would be not threatened.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

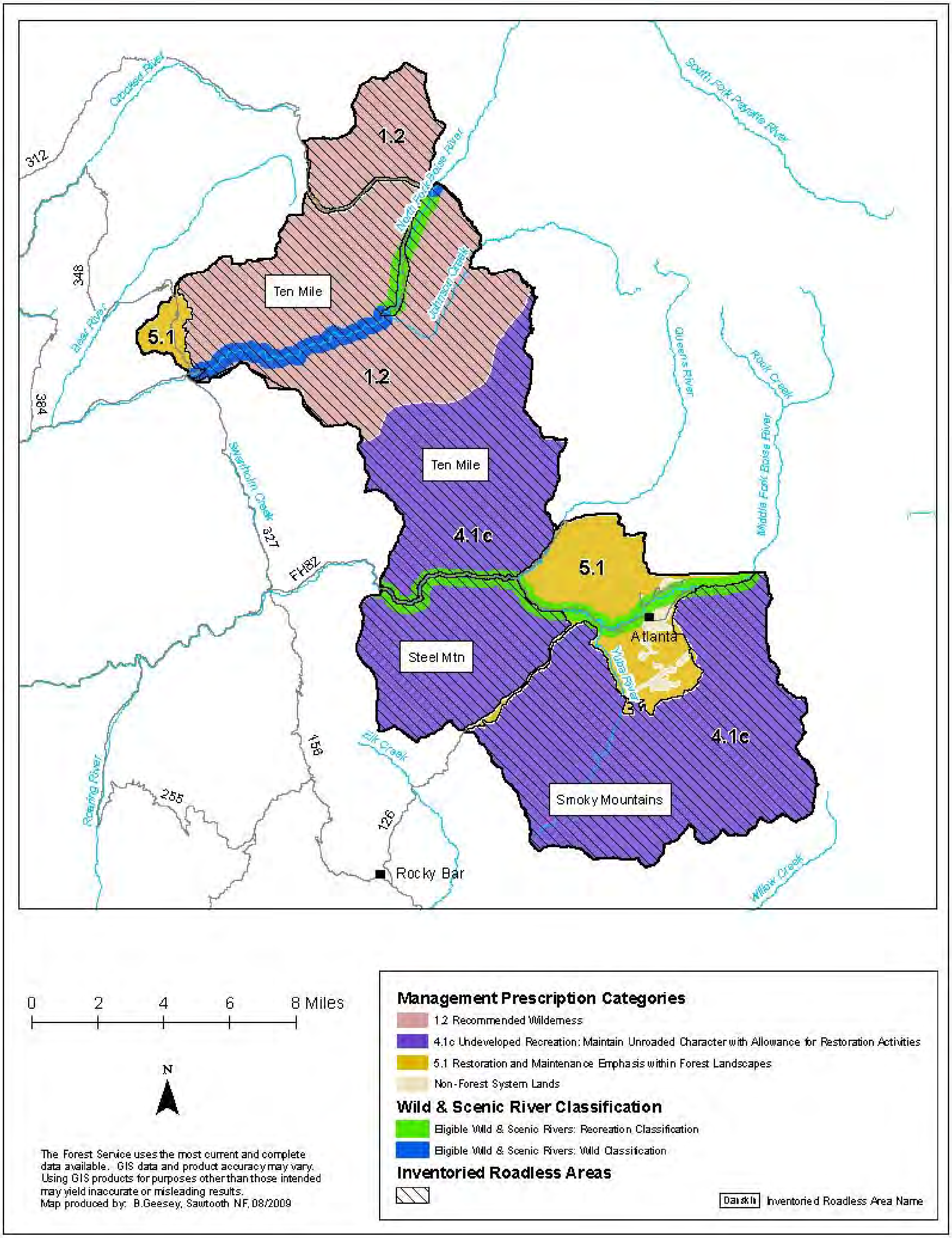
MPC/Resource Area	Direction	Number	Management Direction Description
Air Quality and Smoke Management	Guideline	0412	When actions are proposed within the non-attainment or maintenance area, contact local or state air quality regulators for applicable regulations (e.g. General Conformity) and planning requirements.
Soil, Water, Riparian, and Aquatic Resources	Objective	0413	Reduce impacts of accelerated erosion and soil compaction from motorized recreation on user-defined non-system roads and trails, particularly in the Boise Ridge Road corridor, Pine Creek, Robie Creek, and Boise Front areas. Reduce impacts from dispersed campsites along streams.
	Objective	0414	Reduce impacts of accelerated erosion and soil compaction from motorized recreation, particularly in the Boise Ridge Road corridor, Robie Creek, and Boise Front areas.
	Objective	0415	Work with the state and other federal agencies to initiate actions needed to re-establish bull trout in the Lucky Peak core area.
	Guideline	0416	Coordinate watershed restoration activities with River to Ridge Trail organization.
Vegetation	Objective	0417	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	0418	Pursue partnerships for vegetation management in mixed land ownership areas.
	Objective	0419	Restore plant species composition and structure in riparian areas, with emphasis on increasing native cottonwoods, broadleaf shrubs, and Carex species, while reducing non-native plant species.
	Objective	0420	Restore PVG1 (Dry Ponderosa Pine/Xeric Douglas-fir) PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine) and PVG3 (Cool, Moist Douglas-fir) vegetation groups as described in Appendix A emphasizing the large tree size class in the Harris Creek (5th code HUC 1705012216) and Lower Grimes Creek (5th code HUC 1705011203) watersheds.
Botanical Resources	Objective	0421	Maintain or restore known populations and occupied habitats of TEPCS plant species, including giant helleborine orchid, to contribute to the long-term viability of these species.
	Objective	0422	Emphasize reducing rush skeletonweed and other introduced noxious/exotic species within rare plant occupied and potential habitats.
Non-native Plants	Objective	0423	Control or contain rush skeletonweed and cheatgrass along lower elevations and the Boise Front area.
Wildlife Resources	Objective	0424	Maintain or restore bald eagle wintering habitat around Lucky Peak Reservoir and the Deer Creek/Dog Creek area.
	Objective	0425	Use prescribed fire to restore wildlife winter range.
	Objective	0426	Work with the Idaho Fish and Game Department to identify important winter range and elk calving habitat along Warm Springs Ridge.
	Guideline	0427	Project design and implementation should provide, maintain, and restore habitat for elk calving between Casner Mountain and Warm Springs Point.
Recreation Resources	Objective	0428	Coordinate with the Bogus Basin Mountain Resort on implementing their master development plan.
	Objective	0429	Develop and implement a management strategy for dispersed use along the Grimes Creek corridor and other low-elevation areas to reduce resource impacts.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="12">Recreation Resources</td><td>Objective</td><td>0430</td><td>Facilitate and participate in the development of a scenic byway corridor management plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.</td></tr>
<tr><td>Objective</td><td>0431</td><td>Coordinate with the City of Boise to integrate the Public Lands Open Space Management Plan for the Boise Foothills into forest management activities in the Boise foothills.</td></tr>
<tr><td>Objective</td><td>0432</td><td>Coordinate with Ridge to River trail organization to implement trail improvements.</td></tr>
<tr><td>Objective</td><td>0433</td><td>Minimize conflicts between backcountry skiers and snowmobilers.</td></tr>
<tr><td>Objective</td><td>0434</td><td>Increase opportunities for snow play and ungroomed ski-trail use near Boise by expanding wintertime high-elevation parking facilities where appropriate along the Bogus Basin Road.</td></tr>
<tr><td>Objective</td><td>0435</td><td>Expand dispersed recreation opportunities by developing additional summer and winter trails along the heavily used Boise Front.</td></tr>
<tr><td>Objective</td><td>0436</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from off-road ATV/motorbike use in the Macks Creek subwatershed. Methods to consider include annual weed inspection and treatment of trailheads and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0437</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation use in the Dagger Creek subwatershed. Methods to consider include annual weed inspection and treatment of trailheads and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Objective</td><td>0438</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Retention</td><td>3%</td><td>3%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>0%</td><td>85%</td></tr>
<tr><td>Roaded Natural</td><td>33%</td><td>9%</td></tr>
<tr><td>Roaded Modified</td><td>64%</td><td>3%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Standard</td><td>0439</td><td>Prohibit all motorized, mountain bike, and horse travel on the Mores Mountain Interpretive Trail, which is designed to provide an educational experience for hikers.</td></tr>
<tr><td>Standard</td><td>0440</td><td>Continue to authorize a range of appropriate activities at Bogus Basin Mountain Resort as allowed by recreation special use permit.</td></tr>
<tr><td>Standard</td><td>0441</td><td>Allow snowmobile travel outside of the Bogus Basin Winter Recreation Area except where this use will cause resource damage or endanger key wildlife habitats or other Forest users.</td></tr>
<tr><td>Cultural Resources</td><td>Objective</td><td>0442</td><td>Maintain the National Register status of eligible properties, specifically those associated with the mining and logging railroad eras.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Cultural Resources	Objective	0443	Inventory Shafer Butte to identify CCC sites in the area.
Timberland Resources	Objective	0444	Manage stand density through thinning and other appropriate silvicultural treatments on suited timberlands to promote growth, to provide wood products, and to reduce hazards from uncharacteristic fire, insects, and diseases. Use thinning also to reduce the spread and intensification of dwarf mistletoe.
	Objective	0445	Protect and manage the Holcomb Seed Orchard to produce genetically improved seeds for future reforestation on southwest Idaho forests. Use thinning, fertilization, and pollen management as needed to produce seed cones for ponderosa pine.
	Objective	0446	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Voquelin-Deer, Robie Creek, Dagger Creek, Pine Creek, Clear Creek, Macks Creek, and Shafer Creek subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fireline construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	0447	Vegetation management projects should be designed and implemented to minimize the spread and intensification of dwarf mistletoe in Douglas-fir and ponderosa pine.
	Guideline	0448	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Voquelin-Deer, Robie Creek, Dagger Creek, Pine Creek, Clear Creek, Macks Creek, and Shafer Creek subwatersheds.
Rangeland Resources	Objective	0449	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Voquelin-Deer and Shafer Creek subwatersheds. Methods to consider include changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Mineral Resources	Objective	0450	Withdraw Bogus Basin area from mineral entry to eliminate potential conflicts with mining and recreation/special permitted uses.
Fire Management	Objective	0451	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0452	Continue working with rural fire departments and Idaho Department of Lands to provide protection to local residents.
	Objective	0453	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Guideline	0454	Coordinate with adjacent land managers to develop compatible wildland fire suppression strategies.
Lands and Special Uses	Objective	0455	Consolidate communication authorizations to achieve a maximum of one communication authorization per lot for management efficiency.

MPC/Resource Area	Direction	Number	Management Direction Description
Lands and Special Uses	Objective	0456	Pursue land consolidation opportunities in the Boise Front, Robie Creek, Clear Creek, and Macks Creek areas to improve management efficiency.
	Objective	0457	Develop cost share opportunities for road use with the State of Idaho and private owners to improve transportation management efficiency and public service.
	Standard	0458	Issue only site permits for new electronic site locations. Each permit will provide for construction of necessary buildings, towers, suitable rental space to other users, and the operation of the electronic equipment.
Facilities and Roads	Objective	0459	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Voquelin-Deer, Shafer Creek, and Macks Creek subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Objective	0460	Provide for visual quality along the Highway 21 scenic byway corridor by developing a vegetation management plan for the corridor.
	Standard	0461	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Bogus Basin Mountain Resort	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 297	1	R	R	PR	R	PR	PR	R	PR	M
Highway 21	1	R	R	PR	R	PR	PR	R	PR	M
Wilderness Ranch	1	R	R	PR	R	PR	PR	R	PR	M
Shafer Butte Recreation site	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 260	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 374	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 364	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trail 155	2	PR	PR	M	PR	M	M	PR	M	MM
Mores Mountain Interpretive and Mores Mountain Biking trails	1	R	R	PR	R	PR	PR	R	PR	M
Bogus Basin Nordic Trail	1	R	R	PR	R	PR	PR	R	PR	M
Shingle Creek Trail 610	1	R	R	PR	R	PR	PR	R	PR	M
Hulls Gulch Trail	1	R	R	PR	R	PR	PR	R	PR	M
Trail 4	1	R	R	PR	R	PR	PR	R	PR	M



Management Area 05. Upper Boise River Location Map

Management Area 5
Upper Boise River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 1 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	33
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	51
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	6

General Location and Description - Management Area 5 is located within the upper portion of the Middle Fork and North Fork Boise River drainages, just west of the Sawtooth Wilderness Area. This management area is administered by the Idaho City Ranger District, and lies in Elmore County (see map, opposite page). The management area is an estimated 119,800 acres, of which roughly 99 percent are managed by the Forest Service, and 1 percent are privately owned. Most of the private inholdings are centered around the historic mining town of Atlanta. The area is bordered by Boise National Forest to the west and north, Sawtooth National Forest to the south, and the Sawtooth Wilderness to the east. The primary uses and activities in this management area have been developed and dispersed recreation, mineral development, livestock grazing, and timber management.

Access - The main access to the area is by Forest Road 268 along the Middle Fork Boise River. Other access routes include Forest Road 327 (North Fork Road), Forest Road 312 to Graham in the north, and Forest Road 126 from Rocky Bar to Atlanta in the south. The density of classified roads for the management area is an estimated 0.6 miles per square mile, as most of the area is inventoried as roadless. Total road density for area subwatersheds ranges between 0 and 1.3 miles per square mile. Portions of the roadless areas are accessed by trails.

Special Features – This area is generally undeveloped and primitive in character. Although the remote community of Atlanta occurs here, an estimated 88 percent of the management area is inventoried as roadless, including portions of the Tenmile/Black Warrior, Steel Mountain, and Smoky Mountains Roadless Areas. This area lies adjacent to the Sawtooth National Recreation Area. The Forest has recommended the Tenmile/Black Warrior Roadless Area for Wilderness designation.

Portions of three eligible Wild and Scenic Rivers fall within this management area, the Middle Fork Boise River and the North Fork Boise River. The Middle Fork Boise River has one segment in this management area with a classification of Recreational. It is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, and cultural resource values. The North Fork Boise River has two segments in this area with classifications of Recreational and Wild. It is considered eligible because of its outstandingly remarkable scenic values.

Air Quality - This management area lies within Montana/Idaho Airshed ID-21 and in Boise and Elmore Counties. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Idaho City to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the counties was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Boise County (less than 100 acres) and moderately low (an estimated 5,000 acres) within Elmore County. Elmore County had point sources contributing minor amounts to the annual total PM 2.5 emissions within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 4,000 feet on the Middle Fork Boise River to 9,730 feet atop Steel Mountain. Management Area 5 falls within portions of multiple subsections, including the Sawtooth Foothills, Middle Fork Boise Canyon and Streamcut Lands, and Cayuse Point. The main geomorphic landforms associated with the subsections are glaciated uplands, deeply entrenched canyonlands, and strongly dissected mountain slopes and fluvial lands. Slope gradients average between 25 to 65 percent in the uplands, and 45 to 65 percent in the canyonlands, strongly dissected mountain slopes, and fluvial lands. The surface geology is predominantly Idaho batholith granitics. Sediment delivery to stream channels is naturally high. Soils generally have moderate to high surface erosion potential, and moderate to low productivity. Subwatershed vulnerability ratings range from low to high, with the majority being moderate (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below). Although much of this area is undeveloped, localized areas receive impacts from roads, livestock grazing, mining, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of the Upper Middle Fork and Upper North Fork Boise River Watersheds, and small portions of the Black-Warrior and Taylor-Lodgepole Watersheds. These watersheds are part of the North and Middle Fork Boise River Subbasin that drains southwest into Arrowrock Reservoir. The main streams in the area are: the Middle Fork Boise River, North Fork Boise River, Yuba River, Queens River, Bear River, and Black Warrior Creek. There are numerous small alpine lakes in the high cirque basins of the area. The Joe Daley-James subwatershed is part of a state-regulated public water system for the community of Atlanta.

Water quality varies throughout the area. Streams and rivers with little or no disturbance have excellent water quality. Water quality has been reduced in streams and rivers where land-disturbing activities (mining, logging, road building) have taken place. Some waters are contaminated with heavy metals that are potentially a health risk, especially for aquatic species. It is believed the Upper Middle Fork Boise River, Yuba River, and Decker Creek contain elevated levels of heavy metal contaminants, and that approximately 260,000 cubic yards of contaminated sediment are stored behind the Kirby Dam. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). Localized areas receive accelerated sediment from roads, mining, livestock grazing, wildfire, and recreation. There are no impaired water bodies listed under Section 303(d) of the Clean Water Act, nor are there currently any TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
3	6	2	4	6	1	0	10	1	0	0	1

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Many native fish species inhabit the area. Threatened Bull trout are found throughout the area, with strong local populations in the Bald Mountain-Eagle, Johnson Creek, Queens, and Little Queens River subwatersheds. Redband trout are found in the Joe Daley-James and Bald Mountain-Eagle subwatersheds. Other native species include three sucker species, northern pike minnow, chiselmouth chub, redside shiner, and two dace species. Three non-native species are known to inhabit the area: brook trout, golden trout and cutthroat trout. This area provides important habitat for bull trout, encompassing special emphasis watersheds (USF&W Biological Opinion 1998) where management priority is given to bull trout preservation, protection, and recovery. The Middle Fork Boise River and North Fork Boise River are managed as high quality fisheries by the Idaho Department of Fish and Game. Aquatic habitat is functioning at risk in localized areas due to accelerated sediment and heavy metal pollutants. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above.

Vegetation - Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 34 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Cool Dry Douglas-fir (11 percent), Dry Ponderosa Pine/Xeric Douglas-fir (15 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (7 percent), Cool Moist Douglas-fir (6 percent), Warm Dry Subalpine Fir (16 percent), High Elevation Subalpine Fir (1 percent), and Persistent Lodgepole Pine (10 percent).

The Mountain Big Sagebrush and Montane Shrub groups are functioning properly, but they are trending toward older age structure, denser canopies, and less herbaceous ground cover due to fire exclusion. Perennial Grass Slopes are also functioning properly, but fire frequency is less than historic intervals, and exotic species are increasing.

The Cool Dry Douglas-fir, Cool Moist Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine groups are functioning at risk. Stands that have recently burned have experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands, where fire frequency is occurring at less than historic intervals. Insect and disease infestations have increased tree mortality and the risk of uncharacteristic large wildfire. These groups also lack young structural stages and seral ponderosa pine and aspen.

The Warm Dry Subalpine Fir group is functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Shade-tolerant subalpine fir is increasing, and early seral Douglas-fir and aspen are decreasing. Persistent Lodgepole Pine is functioning properly, although much of this group burned in 1994 and shifted to open or young structural stages. High Elevation Subalpine Fir is also functioning properly, but fire exclusion has allowed natural succession to approach late seral conditions in most areas. Stands are generally old and dense, with increasing subalpine fir and decreasing whitebark pine.

Riparian vegetation is functioning at risk in localized areas due to impacts from roads, mining, and recreation.

Botanical Resources – Region 4 Sensitive species known from this management area include Idaho douglasia, giant helleborine orchid, and Bryum moss. Kellogg’s bitterroot, a proposed Region 4 Sensitive species is also known to occur here. Swamp onion, a Region 4 Watch species, also occurs in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies’-tresses and slender moonwort may exist. Ute ladies’-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Dalmatian toadflax, St. Johnswort, whitetop, Canada thistle, and yellow toadflax are noxious weeds that occur in the area, particularly along the main road corridors. An estimated 20 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. Dalmatian toadflax appears to be the main weed of concern within this management area.

The Taylor-Lodgepole subwatershed has an inherently high risk of weed establishment and spread. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from recreation and trail use in this area.

Wildlife Resources—The lower-elevation river corridors provide important winter range for elk and deer. Low and mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation forests provide habitat for boreal owls, wolverine, and fisher, as well as summer range for elk, deer, and mountain goat. Potential lynx denning habitat is scattered throughout the higher elevations. The entire area provides nesting and forage habitat for migratory landbirds, and general habitat for wide-ranging mammals such as elk, bear, and wolves. One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays the northern portion of this Management Area: Boise River.

Overall, terrestrial habitat is functioning properly, although the 1994 Boise River Fire has created migration or travel barriers for some species due to changes in structural stages. The Black Warrior-Bald Mountain (5th code HUC 1705011107) watershed has been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. Consequently, it is identified as a short-term high priority area for a subsequent site-specific investigation at a finer scale.

Recreation Resources - Although the Middle Fork and North Fork Boise River corridors have several developed campgrounds, most of the management area has an undeveloped emphasis centered around dispersed recreation such as hunting, fishing, and dispersed camping. During the summer season, the management area generally offers motorized trail opportunities in a semi-primitive setting. Most of the area is open to snowmobile use in the winter. A portion of the Tenmile/Black Warrior IRA has been recommended for Wilderness designation and is managed to maintain or enhance wilderness characteristics. Many recreation users come from the Treasure Valley, but regional use is increasing, as this area has a number of trails that provide access into the popular Sawtooth Wilderness. The area is located partially within Idaho Fish and Game Management Unit 39. Recreation attractions include numerous hot springs in the upper Middle Fork drainage, rental cabins at Graham, Atlanta, and Deer Park, dispersed sites along the North Fork and Middle Fork Rivers, a resort in Atlanta, and airstrips in Graham, Atlanta, and Weatherby. There are two isolated recreation residence cabins located at Deer Park.

Cultural Resources - Cultural themes in this area include Mining, Ethnic Heritage, Forest Service History, and the CCC. This management area contains Atlanta and Graham, historic mining camps dating to the 1860s and late 1880s, respectively. A portion of Atlanta town site is listed on the National Register of Historic Places. In 1863, gold was discovered on the Middle Fork Boise River. By 1870, Chinese miners at Alturas Bar controlled the largest and most complex of the placer operations on the river. Other National Register eligible properties in the area are associated with the dredge and lode mining that occurred until the mid 1950s. In 1906, miners built the first hydroelectric dam on the Boise River to power the stamp mills in Atlanta. The Kirby Dam, listed on the National Register, collapsed in 1990. It was replaced with a hazardous materials containment structure and a fish ladder to ensure bull trout migration up the river. In 1907, the FS helped finish the Middle Fork Boise River Road into Atlanta. Ranger Charles Gray supervised the road construction and the building of Atlanta Guard Station in 1909.

Rangers salvaged 1880s era log cabins to build Graham Guard Station in 1912. Deer Park Guard Station was established in 1913. In 1933, CCC crews replaced the structures at all of these administrative sites. They also reconstructed the Graham and Middle Fork Roads, and developed several campgrounds on the North Fork and Middle Fork Boise Rivers.

Timberland Resources - Of the estimated 58,700 tentatively suited acres in this management area, 5,600 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 1 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 1.2 and 4.1c are identified as not suited for timber production. Localized historic logging occurred in the Atlanta and river corridor areas to provide timber for construction, mine props, and fuelwood. An estimated 89 percent of the management area is in Inventoried Roadless Areas, which have been identified as not appropriate for timber management.

Rangeland Resources - The management area contains portions of three sheep allotments. Management Area 5 provides an estimated 19,100 acres of capable rangeland. These acres represent about 5 percent of the capable rangeland on the Forest.

Mineral Resources - The area is open to mineral activities and prospecting. Considerable historic mining has occurred in this management area, particularly around Atlanta. Current activities include and hard rock and placer mining and exploration. The Idaho Department of Water Resources (IDWR) controls and administers recreational suction dredging. IDWR has confined recreational dredging to the main course of the Middle Fork Boise River, excluding it from North Fork Boise River Basin and from tributaries of Middle Fork. The locatable mineral potential is high in areas of current and past activity, and moderate elsewhere. The leasable mineral potential for geothermal resources is moderate to high, with the high areas in the Middle Fork Boise River corridor. The potential for other leasable minerals is either low or unknown. The potential for common variety mineral materials is high around Atlanta, and moderate or unknown elsewhere.

Fire Management—Over the past 20 years there were approximately 75 fire starts over 95 percent of which were lightning-caused. Large wildfires (1994 Rabbit Creek Fire of 1994, 2000 Trail Creek Fire and 2003 Hot Creek Fire) have burned an estimated 73 percent of the management area. Prescribed fire activities have occurred in small acreages to reduce natural fuel loadings. This management area is in the Forest's wildland fire use planning area.

Atlanta is a National Fire Plan community, and the area around Atlanta, as well as the recreation residences near Deer Park, are considered wildland-urban interface areas due to private development adjacent to and within the Forest. The Joe Daley-James Creek subwatershed is also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 15 percent lethal, 52 percent mixed1 or 2, and 33 percent non-lethal. An estimated 7 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 40 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch

sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.
Lands and Special Uses - The Kirby Hydroelectric Project Dam provides power for Atlanta, and provides a holding area for mining-related metal contaminants. Montezuma Creek is the municipal water supply for Atlanta. There are numerous special use permits for utility corridors in the Atlanta area. The James Creek designated communication site is located within the management area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	0501	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	0502	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	0503	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	0504	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	0505	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0506	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
EligibleWild and Scenic Rivers	General Standard	0507	Manage the Middle Fork Boise River and North Fork Boise River eligible river corridors to their assigned classification standards, and preserve their ORVs and free-flowing status until the rivers undergo a suitability study and the study finds them suitable for designation by Congress, or releases them from further consideration as Wild and Scenic Rivers.
	Vegetation Standard	0561	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably addresses other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
EligibleWild and Scenic Rivers	Vegetation Guideline	0508	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0509	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	0510	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
4.1c Undeveloped Recreation	General Standard	0511	Management actions—including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
MPC 4.1c Maintain Unroaded Character with Allowance for Restoration Activities	Vegetation Standard	0562	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	0512	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0513	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably addresses other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0563	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	0514	New roads and landings shall be located outside of RCAs in the MPC 5.1 portions of the Queens River and Bald Mountain-Eagle subwatersheds unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	0515	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	0564	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0516	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

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[3] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

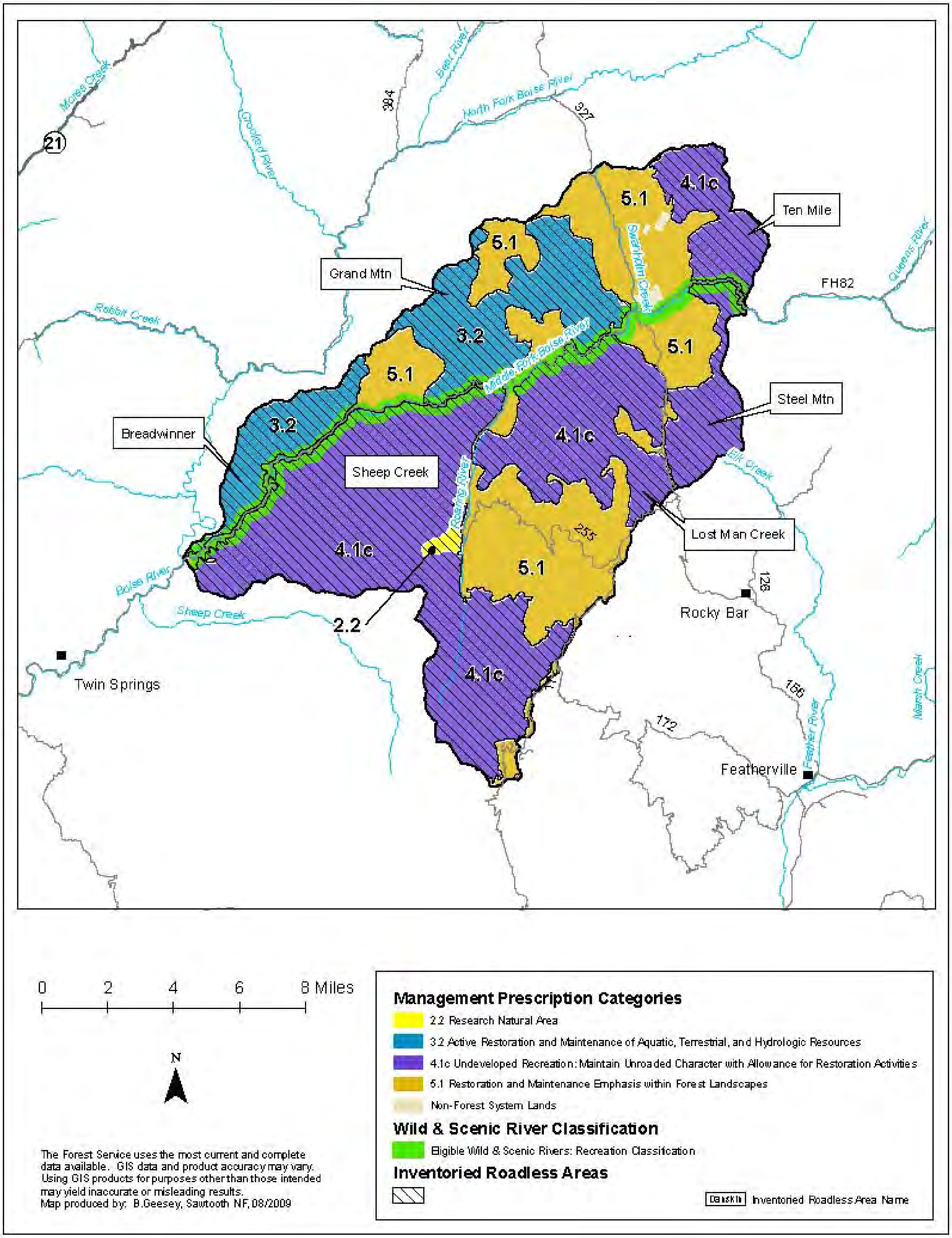
MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Road Guideline	0517	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0565	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
Soil, Water, Riparian, and Aquatic Resources	Objective	0518	Assess historic mining's effect on water quality, and determine the amount and character of accelerated sediment and heavy metal/ chemical contaminants from the activity. Determine where water quality could be improved and apply appropriate mitigation measures.
	Objective	0519	Initiate management actions designed to reduce sediment delivery from roads adjacent to North Fork and Middle Fork Boise Rivers.
	Objective	0520	Evaluate the recently installed fish ladder at the Kirby Hydroelectric Project Dam and its effectiveness in providing desired levels of passage for bull trout and other native fish.
Vegetation	Objective	0521	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	0522	Design vegetation management actions in high-elevation forested stands to favor release and reproduction of whitebark pine to meet desired conditions as described in Appendix A.
	Guideline	0566	Manage PVG11 (High Elevation Subalpine Fir) to protect existing whitebark pine, reduce competition, and favor reproduction.
Botanical Resources	Objective	0523	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, Bryum moss, and Kellogg's bitterroot, to contribute to the long-term viability of these species.
	Objective	0524	Maintain hot spring habitats that support TEPCS and rare plant species.
	Objective	0525	Consider establishing Swanholm Peak and Shepard Peak as Botanical Special Interest Areas.
	Standard	0526	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	0527	Emphasize treatment of Dalmatian toadflax around the Atlanta area.
	Objective	0528	Emphasize weed prevention with wilderness and backcountry user groups.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="4">Non-native Plants</td><td>Objective</td><td>0529</td><td>Develop yearly monitoring program to identify new populations (especially adjacent to SNRA)</td></tr>
<tr><td>Objective</td><td>0530</td><td>Support CWMA (Cooperative Weed Management Area) control and eradication programs.</td></tr>
<tr><td>Objective</td><td>0531</td><td>Designate stock unloading and feeding areas for trail users.</td></tr>
<tr><td>Objective</td><td>0532</td><td>Develop education and prevention programs to be given during high use periods (trail guiding and hunting seasons).</td></tr>
<tr><td rowspan="2">Wildlife Resources</td><td>Objective</td><td>0533</td><td>During vegetation management activities, promote objectives to provide additional suitable habitats (if applicable) for lynx, flammulated owl, wintering bald eagle, wolf and white-headed woodpecker.</td></tr>
<tr><td>Objective</td><td>0567</td><td>Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Black Warrior-Bald Mountain (5th code HUC 1705011107) priority watersheds. (<i>Refer to Conservation Principle 6 in Appendix E</i>.)</td></tr>
<tr><td rowspan="5">Recreation Resources</td><td>Objective</td><td>0534</td><td>Provide motorized recreation opportunities and experiences outside of the Steel Mountain and Tenmile/Black Warrior Roadless Areas.</td></tr>
<tr><td>Objective</td><td>0535</td><td>Provide trailhead access and information pertaining to the Sawtooth Wilderness to enhance recreation opportunities in the area.</td></tr>
<tr><td>Objective</td><td>0536</td><td>Reconstruct and repair trails damaged during the Trail Creek fire to maintain dispersed recreation opportunities in the area.</td></tr>
<tr><td>Objective</td><td>0537</td><td>Evaluate recreation residences that are not part of an established recreation residence tract for continuance in the Atlanta and Deer Park areas.</td></tr>
<tr><td>Objective</td><td>0538</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Taylor-Lodgepole subwatershed. Consider annual weed inspection and treatment of trailheads, campsites, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Recreation Resources</td><td>Objective</td><td>0539</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>50%</td><td>1%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>26%</td><td>93%</td></tr>
<tr><td>Roaded Natural</td><td>8%</td><td>6%</td></tr>
<tr><td>Roaded Modified</td><td>16%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="2">Cultural Resources</td><td>Objective</td><td>0540</td><td>Protect and interpret the historic landscape created by nearly a century of placer, dredge, and lode mining. Maintain the National Register status of Atlanta Guard Station and Deer Park Guard Station, which are on the Forest's cabin rental program.</td></tr>
<tr><td>Objective</td><td>0541</td><td>Facilitate community partnerships to promote historic preservation and public stewardship for cultural resources in the area.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Cultural Resources	Objective	0542	Conduct a sample inventory to identify historic properties in the management area, specifically along the North Fork Boise River and its tributaries near Graham. Monitor the conditions of National Register eligible properties in the management area.
	Objective	0543	Nominate the Atlanta Historic Mining District, Atlanta Guard Station, Deer Park Guard Station, and Graham Guard Station to the NRHP. List Graham Guard Station on the Forest's cabin rental program. Develop management plans to protect the historic character of these facilities. Provide interpretive materials to the public using the guard stations.
	Objective	0544	Inventory the historic properties contributing to the Atlanta Historic Mining District. Develop a partnership with the Atlanta Historical Society to identify, protect, restore, and interpret historic properties in the area.
Timberland Resources	Objective	0545	Provide small sale and wood product opportunities around community of Atlanta and to protect improvements (roads, campgrounds, rental cabins, trails).
Mineral Resources	Objective	0546	Assess the adverse effects of historic mining in the Atlanta area. Determine where problem areas exist, and cooperate with landowners in mitigation and restoration.
	Objective	0547	Inventory known heavy metal sites and develop management strategies on a case-by-case basis to address impacts from sites.
	Objective	0548	Develop monitoring strategies to better understand heavy metal input rates and area of impact in water and soil.
	Objective	0549	Manage Atlanta Hill for mineral development.
Fire Management	Objective	0550	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0551	Identify areas appropriate for Wildland Fire Use. Use wildland fire in these areas to restore or maintain desired vegetative conditions and to reduce fuel loadings.
	Objective	0552	Coordinate and emphasize fire education and prevention programs with private landowners and the State of Idaho to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Objective	0553	Coordinate with Atlanta rural fire department for training and cooperation during wildland fire and prescribed fire events.
	Guideline	0554	Coordinate with the Sawtooth National Forest to develop compatible wildland fire suppression and wildland fire use strategies.
Lands and Special Uses	Objective	0555	Resolve existing encroachment and trespass cases within urban interface areas, particularly in and around Atlanta to preserve the public estate.
Facilities and Roads	Objective	0556	Maintain the historic values and settings of the Atlanta, Graham, and Deer Park Guard Stations.
	Objective	0557	Coordinate with the Atlanta Highway District on road maintenance of the Middle Fork Road (Forest Road 268).

MPC/Resource Area	Direction	Number	Management Direction Description
Special Features	Objective	0558	Identify opportunities/strategies to improve or protect the ecological integrity of hot springs and high mountain lakes to reduce degradation by increased human use.
	Guideline	0559	Activities and developments adjacent to the Sawtooth National Recreation Area that would compromise its scenic and recreational values should be avoided.
Scenic Environment	Standard	0560	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
North Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Ten Mile-Black Warrior Recommended Wilderness	1	P	P	P	P	P	P	P	P	P
Middle Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 268	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 268 within HU 150501110803	1	PR	PR	PR	M	M	M	M	M	M
Middle Fork Boise River Developed Sites	1	R	R	PR	R	PR	PR	R	PR	M
Riverside and Power Plant Campgrounds	1	PR	PR	PR	PR	M	M	M	M	M
Forest Trail 051	1	R	R	PR	M	M	M	M	M	M
Forest Trail 057	1	R	R	PR	R	PR	PR	R	PR	M
Forest Roads 126, 207, 289, 306, 312	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 047, 050, 052, 053, 054, 059, 064, 065, 066, 081, 087, 098	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trail 060	1	PR	PR	PR	PR	PR	PR	PR	PR	PR
Forest Roads 126, 207, 289 within HU 150501110803	2	M	M	M	M	M	M	M	M	M



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 06. Middle Fork Boise River Location Map

Management Area 6
Middle Fork Boise River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 6 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	1
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	15
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	52
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	32

General Location and Description - Management Area 6 is located in the lower portion of the Middle Fork Boise River drainage, about 30-50 miles northeast of Boise, Idaho. This area is administered by the Mountain Home and Idaho City Ranger Districts, and lies in Elmore County. It extends from the confluence of the Middle Fork and North Fork Boise Rivers in the southwest to the Swanholm Creek drainage in the northeast (see map, opposite page). The management area is an estimated 105,800 acres, of which over 99 percent are managed by the Forest Service, and less than 1 percent is privately owned. Lands administered by the Boise National Forest surround the area. The primary uses or activities in this management area have been developed and dispersed recreation, timber management, livestock grazing, and mineral development.

Access - The main access to the area is by County Road 268 along the Middle Fork Boise River. Other access routes include Forest Road 255 along Roaring River, County Road 156 along Phifer Creek, and Forest Road 327 along Swanholm Creek. The density of classified roads for the entire area is an estimated 1.2 miles per square mile, although some areas have relatively high densities (Swanholm Creek, Lost Man Creek), and other areas have few or no roads. Total road density for area subwatersheds ranges between 0.1 and 2.4 miles per square mile. Trails provide access to portions of the roadless areas.

Special Features – A portion of one eligible Wild and Scenic River, the Middle Fork Boise River, lies within the management area. The Middle Fork Boise River has one segment in this area with a Recreational classification. It is an estimated 26.5 miles, with a river corridor area of 8,474 acres. The Middle Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, botanical, and cultural resource values.

The Roaring River RNA (423 acres) contains Idaho goldenweed, a candidate species for federal listing. The Middle Fork Boise River provides wintering habitat for bald eagles and is a popular area for fishing, camping, and other recreation use. An estimated 68 percent of the management area lies in portions of the following inventoried roadless areas: Lost Man Creek, Grand Mountain, Sheep Creek, Steel Mountain, Tenmile/Black Warrior, Breadwinner, and Rainbow.

Air Quality - This management area lies within Montana/Idaho Airshed ID-21 and within Elmore County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Idaho City to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in Elmore County improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter within the county was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was moderately low (an estimated 5,000 acres) within the county. Point sources contributed minor amounts to the annual total PM 2.5 emissions within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 3,500 feet on the Middle Fork Boise River to 9,000 feet near Steel Mountain. Management Area 6 lies mostly within the Middle Fork Boise Canyon and Streamcut Lands Subsection. Geomorphic landforms within this subsection include strongly dissected fluvial lands, frost-churned uplands, and over-steepened canyonlands. The dominant slope range is 45 to 65 percent. Surface geology is mainly Idaho Batholith granitics. Soils generally have moderate to high surface erosion potential and moderate productivity. Subwatershed vulnerability ratings range from moderate to high, with the majority being high. Subwatershed Geomorphic Integrity ratings vary from high (functioning appropriately) to low (not functioning appropriately). Some areas have localized impacts from roads, timber harvest, livestock grazing, mining, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of the Browns-Big Five and Roaring-Granite Watersheds, and one 6th field hydrologic unit (Swanholm-Hot) in the Black-Warrior Watershed. These watersheds are part of the Middle Fork and North Fork Boise River Subbasin that drains southwest into Arrowrock Reservoir. The main streams in the area are the Middle Fork Boise River and the following tributaries: Big Five Creek, Buck Creek, Browns Creek, Swanholm Creek, and Roaring River. A couple of high alpine lakes exist in the upper reaches of Roaring River. Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below).

Water quality is functioning at risk in some areas due to localized accelerated sediment from roads, mining, timber harvest, livestock grazing, and recreation. Three of the seven subwatersheds in this area were listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Big Five-Pool, Browns-Mink, and Granite-Buck. The pollutant of concern for each listed subwatershed is sediment. Currently there are no TMDLs for any of the listed subwatersheds.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
5	2	0	3	2	2	0	6	1	3	0	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Bull trout have been found in all of this area except for the Lost Man subwatershed. Redband trout also occur across the area except for the Lost Man and Roaring River subwatersheds. The Middle Fork Boise River is managed as a high quality fishery. Aquatic habitat is functioning at risk due to accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above. The Roaring River subwatershed has been identified as important to bull trout recovery, and as a high-priority area for restoration.

Vegetation - Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 26 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Bitterbrush, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Cool Dry Douglas-fir 13 percent), Cool Moist Douglas-fir (11 percent), Dry Ponderosa Pine/Xeric Douglas-fir (16 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (17 percent), Warm Dry Subalpine Fir (6 percent), Persistent Lodgepole Pine (10 percent) and High Elevation Subalpine Fir (1 percent).

The Mountain Big Sagebrush and Montane Shrub groups are functioning properly, but they are trending toward old age structure, dense canopies, and low levels of herbaceous ground cover in unburned areas. The Perennial Grass Slopes group is functioning at risk due to impacts from fire exclusion and introduced species. Fire frequency is less than historic intervals, and exotic species are competing with native species. Bitterbrush is functioning at risk because of impacts from fire exclusion, livestock grazing, and introduced species. Although some bitterbrush has been lost to recent wildfires, in unburned areas the shrubs are becoming old and dense, and species diversity is decreasing. Past livestock grazing has also altered species composition, although trends are improving with reduced grazing levels. Native species are being replaced by introduced species like cheatgrass and rush skeletonweed.

The Cool Dry Douglas-fir, Cool Moist Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine groups are functioning at risk. Stands that have recently burned have experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands, where fire frequency is occurring at less than historic intervals. Insect and disease infestations have increased tree mortality and the risk of uncharacteristic large wildfire. These groups also lack young structural stages and seral ponderosa pine and aspen.

The Warm Dry Subalpine Fir group is functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Shade-tolerant subalpine fir is increasing, and seral Douglas-fir and aspen are decreasing. Persistent Lodgepole Pine is functioning properly, although some of this group burned in 1994 and shifted to open or young structural stages. High

Elevation Subalpine Fir is near proper functioning condition, but fire exclusion has allowed natural succession to approach late seral conditions in most areas. Stands are generally old and dense, with increasing subalpine fir and decreasing whitebark pine.

Riparian vegetation is functioning at risk in some areas due to localized impacts from roads, mining, and recreation. Fire exclusion has resulted in long fire return intervals, leading to increased fire intensity and severity. Exotic plants have begun to encroach upon riparian areas, but recent prevention and control efforts have kept habitats intact.

Botanical Resources – Region 4 Sensitive species known from this management area include Idaho douglasia and giant helleborine orchid. Kellogg’s bitterroot, a region 4 proposed Sensitive species also occurs here. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies’-tresses and slender moonwort may exist. Ute ladies’-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native plants - Dalmatian toadflax, rush skeletonweed, spotted knapweed, and St. Johnswort occur in the area. An estimated 57 percent of the management area is highly susceptible to invasion by exotic species of concern and noxious weeds. Rush skeletonweed, Dalmatian toadflax, and spotted knapweed are the main weed species of concern in the area, particularly in lower-elevation winter range for big game. Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a “yes” in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Pete-Breadwinner	No	Yes	No	No	No
Big Five-Pool	No	Yes	No	No	No
Browns-Mink	No	Yes	Yes	No	No
Granite-Buck	No	Yes	No	No	No
Swanholm-Hot	No	No	Yes	No	No

Wildlife Resources—The wide range of elevations and vegetation types in the management area provide a variety of wildlife habitats. The Middle Fork Boise River corridor has wintering habitat for bald eagles and nesting habitat for osprey. Much of the lower-elevation grasslands and shrublands are important winter range for elk and deer, as well as foraging habitat for introduced turkey and chukar. Low and mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation forests provide habitat for boreal owls, wolverine, and fisher, as well as summer range for elk, deer, and mountain goat. Potential lynx denning habitat is scattered throughout the higher elevations. The entire area provides nesting and forage habitat for migratory landbirds, and general habitat for wide-ranging mammals such as elk, bear, and wolves. One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays the majority of this Management Area: Boise River.

Overall, terrestrial habitat is near properly functioning condition, although structural diversity could be improved, and fire suppression has increased stand densities, fuel loadings, and the risk of uncharacteristic wildfire. The Roaring-Granite (5th code HUC 1705011106) watershed has been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. Consequently, this watershed is identified as a short-term high priority area for a subsequent site-specific investigation at a finer scale.

Recreation Resources - Dispersed recreation such as hunting, fishing, hiking, sightseeing, snowmobiling, off-road vehicle use, and camping occurs throughout Management Area 6, and there are many dispersed campsites. The Middle Fork Boise River corridor has two developed campgrounds, Troutdale and Neinmeyer. The Middle Fork Boise River corridor is used for fishing, rafting, kayaking, and canoeing. Most recreation use comes from the Treasure Valley. Key recreation areas and travel corridors have objectives designed to protect visual quality. Almost all roads and trails in the area are open to some type of motorized vehicle use. The management area is located primarily within Idaho Fish and Game Management Unit 39.

Cultural Resources - Cultural themes in the area include Prehistoric Archaeology, Mining, Transportation, Forest Service History, CCC, and Timber Industry. Native peoples such as the Shoshone and Northern Paiute Indians were the first inhabitants of the Boise River and its tributaries. They used the Middle Fork Boise River as a transit route to reach high elevation summer camps in the Spangle Lakes area, in what is now the Sawtooth National Recreation Area. Archaeologists have documented prehistoric sites on nearly every river terrace undisturbed by mining. This management area contains numerous historic sites representative of the1860s-1940s mining on the river. The road up this portion of the river was completed after 1905. In 1930, the Forest acquired a mining claim from Frank “Dutch” Miller. CCC crews built Dutch Creek Guard Station on the site. The buildings on the south side of the river date to this period—those on the north side were constructed during the 1950-60s, when the compound was a ranger station. During the 1930s, CCC crews stationed at Alexander Flats reconstructed the Middle Fork Boise River Road to accommodate motorized vehicle traffic.

Timberland Resources - Of the estimated 59,300 tentatively suited acres in this management area, 16,500 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 3 percent of the Forest’s suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 2.2, 3.2 and 4.1c are identified as not suited for timber production. Past timber management activities have been fairly high in roaded areas. Fuelwood, post and poles, and other forest products are collected in designated areas.

Rangeland Resources - The management area contains portions of four cattle and two sheep allotments. Management Area 6 provides an estimated 17,900 acres of capable rangeland. These acres represent about 4 percent of the capable rangeland on the Forest.

Mineral Resources - The area is open to mineral activities and prospecting. Current activities include suction dredge, hardrock, and placer mining along the Middle Fork Boise River, smoky quartz crystal gathering in the Dismal Swamp area, and exploration in Devils Creek. The locatable mineral potential is high in areas of current activity, and relatively unknown elsewhere. The leasable mineral potential for geothermal resources is moderate to high, with the high areas in the Middle Fork Boise River corridor. The potential for other leasable minerals is either low or unknown. The potential for common variety mineral materials is moderate to unknown. Recreational suction dredging is controlled and administered by the Idaho Department of Water Resources. The department has restricted recreation dredging seasonally and to particular areas. Recreational dredging has an undefined impact on stream sedimentation.

Fire Management—During the past 20 years there were approximately 106 fire starts, 90 percent of which were lightning-caused. Large wildfires including the 1994 Rabbit Creek, 2003 Hot Creek and 2006 East Roaring fires have burned about 13 percent of the management area. Prescribed fire has been used to improve winter range conditions and reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. There are no National Fire Plan communities or wildland-urban interface areas in this management area. Historical fire regimes for the area are estimated to be: 13 percent lethal, 42 percent mixed1 or 2, and 45 percent non-lethal. An estimated 13 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 42 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - No special uses currently occur in this area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	0601	Manage the Middle Fork Boise River eligible river corridor to its assigned classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	0644	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Vegetation Guideline	0602	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0603	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0604	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	0605	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	0606	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	0607	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 3.2	General Standard	0608	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	Vegetation Standard	0609	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	0645	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	0610	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	0611	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0612	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	0646	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6[3]
	Road Standard	0613	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0614	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0647	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	0615	The full range of vegetation treatment activities (except wildland fire use) may be used to restore or maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0648	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).

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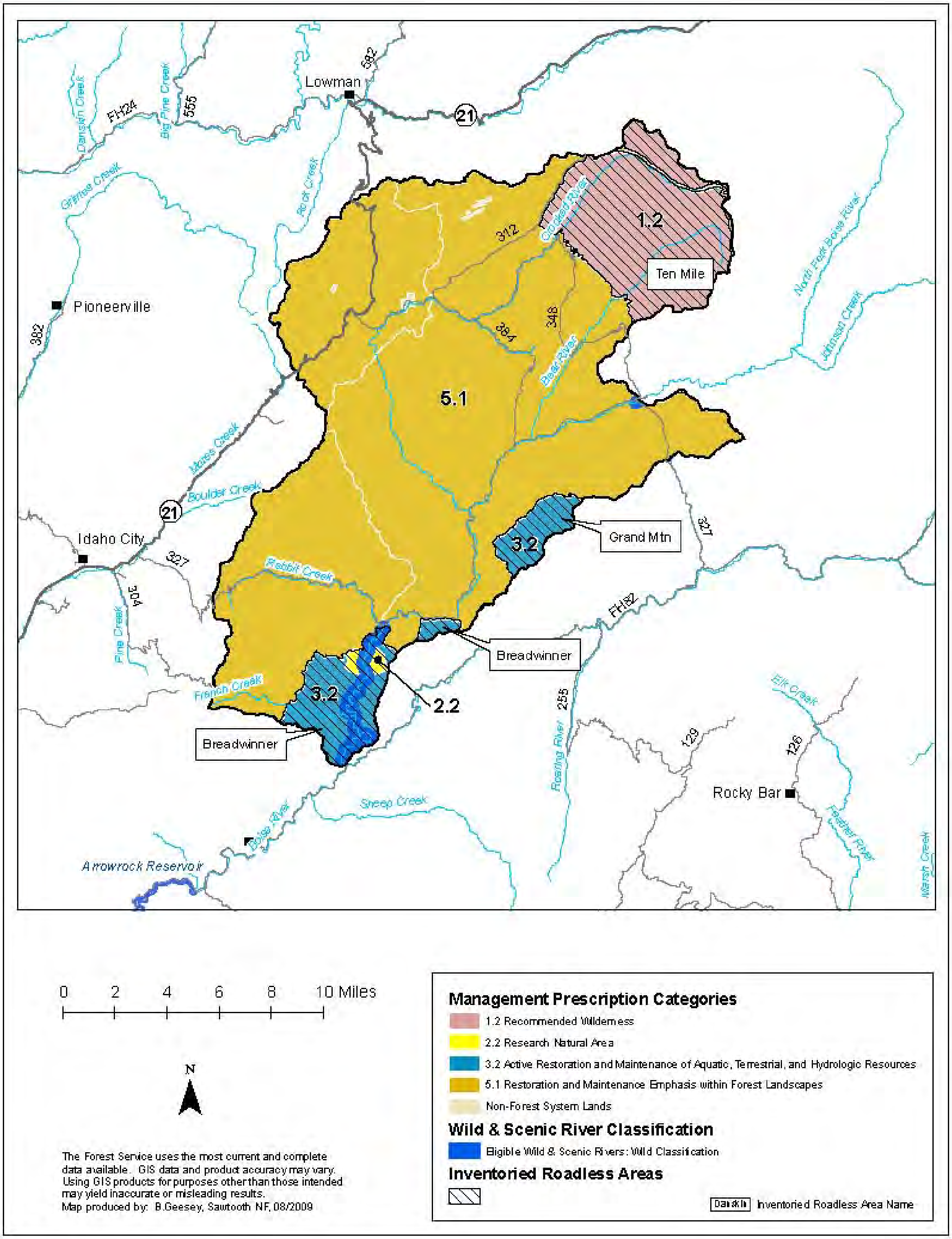
[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	0616	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0617	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To meet access and travel management objectives.
	Road Guideline	0649	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
Soil, Water, Riparian, and Aquatic Resources	Objective	0618	Provide for migration connectivity for bull trout and other native species in the Roaring River and Swanholm-Hot subwatersheds.
	Objective	0619	Assess historic mining's effect on water quality; determine the amount and character of accelerated sediment and heavy metal/chemical contaminants from mining activity. Determine where water quality could be improved and apply appropriate mitigation measures.
	Objective	0620	Assess the sedimentation impact of recreational suction dredging. Cooperate with Idaho Department of Water Resources to keep impacts to an acceptable level.
	Objective	0621	Develop a schedule to inventory existing culverts to determine if they currently provide fish passage and prevent fish entrainment. Prioritize completion of the Roaring River, Hot Creek, and Swanholm Creek inventories.
Vegetation	Objective	0622	Deleted, as part of the 2010 Forest Plan amendment for WCS.
Botanical Resources	Objective	0623	Maintain or restore known populations and occupied habitats of TEPCS plants, including Idaho douglasia, giant helleborine orchid and Kellogg's bitterroot, to contribute to their long-term viability.
	Objective	0624	Reduce rush skeletonweed, spotted knapweed, and Dalmatian toadflax within rare plant occupied and potential habitat.
	Standard	0625	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	0626	Control noxious weeds, particularly rush skeletonweed, Dalmatian toadflax, and spotted knapweed, in the Alexander Flats big-game winter range area.
Wildlife Resources	Objective	0627	Maintain or restore bald eagle wintering habitat along the Middle Fork Boise River corridor.
	Objective	0650	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Roaring-Granite (5th code HUC 1705011106) priority watershed. (*Refer to Conservation Principle 6 in Appendix E.*)

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="2">Recreation Resources</td><td>Objective</td><td>0628</td><td>Evaluate the demand or need for additional developed sites along the Middle Fork Boise River corridor.</td></tr>
<tr><td>Objective</td><td>0629</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>27%</td><td>20%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>18%</td><td>67%</td></tr>
<tr><td>Roaded Natural</td><td>24%</td><td>13%</td></tr>
<tr><td>Roaded Modified</td><td>31%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="3">Cultural Resources</td><td>Objective</td><td>0630</td><td>Maintain the National Register status of Dutch Creek Guard Station and other eligible properties.</td></tr>
<tr><td>Objective</td><td>0631</td><td>Inventory sites associated with early Forest Service administrative and CCC activities along the Middle Fork and its tributaries.</td></tr>
<tr><td>Objective</td><td>0632</td><td>Nominate Dutch Creek Guard Station to the NRHP, develop a management plan to protect its historic character. List the guard station on the Forest’s cabin rental program.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>0633</td><td>Manage stand density through thinning and other appropriate silvicultural treatments on suited timberlands to promote growth, to provide timber products, and to reduce hazards from uncharacteristic fire, insects, and diseases. Use thinning also to reduce the spread and intensification of dwarf mistletoe.</td></tr>
<tr><td rowspan="2">Timberland Resources</td><td>Objective</td><td>0634</td><td>Reduce the opportunity for noxious weed establishment and spread by keeping weed sites to a minimum during timber harvest activities in the Browns-Mink and Swanholm-Hot subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fireline construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.</td></tr>
<tr><td>Guideline</td><td>0635</td><td>Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Browns-Mink and Swanholm-Hot subwatersheds.</td></tr>
<tr><td>Rangeland Resources</td><td>Objective</td><td>0636</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Pete-Breadwinner, Big Five-Pool, Browns-Mink, and Granite-Buck subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.</td></tr>
<tr><td>Minerals</td><td>Objective</td><td>0637</td><td>Develop a minerals management strategy for the Dismal Swamp area.</td></tr>
<tr><td rowspan="2">Lands and Special Uses</td><td>Objective</td><td>0638</td><td>Coordinate with the Elmore County Highway district on ingress and egress related to their jurisdiction.</td></tr>
<tr><td>Standard</td><td>0639</td><td>Special use permits for road ingress and egress on National Forest System lands that fall with the Elmore County Highway District shall include a condition in the special use permit requiring that the permittee secure an ingress/egress permit from this highway district.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	0640	Restore historic features and setting of Dutch Creek Ranger Station.
	Standard	0641	When constructing new roads on National Forest System lands that intersect with Elmore County Highway district, secure an ingress/egress permit.
Special Features	Objective	0642	Identify opportunities to restore or maintain the ecological integrity of hot springs.
Scenic Environment	Standard	0643	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Middle Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Middle Fork Boise River Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 268	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 327	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 045, 046, 047, 124, 154	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trail 051	1	R	R	PR	M	M	M	M	M	M
Forest Trail 048	2	M	M	M	M	M	M	M	M	MM



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 07. North Fork Boise River Location Map

Management Area 7
North Fork Boise River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 7 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	13
2.2 – Research Natural Areas	1
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Watershed Resources	6
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	80

General Location and Description - Management Area 7 is located within the North Fork Boise River drainage, about 5-25 miles east of Idaho City, Idaho. This management area is administered by the Idaho City Ranger District, and lies in Elmore and Boise Counties. It extends from the confluence of the Middle Fork and North Fork Boise Rivers in the southwest to the Bear River drainage in the northeast (see map, opposite page). The management area is an estimated 171,400 acres, of which the Forest Service manages over 99 percent, and less than 1 percent is privately owned. The area is surrounded by land administered by the Boise National Forest. The primary uses or activities in this management area have been timber management, developed and dispersed recreation, livestock grazing, and mineral development.

Access - The main access to the area is by Forest Road 327 that leaves State Highway 21 near Idaho City, climbs over Rabbit Creek Summit, and then follows Rabbit Creek and the North Fork Boise River through the middle of the management area. State Highway 21 also accesses the northwest corner of the management area. The density of classified roads in the management area is an estimated 2.8 miles per square mile, as much of the area is roaded. Total road density for area subwatersheds ranges between 1.2 and 4.4 miles per square mile. Motorized, stock, hiking, and user-defined trails all occur within the area.

Special Features - A portion of one eligible Wild and Scenic River, the North Fork Payette River, fall within the management area. The North Fork Payette River has one segment in this area with a Recreational classification. It is an estimated 9.4 miles, with a river corridor area of 3,020 acres. The North Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic values.

The North Fork Boise River Research Natural Area (876 acres) lies in this management area and preserves riparian habitats and a rare plant species, *Chaenactis evermanii*. The Idaho State-designated Ponderosa Pine Scenic Byway (Highway 21) lies partly within this management area.

The North Fork Boise River corridor provides wintering habitat for bald eagles, nesting habitat for osprey, and elk winter range. An estimated 19 percent of the management area is inventoried as roadless, including portions of the Breadwinner, Grand Mountain, and Tenmile/Black Warrior Roadless Areas. The Forest has recommended a portion of the Tenmile/Black Warrior Roadless Area for Wilderness designation. Part of the Ponderosa Pine State Scenic Byway (Highway 21) runs through the northwest corner of the management area.

Air Quality - This management area lies within Montana/Idaho Airshed ID-21 and in Boise and Elmore Counties. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located in Garden Valley and Idaho City to obtain current background levels, trends, and seasonal patterns of particulate matter. Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate emissions, although the amount of agricultural-related burning was very low in Boise County (less than 100 acres) and moderately low (an estimated 5,000 acres) in Elmore County. Point sources contributed minor amounts to the annual total PM 2.5 emissions within Elmore County.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 3,500 feet on the North Fork Boise River to a little over 8,000 feet. Management Area 7 falls primarily within the Middle Fork Boise Canyon and Streamcut Lands and Lowman Uplands Subsections. The main geomorphic landforms associated with these subsections are strongly dissected or mature relief fluvial lands, frost-churned uplands, and oversteepened canyonlands. The dominant slope range is 45 to 65 percent in the Middle Fork Boise Canyon and Streamcut Lands, and 15 to 45 percent in the Lowman Uplands. Sediment delivery to stream channels is naturally high. The surface geology is predominantly granitic rock of the Idaho batholith. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). Localized areas have had impacts from roads, timber harvest, livestock grazing, mining, wildfire, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of the Lower North Fork Boise River and Crooked River Watersheds, and four 6th field hydrologic units in the Bear-Trail Watershed. These watersheds are part of the Middle Fork and North Fork Boise River Subbasin that drains southwest into Arrowrock Reservoir. The main streams in the area are the North Fork Boise River and the following tributaries: Crooked River, Bear River, and Rabbit Creek. Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being low (see table below). There is localized accelerated sediment from roads, mining, timber harvest, livestock grazing, wildfire, and recreation. There are no impaired water bodies currently listed under Section 303(d) of the Clean Water Act, nor are there any TMDL-assigned watersheds within this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
3	5	3	0	6	5	0	2	9	0	0	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. There is one strong reproducing population of bull trout in the Crooked River watershed. Bull trout also inhabit the Lower Crooked River, using it as nodal habitat. Redband trout occur in about half the subwatersheds in this area. The North Fork Boise River is managed as a high-quality fishery. Aquatic habitat is functioning at risk due to accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above. The Upper Bear Creek and Pikes Fork subwatersheds have been identified as important to the bull trout recovery, and as high-priority areas for restoration.

Vegetation - Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Forest communities of subalpine fir are found in the upper elevations.

An estimated 26 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Cool Dry Douglas-fir (10 percent), Cool Moist Douglas-fir (1 percent), Dry Ponderosa Pine/Xeric Douglas-fir (14 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (25 percent), Warm Dry Subalpine Fir (4 percent), and Persistent Lodgepole Pine (7 percent). A large amount of forested vegetation has recently burned in lethal wildfires.

The Mountain Big Sagebrush and Montane Shrub groups are functioning properly, but they are trending toward old age structure, dense canopies, and low levels of herbaceous ground cover due to fire exclusion. The Perennial Grass Slopes group is also functioning properly, although minor impacts have occurred from fire exclusion and introduced plants.

The Cool Dry Douglas-fir, Cool Moist Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine groups are functioning at risk. Stands that have recently burned have experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned or unmanaged stands, where fire frequency is occurring at less than historic intervals. Insect and disease infestations have increased tree mortality and the risk of uncharacteristic large wildfire. These groups also lack young structural stages and seral ponderosa pine and aspen in unburned or unmanaged areas.

The Warm Dry Subalpine Fir group is functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Late seral subalpine fir is increasing, and early seral Douglas-fir and aspen are decreasing. Persistent Lodgepole Pine is functioning properly, although much of this group burned in 1994 and shifted to open or young structural stages.

Riparian vegetation is functioning at risk due to localized impacts from roads and recreation. Fire exclusion has resulted in longer fire return intervals, leading to increased fire intensity and severity. Exotic plants have begun to encroach upon riparian areas, but recent prevention and control efforts have kept habitats intact.

Botanical Resources – Idaho douglasia, a current Region 4 Sensitive species, occurs in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Spotted knapweed, diffuse knapweed, rush skeletonweed, musk thistle, Canada thistle, St. Johnswort, and Dalmatian toadflax occur in this area. An estimated 51 percent of the management area is highly susceptible to invasion of noxious weeds and exotic plant species. Spotted knapweed and rush skeletonweed are the main species of concern, particularly in low-elevation winter range for big game. Dalmatian toadflax is also a concern throughout the area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Meadow-French	Yes	Yes	Yes	No	No
Rabbit Creek	Yes	Yes	Yes	No	No
Beaver-Edna	Yes	Yes	Yes	No	No
Pikes Fork	Yes	No	Yes	No	No
Hungarian-Beaver	No	Yes	Yes	No	No

Wildlife Resources—The North Fork Boise River corridor has wintering habitat for bald eagles and nesting habitat for osprey. Much of the lower-elevation grasslands and shrublands are important winter range for elk. Mid-elevation forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation forests provide habitat for boreal owls, wolverine, and fisher, as well as summer range for elk, deer, and mountain lion. Potential lynx denning habitat occurs in the upper portions of the Crooked River, Bear River and Pikes Fork drainages. The entire area provides nesting and forage habitat for migratory landbirds, and general habitat for wide-ranging mammals such as elk, bear, and wolves. This Management Area lies entirely within the Boise River Idaho Comprehensive Wildlife Conservation Strategy focal area. Overall, terrestrial habitat is functioning properly, although structural diversity could be improved, and recent wildfire has created migration or travel barriers for some small mammals and reptiles.

Recreation Resources - Dispersed recreation such as hunting, fishing, hiking, sight-seeing, snowmobiling, cross-country skiing, trail riding, and camping occurs throughout Management Area 7, and there are many dispersed camp sites, particularly along the roaded corridor of the North Fork Boise River, which receives high use. The area has four developed campgrounds--Black Rock, Edna Creek, Whoop-Um-Up, and Willow Creek--plus three rental cabins available for public use. The North Fork Boise River corridor is used for fishing and seasonal float trips. The North Fork of the Boise River from Black Rock Campground to the Middle Fork confluence is used for boating. Most recreation users come from the Treasure Valley. Key recreation areas and travel corridors have objectives designed to protect visual quality. Most roads and trails in the area are open to some type of motorized vehicle use. The management area is located within Idaho Fish and Game Management Unit 39. Recreation special uses include the Ea-Da-How organization camp located along State Highway 21.

Cultural Resources - Cultural themes for this area include Mining, Ethnic Heritage, Timber Industry, Forest Service History, and the CCC. Mining and timber have been important industries in this management area. In the 1860s, placer miners on Crooked River discovered enough silver in their gold “diggings” to prompt exploration for a lode source. In 1864, they discovered a silver ledge on Banner Ridge. Miners, many of them Chinese, established two towns in the area named Banner and Eureka. The Banner Mining District was a thriving enterprise until the early 1920s, producing over three million dollars in silver. In 1903, Barber Lumber Company established field quarters at Barber Flat in anticipation of driving logs down Crooked River and the North Fork Boise River. In 1923, the Forest developed Barber Flat into an administrative site. In the 1930s, the CCC built new buildings on this site and at Beaver Creek Guard Station, established in 1912.

Timberland Resources—Of the estimated 100,900 tentatively suited acres in this management area, 65,700 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 12 percent of the Forest’s suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 1.2, 2.2, and 3.2 are identified as not suited for timber production. Timber management has been and is one of the primary uses in this management area. Past management activity has been high in roaded areas, and fire salvages sales have recently occurred in roadless areas. Fuelwood, posts, poles, Christmas trees, and other forest products are collected in designated areas.

Rangeland Resources - Management Area 7 contains portions of two sheep allotments, and provides an estimated 62,300 acres of capable rangeland. These acres represent about 16 percent of the capable rangeland on the Forest.

Mineral Resources - The area is open to mineral activities and prospecting, but is closed to recreational suction dredging. Some historic mining has occurred, mostly in the upper reaches of Banner Creek. Current activities include limited hard rock and placer exploration in isolated areas. The locatable mineral potential is high in the upper reaches of Banner Creek, moderate in isolated areas, and relatively unknown elsewhere. The leasable mineral potential for geothermal resources is moderate. The potential for other leasable minerals is either low or unknown. The potential for common variety mineral materials is moderate to high.

Fire Management—Prescribed fire has been used to reduce natural fuel loadings, improve winter range conditions and reduce activity-generated fuels. This area is in the Forest's wildland fire use planning area. During the past 20 years there were approximately 205 fire starts, 90 percent of which were lightning-caused. Approximately 55 percent of the management area has burned in the past 20 years primarily from the 1994 Rabbit Creek Fire. About two thirds of the Rabbit Creek Fire was high intensity lethal wildfire while the Trapper Ridge Wildland Fire Use was mixed intensity.

There are no National Fire Plan communities in this management area. However, the area around the recreation residences at Deer Park are considered wildland-urban interface. Historical fire regimes for the area are estimated to be: 10 percent lethal, 39 percent mixed1 or 2, and 51 percent non-lethal. An estimated 12 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 35 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - The Pilot Peak designated communications site lies within the management area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	0701	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	0702	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	0703	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	0704	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	0705	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	Fire Guideline	0706	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
Eligible Wild and Scenic Rivers	General Standard	0707	Manage the North Fork Boise River eligible river corridor to its assigned classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	0764	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Fire Guideline	0708	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	0709	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	0710	Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the area was established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	0711	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	0712	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	0713	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	0714	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Vegetation Standard	0765	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	0715	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	0716	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0766	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Vegetation Guideline	0717	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	0767	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0718	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0719	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To meet access and travel management objectives.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

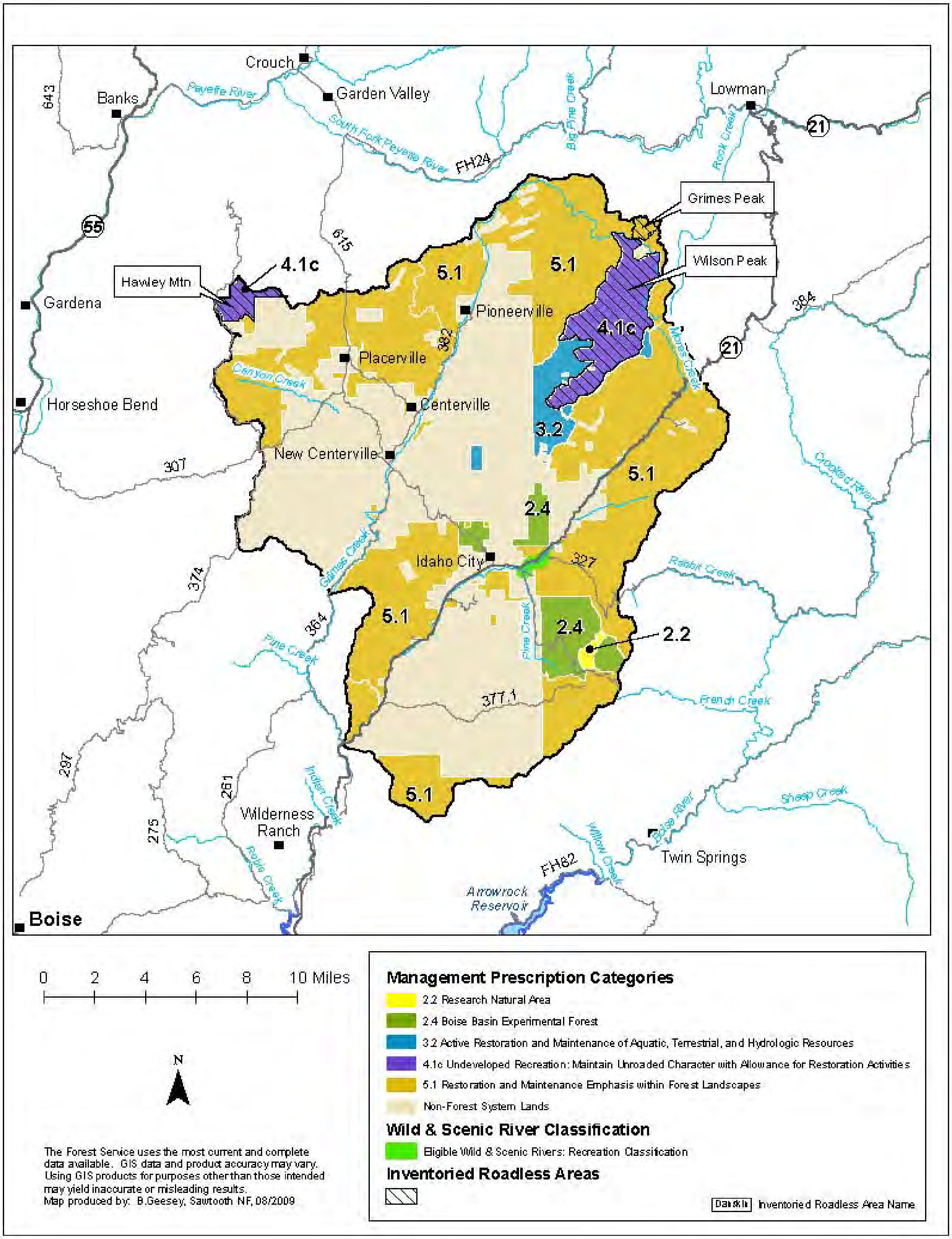
MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	0768	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Standard	0720	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0721	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0722	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	0723	Restore water quality by reducing accelerated sediment from roads within the management area, with emphasis in the Trapper-Trail, Big Owl-Wren, Lower Bear River, and Lower Crooked River drainages.
	Objective	0724	Encourage the natural recovery of stream channels of Trapper-Trail, Big Owl-Wren, Lower Bear River, and Lower Crooked River drainages within areas of recent fire and flood events.
	Objective	0725	Restore migration connectivity for bull trout throughout the management area by removing migration barriers caused by existing road design.
	Objective	0726	Restore fish habitat by reducing sediment delivery and repairing instream structures, with emphasis on Pikes Fork, Beaver Creek, and Edna Creek.
	Objective	0727	Initiate restoration of watershed conditions and fish habitat in the Pikes Fork and Upper Bear River subwatersheds to help strengthen local bull trout populations.
	Objective	0728	Continue to design and implement road-related watershed restoration projects in the North Fork Boise River Recovery Area.
	Objective	0729	Develop a schedule to inventory existing culverts to determine if they currently provide fish passage and prevent fish entrainment. Prioritize completion of the Beaver Creek, Big Owl Creek, Trapper Creek, Wren Creek, and Trail Creek inventories.
	Guideline	0730	In the Trapper-Trail Subwatershed, bull trout fish passage should be a high priority. Culverts should be inventoried and modified as needed to ensure fish passage occurs during required times of the year.
	Guideline	0731	In the Beaver-Edna, Pikes Fork, Upper Crooked River, and Lower Crooked River Subwatersheds, existing roads should be reconstructed with effective cross-drain spacing and drain dip locations to route water into slope filtration rather than to first-order streams in order to reduce sediment delivery to bull trout habitat.
	Guideline	0732	Modify grazing allotments and management practices as needed in the Beaver-Edna, Pikes Fork, Upper Crooked River, and Lower Crooked River Subwatersheds in order to reduce sediment delivery, increase streambank and channel stability, and restore riparian vegetation in or near bull trout habitat.
Vegetation	Objective	0733	Deleted, as part of 2010 Forest Plan amendment for WCS.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="3">Botanical Resources</td><td>Objective</td><td>0734</td><td>Maintain or restore known populations and habitats of TEPSC plant species, including Idaho douglasia, to contribute to the long-term viability of these species.</td></tr>
<tr><td>Objective</td><td>0735</td><td>Emphasize reducing spotted knapweed and rush skeletonweed within rare plant occupied and potential habitat.</td></tr>
<tr><td>Standard</td><td>0736</td><td>Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.</td></tr>
<tr><td>Non-native Plants</td><td>Objective</td><td>0737</td><td>Prevent new infestations and control spread of rush skeletonweed and spotted knapweed in winter range areas, specifically Barber Flats. Eradicate toadflax infestations.</td></tr>
<tr><td>Wildlife Resources</td><td>Objective</td><td>0738</td><td>Maintain or restore bald eagle wintering habitat along the North Fork Boise River corridor.</td></tr>
<tr><td rowspan="4">Recreation Resources</td><td>Objective</td><td>0739</td><td>Emphasize non-motorized uses on the Banner Ridge, Elkhorn, Summit, Skyline, and Beaver Creek groomed cross-country ski trails to maintain this winter recreation opportunity.</td></tr>
<tr><td>Objective</td><td>0740</td><td>Conduct a recreation inventory of the North Fork Boise River area to assess recreation uses and impacts, and to identify the need and location for future recreation sites.</td></tr>
<tr><td>Objective</td><td>0741</td><td>Manage dispersed recreation use in riparian corridors to reduce impacts to soil, water, and fish habitat, and to improve the recreational setting.</td></tr>
<tr><td>Objective</td><td>0742</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>14%</td><td>35%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>Trace</td><td>61%</td></tr>
<tr><td>Roaded Natural</td><td>18%</td><td>4%</td></tr>
<tr><td>Roaded Modified</td><td>68%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="2">Recreation Resources</td><td>Objective</td><td>0743</td><td>Facilitate and participate in the development of a scenic byway corridor management plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.</td></tr>
<tr><td>Objective</td><td>0744</td><td>Continue the current use of National Forest System lands by the Ea-Da-How organization camp.</td></tr>
<tr><td rowspan="3">Cultural Resources</td><td>Objective</td><td>0745</td><td>Maintain the National Register status of National Register eligible properties including Barber Flat and Beaver Creek Guard Stations, which are on the Forest’s cabin rental program.</td></tr>
<tr><td>Objective</td><td>0746</td><td>Conduct an inventory to identify historic properties on Crooked River, specifically in the Trapper Flat vicinity.</td></tr>
<tr><td>Objective</td><td>0747</td><td>Inventory the historic properties contributing to the Banner Historic Mining District. Nominate the Banner Historic Mining District to the NRHP.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	0748	Monitor the conditions of Barber Flat Guard Station and other National Register eligible properties in the management area. Nominate Barber Flat Guard Station to the NRHP, and develop a maintenance plant to protect its historic character.
	Objective	0749	Interpret the legacy of historic mining, logging, and early Forest Service activities at Barber Flat, Banner, and along the North Fork Boise River for public education and recreation.
Timberland Resources	Objective	0750	In burned areas, protect and release conifer regeneration to maintain stocking at minimum or greater levels and desired species mix. Implement stocking control on overstocked areas while trees are less than 15 years in age.
	Objective	0751	2Use mechanical and prescribed fire treatments to thin over-stocked Douglas-fir and ponderosa pine stands. Emphasize treatments in stands that are at high risk for Douglas-fir bark beetle and Douglas-fir mistletoe by establishing and or promoting ponderosa pine.
	Objective	0752	Thin/regenerate lodgepole pine stands to reduce the risk of mountain pine beetle epidemic.
	Objective	0753	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Meadow-French, Rabbit Creek, Hungarian-Beaver, Beaver-Edna, and Pikes Fork subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	0754	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Meadow-French, Rabbit Creek, Hungarian-Beaver, Beaver-Edna, and Pikes Fork subwatersheds.
Rangeland Resources	Objective	0755	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Meadow-French, Rabbit Creek, Beaver-Edna, and Hungarian-Beaver subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Mineral Resources	Objective	0756	Manage for mineral development in the Pikes Fork drainage.
	Objective	0757	Assess the adverse effects of historic mining in the Banner Mine area. Determine where problem areas exist, and cooperate with landowners in mitigation and restoration.
Fire Management	Objective	0758	Identify areas appropriate for Wildland Fire Use. Use wildland fire to restore or maintain desired vegetative conditions and to reduce fuel loadings.
	Objective	0759	Use prescribed fire as appropriate in burned areas (within 1994 Rabbit Creek Fire) as vegetation recovers from disturbance. Identify and implement maintenance underburns within areas that experienced low intensity wildfire in 1994.
	Objective	0769	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.

MPC/Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	0760	Stabilize Forest Road 327 along the North Fork Boise River to provide for public safety and to reduce sediment delivery to the river.
	Objective	0761	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Meadow-French, Rabbit Creek, Beaver-Edna, and Pikes Fork subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Objective	0762	Provide for visual quality along the Highway 21 scenic byway corridor by developing a vegetation management plan for the corridor.
	Standard	0763	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
North Fork Boise River	1	R	R	PR	R	PR	PR	R	PR	M
Ten Mile/Black Warrior Recommended Wilderness	1	P	P	P	P	P	P	P	P	P
Highway 21	1	R	R	PR	R	PR	PR	R	PR	M
Forest Trails 051, 158, 197	1	R	R	PR	R	PR	PR	R	PR	M
Edna Creek, Black Rock Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Roads 312, 316, 327, 348, 384	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 315, 333, 351	2	M	M	M	M	M	M	M	M	MM
Forest Trails 048, 049, 166, 167, 168, 169	2	M	M	M	M	M	M	M	M	MM
Forest Trail 171	2	PR	PR	M	PR	M	M	PR	M	MM
Willow Creek	2	PR	PR	M	PR	M	M	PR	M	MM



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 08. Mores Creek Location Map

Management Area 8
Mores Creek

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 8 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	Trace
2.4 – Boise Basin Experimental Forest	6
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	4
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	9
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	81

General Location and Description - Management Area 8, Mores Creek, is comprised of Forest Service lands in the Boise River drainage near Idaho City, about 20-40 miles northeast of Boise, Idaho (see map, opposite page). The management area is an estimated 196,200 acres, of which 55 percent are managed by the Forest Service, 22 percent are privately owned, 21 percent are State of Idaho lands, and 2 percent are BLM lands. Inholdings include large blocks of private and state land both south and north of Idaho City. Lands administered by the Boise National Forest, Idaho City Ranger District, surround the management area. The primary uses or activities in this management area have been mineral development, livestock grazing, and timber management. Current trends include community and residential development, tourism, timber management, and developed and dispersed recreation.

Access - The main access to the area is by paved State Highway 21 from Boise, Idaho, which runs along Mores Creek, through Idaho City, and over Mores Creek Summit to Lowman. Other access routes include the Grimes Creek Road (Forest Road 382) through Pioneerville and Centerville, Forest Road 615 from Garden Valley to Placerville, and Forest Road 307 from Idaho City to Horseshoe Bend. These are well-maintained, gravel roads. The density of classified roads in the management area is an estimated 2.8 miles per square mile. Total road density for area subwatersheds ranges between 1.4 and 4.7 miles per square mile. Many roads, user-defined trails, and several system trails exist in the management area.

Special Features - One eligible Wild and Scenic River, Mores Creek, falls within the management area. Mores Creek has one segment in this area with a Recreational classification. It is an estimated 1.2 miles, with a river corridor area of 394 acres. Mores Creek is considered eligible for Wild and Scenic River status because of its outstandingly remarkable recreational (?) values.

The Idaho State-designated Ponderosa Pine Scenic Byway lies partly within this management area. This highway is also a National Forest Scenic Byway. An estimated 5 percent of the management area is inventoried as roadless, including all of the Wilson Peak, and small portions of the Grimes Pass and Hawley Mountain Inventoried Roadless Areas.

The Boise Basin Experimental Forest (8,740 acres) is administered by the USDA Forest Service, Rocky Mountain Research Station, headquartered in Fort Collins, Colorado. This forest was originally established in the 1930s to conduct silvicultural and other related research in the ponderosa pine type. It includes the Bannock Creek Research Natural Area (445 acres), which was set aside to represent mixed conifer vegetation in the management area. The RNA has also been identified as a potential National Natural Landmark.

Air Quality - Portions of this management area lie within Montana/Idaho Airsheds ID-15 and 21 and in Boise and Elmore Counties. Particulate matter is the primary pollutant of concern for Forest management. There are ambient air monitors located in Garden Valley and Idaho City to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the counties was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Boise County (less than 100 acres) and moderately low (an estimated 5,000 acres) in Elmore County. Elmore County had point sources contributing minor amounts to the annual total PM 2.5 emissions.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet at Mores Creek to 8,128 feet atop Pilot Peak. Management Area 8 falls primarily within the Boise Basin Lands, Mores Flat, and Lowman Uplands Subsections. The main geomorphic landforms associated with these subsections are mature relief fluvial lands, dry fluvial slopes, volcanic flow lands, depositional lands, and frost-churned uplands. Slope gradients average between 10 to 50 percent in the Boise Basin Lands, 5 to 30 percent in Mores Flat, and 15 and 45 percent in the Lowman Uplands. The surface geology is dominated by Idaho Batholith granitics in the north and central portions of the area, and basalt volcanics in the south. Soils generally have moderate to high surface erosion potential, and moderate to high productivity. Subwatershed vulnerability ratings range from low to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). There are localized impacts from roads, timber harvest, livestock grazing, mining, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is comprised of all or portions of the Upper Grimes Creek, Granite Creek, Upper Mores Creek, Lower Grimes Creek, and Middle Mores Creek Watersheds. These watersheds all flow into the Boise-Mores Subbasin, which drains south into Lucky Peak Reservoir. The main streams in the area are Mores Creek, Grimes Creek, Elk Creek, and Thorn Creek. There are no natural lakes, and only a few small reservoirs. The Lower and Upper Elk Creek subwatersheds are part of a state-regulated public water system for the community of

Idaho City. A large number of wells and septic systems are present within and adjacent to this MA as a result of housing developments. Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below).

Water quality is functioning at risk due to localized accelerated sediment from roads, mining, timber harvest, livestock grazing, and recreation. Only one of the 16 subwatersheds in this MA was listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. This subwatershed is Minneha-Wildcat, and the pollutant of concern is sediment. There are currently no TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
4	7	5	0	8	8	0	8	8	1	0	2

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Bull trout are now absent from most of this area. They are presently known to occur in the Granite-Illinois and Upper Mores Creek subwatersheds, and at depressed levels. Redband trout have not recently been documented in this area. Brook trout are scattered throughout area streams. Other non-native species have been introduced to area streams for sport fishing. Aquatic habitat is functioning at risk due to accelerated sediment from historic mining practices, roads built during the early 1900s along streams and water courses, livestock grazing, and roads associated with timber management. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above. The Upper Mores Creek subwatershed has been identified as important to bull trout recovery, and as a high-priority area for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Cold forest communities of subalpine fir are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 8 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Bitterbrush, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Cool Dry Douglas-fir (6 percent), Cool Moist Douglas-fir (11 percent), Dry Ponderosa Pine/Xeric Douglas-fir (8 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (47 percent), and Warm Dry Subalpine Fir (19 percent).

The Mountain Big Sagebrush and Montane Shrub groups are functioning properly, but they are trending toward old age structure, dense canopies, and low levels of herbaceous ground cover due to fire exclusion. The Perennial Grass Slopes group is also functioning properly, although introduced species are increasing. Bitterbrush is functioning at risk because of impacts from fire exclusion, livestock grazing, and introduced species. Past livestock grazing and fire exclusion have altered structure and species composition. Native species are competing with introduced species like cheatgrass, spotted knapweed, and rush skeletonweed.

The Cool Dry Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine, and Cool Moist Douglas-fir groups are functioning at risk. Stands that have recently burned have experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved this group from a non-lethal to a lethal fire regime. These high density and fuel conditions still exist in unburned stands, where fire frequency is occurring at less than historic intervals. Insect and disease infestations have increased tree mortality and the risk of uncharacteristic wildfire. These groups also lack young structural stages and seral ponderosa pine and aspen. Past reforestation practices in the Quartzburg Fire area have left thousands of acres of undesirable genetic stock. The Granite Creek (5th code HUC 1705011204), Lower Grimes Creek (5th code HUC 1705011203), and Upper Mores Creek (5th code HUC 1705011207) watersheds are high priorities for active management to restore the large tree size class.

The Warm Dry Subalpine Fir group is functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Late seral subalpine fir is increasing, and seral Douglas-fir, lodgepole pine, and aspen are decreasing.

Riparian vegetation is functioning at risk due to localized impacts from roads, mining, livestock grazing, and recreation. Fire exclusion has resulted in longer fire return intervals, leading to increased fire intensity and severity. Exotic plant species have begun to encroach upon riparian areas, but recent prevention and control efforts have kept habitats intact.

Botanical Resources - Giant helleborine orchid, a Region 4 Sensitive species, and Kellogg's bitterroot (Lewisia kelloggii), a proposed Sensitive species, are known from this management area. Swamp onion, a Region 4 Watch species, also occurs in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Dalmatian toadflax, diffuse knapweed, spotted knapweed, Canada thistle, St. Johnswort, and tansy ragwort occur in the area, particularly along the main road corridors. Purple loosestrife has been found in riparian ecosystems in the area. All known infestations appear to have been eradicated. This species poses a significant risk to riparian ecosystems, especially wet meadows. An estimated 67 percent of the area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weeds of concern are rush skeletonweed and spotted knapweed, which currently occur in scattered populations. A cooperative agreement exists between the Forest Service and Boise County to aggressively treat noxious weeds.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Upper Granite	No	Yes	Yes	No	No
Lower Granite	Yes	Yes	Yes	No	No
Lewis-Clay	Yes	Yes	Yes	No	No
Gregory-Johnny	Yes	Yes	Yes	No	No
Lower Elk	Yes	Yes	Yes	No	No
Bannock-Thomas	Yes	Yes	Yes	No	No
Granite-Illinois	Yes	Yes	Yes	No	No
Minneha-Wildcat	No	No	No	No	No
Clear Creek	No	No	Yes	No	No
Upper Mores Creek	Yes	No	Yes	No	No
Wild Goat-Deadhorse	Yes	No	Yes	No	No

Wildlife Resources—The wide range of elevations and vegetation types in the management area provide a variety of wildlife habitats. The lower Grimes Creek and Mores Creek corridors have wintering habitat for bald eagles. Much of the lower elevation grasslands and shrublands are important winter range for elk, as well as foraging habitat for introduced turkey and chukar. Dry forests provide habitat for a number of Region 4 sensitive species, including northern goshawk, flammulated owl, and white-headed woodpecker. High-elevation cold forests provide nesting and foraging habitat for boreal owl and three-toed woodpecker. The entire area provides nesting and forage habitat for migratory landbirds, and general habitat for wide-ranging mammals such as elk, bear, wolves, and mountain lion. High road densities may influence use of habitat by wildlife species negatively influenced by road-associated factors.

Overall, terrestrial habitat is functioning at risk due to past silvicultural management practices and changes in fire disturbance patterns. The Upper Mores Creek watershed (5th code HUC 1705011207) has been identified as important to the recovery of Forest sensitive species and other native wildlife utilizing late-seral forests with low canopy conditions, and is identified as a short-term high-priority watershed for restoration.

Recreation Resources - Paved road access, local residences, and proximity to Boise and Idaho City make the Mores Creek corridor a heavily used, year-round recreation area. Dispersed recreation such as hunting, hiking, sight-seeing, snowmobiling, back-country skiing, off-road vehicle use, and camping occurs throughout the area, and there are many dispersed camp sites and six developed campgrounds. The area is located primarily within Idaho Fish and Game Management Unit 39. This is a popular area for dispersed winter recreation, particularly for back-country skiing and snowmobiling. Most summer recreation is road-oriented, and a number of user-defined, non-system trails exist in the area. Public access through private lands is a concern in areas near extensive inholdings. Special use permits are issued for summer residences within the Ten Mile Summer Residence tract. This area attracts many recreation special use permit requests, and the trend is expected to continue.

Cultural Resources - Cultural themes in this area include Mining, Ethnic Heritage, Timber Industry, Transportation, Forest Service History, and the CCC. Mores Creek has the highest density of sites of all the management areas on the Forest. The majority of sites are associated with historic mining. The management area encompasses Boise Basin, where miners discovered gold in 1862. The basin was the state's leading gold producer well into the twentieth century, and contains a broad spectrum of sites associated with placer, hydraulic, dredge, and lode mining. Many of these sites reflect the unique legacy of Chinese immigrants to Idaho history. Idaho City and Placerville are historic mining towns in the area listed on the National Register of Historic Places. After 1900, commercial export logging became increasingly important to the basin's economy. In the 1920s, the Boise-Payette Lumber Company extended the Intermountain Railroad from the confluence of Grimes and Mores Creeks to Idaho City and beyond. This management area, as a result, contains numerous logger camps. The 1930s are represented by sites such as the Boise Basin Experimental Station, built by the CCC as a research center for Forest Service issues concerning soil erosion, and range and timber management.

Timberland Resources—Of the estimated 82,700 tentatively suited acres in this management area, 59,600 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 11 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the management area MPC map. Lands within MPC 2.2, 2.4, 3.2 and 4.1c are identified as not suited for timber production. Much of this area has had a high level of past timber management, and has been selectively harvested for mine timbers, construction lumber, and fuelwood as far back as the 1860s. This area also has the Idaho City Seed Orchard, developed and maintained to produce seeds of desirable genetic quality. Fuelwood, post and poles, Christmas trees, and other forest products currently receive a lot of public use and interest since this area is within an hour's drive of Boise.

Rangeland Resources - The management area contains all or portions of two sheep allotments located primarily in the northern and eastern portions of the area. Management Area 8 provides an estimated 48,700 acres of capable rangeland. These acres represent about 12 percent of the capable rangeland on the Forest.

Mineral Resources - The area is open to mineral activities and prospecting, with the exception of lands within the Boise Basin Experimental Forest that have been withdrawn from mineral entry. There has been a considerable amount of hard rock and placer mining since 1862. Most operations have ceased or lie dormant, but they have left lingering traces. Dredge tailings are the most obvious remnant, primarily along Mores, Grimes and Granite Creeks. There are old hydraulic mining sites such as Humbug Gulch. Traces of small-scale prospects and placer operations abound. Remnants of underground mining include waste rock piles, mill tailings, and occasional structures. Old underground sites are found in the upper Granite Creek (Quartzburg area), upper Grimes Creek (Missouri and Comeback Mines), and the Illinois Gulch area. There is still a small amount of small-scale mining and mineral exploration. There are limited public recreation mining areas on Grimes Creek. The locatable mineral potential is generally moderate, as is the leasable mineral potential for geothermal resources. The potential for other leasable minerals is low to moderate.

Fire Management—Wildland fires occur more frequently in this management area than in any other on the Idaho City District, both from lightning and human activities. The majority of these fires are successfully suppressed in the initial attack phase. Over the past 20 years there were approximately 320 fire starts, about 35 percent of which were human-caused. This management area had the third highest proportion of human-caused fires relative to the other management areas. Large fires since 1988 include the Minneha Fire, King Gulch Fire, Mores-Bannock Creek Fire, Dunnigan Fire, Star Gulch Fire and Gregory. Portions of the Boise Basin Experimental Forest and Bannock Creek RNA were also burned in 1994. In total, about 29 percent of the management area has burned since 1988. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated.

The majority of the National Fire Plan communities on the Idaho City Ranger District are located within this management area, including Idaho City, Placerville, New Centerville, Pioneerville, and New Centerville. A large proportion of the management area is considered wildland-urban interface, and most subwatersheds pose risks to life and property from potential post-fire floods and debris flows. In addition, numerous subdivisions on the outskirts of rural areas also exist, such as Star Gulch and scattered residential structures along Highway 21. All of the interface communities are located in lower-elevation areas, surrounded predominantly by Warm Dry Douglas-fir/Moist Ponderosa Pine stands. Timber harvesting, pre-commercial thinning, and prescribed fire activities have treated stands in the vicinity of these communities, but further treatments are needed to continue restoration or maintenance of these stands to reduce the potential for uncharacteristic wildland fire. In the past, all fires have been actively suppressed in this area, and this policy will continue due to the high occurrence of wildland-urban interface. As such, fire use activities within this area will be limited to prescribed fire treatments.

Historical fire regimes for the area are estimated to be 40 percent mixed1 or 2, and 60 percent non-lethal. An estimated 32 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 40 percent of the area is in moderately departed conditions—19 percent in the mixed1/mixed2 fire regimes, and 21 percent in the non-lethal regimes. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special-use permits are issued for several utility corridors to private inholdings. Opportunities exist to consolidate National Forest lands through exchange with other landowners in the area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	0801	Manage the Mores Creek eligible river corridor to its assigned classification standards, and preserve its outstandingly remarkable values and free-flowing status, until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	0878	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	0802	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	0803	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0804	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	0805	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	0806	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	0807	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 2.4 Boise Basin Experimental Forest	General Objective	0808	Continue to cooperate with Rocky Mountain Research Station on management of the Boise Basin Experimental Forest.
	General Standard	0809	All activities on the experimental forest shall be coordinated with the Scientist-in-Charge of the Boise Basin Experimental Forest (Rocky Mountain Research Station).
	Vegetation Standard	0810	Vegetation management actions using both prescribed fire and mechanical treatment methods may occur as part of planned research activities, or to achieve other objectives, provided that research objectives are not compromised.
	Range Standard	0811	Livestock grazing is prohibited unless prescribed as a management tool to achieve research objectives.
	Vegetation Guideline	0812	Salvage harvest may occur as part of planned research activities.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	0813	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to experimental areas and other investments.
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	0814	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	0815	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	0879	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	0816	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	0817	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0818	Management actions—including mechanical vegetation treatments, salvage harvest prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	0880	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	0819	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0820	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0881	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	0821	The full range of vegetation treatment activities, except wildland fire use, may be used to restore or maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0882	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0822	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0823	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	0883	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0824	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0825	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	0826	Survey areas to identify and prioritize watershed improvement needs. Restore water quality by reducing accelerated sediment and heavy metal or chemical contaminants from historic mining areas, particularly hydraulic placer mining sites such as Humbug.
	Objective	0827	Restore habitat for bull trout in Upper Mores Creek subwatershed by reducing adverse effects from roads, migration barriers, and historical grazing.
	Objective	0828	Continue ongoing studies in Mores Creek on bull trout distribution, abundance, life histories, and factors affecting them to help promote recovery of the species.
	Objective	0829	Survey and evaluate fish habitat, concentrating on Grimes and Mores Creeks and old dredge mining sites. Cooperate with landowners in mitigation and restoration of problem areas.
	Objective	0830	Coordinate and work with Boise County on road maintenance to reduce sediment and restore fish passage.
Vegetation	Objective	0831	Restore PVG1 (Dry Ponderosa Pine/Xeric Douglas-fir), PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine) and PVG3 (Cool Moist Douglas-fir) as described in Appendix A emphasizing the large tree size class in the Granite Creek (5th code HUC 1705011204), Lower Grimes Creek (5th code HUC 1705011203), and Upper Mores Creek (5th code HUC 1705011207) watersheds.
Botanical Resources	Objective	0832	Maintain or restore known populations and habitats of TEPSC plant species, including giant helleborine orchid and Kellogg's bitterroot, to contribute to the long-term viability of these species.
	Objective	0833	Reduce spotted knapweed and rush skeletonweed within rare plant occupied and potential habitat.
Non-native Plants	Objective	0834	Control and contain noxious weeds, particularly rush skeletonweed and spotted knapweed. Emphasize biological treatments, such as insects, pathogens, and livestock grazing.
	Objective	0835	Eradicate Dalmatian toadflax and tansy ragwort. Implement a prevention program that targets new invaders, with purple loosestrife as a priority species.
	Objective	0836	Continue to cooperate with landowners and the state to reduce non-native plants.
Wildlife Resources	Objective	0837	Maintain or restore bald eagle wintering habitat along Mores Creek and lower tributaries.

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	0838	Provide big-game winter range by maintaining or restoring Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes vegetation groups along the South Fork Payette River corridor.
	Objective	0884	Focus source habitat restoration activities within Upper Mores Creek watershed (5th code HUC 1705011207) in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (Refer to Conservation Principles 2 and 3 in Appendix E.)
	Objective	0885	Reduce open road densities within Upper Mores Creek watershed (5th code HUC 1705011207) where it is determined that they limit use of source habitats by wildlife species identified as TEPC and R4 Regionally Sensitive species. (Refer to Conservation Principles 5 and 6 in Appendix E.)
	Guideline	0886	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Upper Mores Creek watershed (5th code HUC 1705011207) watershed should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (Refer to Conservation Principles 1, 4, and 5 in Appendix E.)
Recreation Resources	Objective	0839	Evaluate the need for new or expanded facilities at the Granite Creek Recreation Area to address increasing recreation use. Develop a plan to expand or construct facilities if the evaluation determines the need.
	Objective	0840	Evaluate non-system trails for inclusion in the Forest trail system. Decommission trails that are not needed, and improve other trails to increase management efficiency and public safety, to reduce soil and water impacts, and to provide a variety of trail use opportunities.
	Objective	0841	Minimize conflicts between backcountry skiers and snowmobilers arising from increased winter recreation use in the upper Mores Creek/Pilot Peak area.
	Objective	0842	Identify and evaluate opportunities to provide a trail system integrated and coordinated with private landowners to enhance recreation experiences.
	Objective	0843	Continue to coordinate with Counties (Boise/Elmore) and other groups related to grooming trails for over-snow activities to maintain these winter recreation opportunities.
	Objective	0844	Identify and evaluate opportunities along the Highway 21 corridor to improve recreation opportunities and experiences through additional parking, trails and trailhead facilities, and yurts, as well as improvements to existing recreation facilities.
	Objective	0845	Protect the groomed cross-country ski system from the Gold Fork parking lot to Beaver Creek Summit from damage by unauthorized snowmobile use.
	Objective	0846	Develop a trail system within the Boise Basin (Mores Creek) to enhance recreation opportunities by incorporating segments of acceptable, relocated or reconstructed sections of existing non-system trails.
	Objective	0847	Maintain the use by recreation residences within the established recreation residence tract at Ten-Mile Creek.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="3"></td><td>Objective</td><td>0848</td><td>Facilitate and participate in the development of a scenic byway corridor management plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.</td></tr>
<tr><td>Objective</td><td>0849</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>0%</td><td>8%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>3%</td><td>70%</td></tr>
<tr><td>Roaded Natural</td><td>14%</td><td>11%</td></tr>
<tr><td>Roaded Modified</td><td>83%</td><td>11%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Guideline</td><td>0850</td><td>Continue coordination with the State of Idaho on management of park-and-ski areas to maintain winter recreation opportunities.</td></tr>
<tr><td rowspan="6">Cultural Resources</td><td>Objective</td><td>0851</td><td>Identify suitable historic landscapes created by placer, dredge, and lode mining for protection and interpretation.</td></tr>
<tr><td>Objective</td><td>0852</td><td>Facilitate community partnerships (e.g., Idaho City Historical Foundation) to promote historic preservation and public stewardship for cultural resources in Boise Basin.</td></tr>
<tr><td>Objective</td><td>0853</td><td>Complete an inventory of the historic properties within the Boise Basin and evaluate the establishment of a Chinese Historic Mining District and an Intermountain Railroad Historic Logging District.</td></tr>
<tr><td>Objective</td><td>0854</td><td>Inventory the historic properties contributing to the Chinese Historic Mining District and the Intermountain Railroad Historic Logging District. Nominate these districts to the NRHP, and provide interpretation at the appropriate contributing properties.</td></tr>
<tr><td>Objective</td><td>0855</td><td>Nominate Hop Lee’s Placer Claim (Granite Creek Trailhead) to the National Register, and complete the heritage trails system and interpretive signs planned for this site.</td></tr>
<tr><td>Objective</td><td>0856</td><td>Develop a management plan for the Boise Basin Experimental Station to protect the historic character of this facility.</td></tr>
<tr><td rowspan="5">Timberland Resources</td><td>Objective</td><td>0857</td><td>Manage stand density and other appropriate silvicultural treatments on suited timberlands to promote growth, provide wood products, and to reduce hazards from uncharacteristic fire, insects, and diseases. Use silvicultural treatments also to reduce the spread and intensification of dwarf mistletoe.</td></tr>
<tr><td>Objective</td><td>0858</td><td>Emphasize stocking control and fuels reduction in plantations.</td></tr>
<tr><td>Objective</td><td>0859</td><td>Reduce densities in mid-aged overstocked stands. Promote early seral species and open stands that can be maintained in a low fire hazard condition by fire in the future.</td></tr>
<tr><td>Objective</td><td>0860</td><td>Manage the collection of fuelwood and other wood products to help achieve vegetation goals.</td></tr>
<tr><td>Objective</td><td>0861</td><td>Manage and protect the Idaho City Seed Orchard to produce genetically improved seeds for future reforestation on southwest Idaho forests. Use thinning, fertilization, and pollen management as needed to produce seed cones for ponderosa pine.</td></tr>
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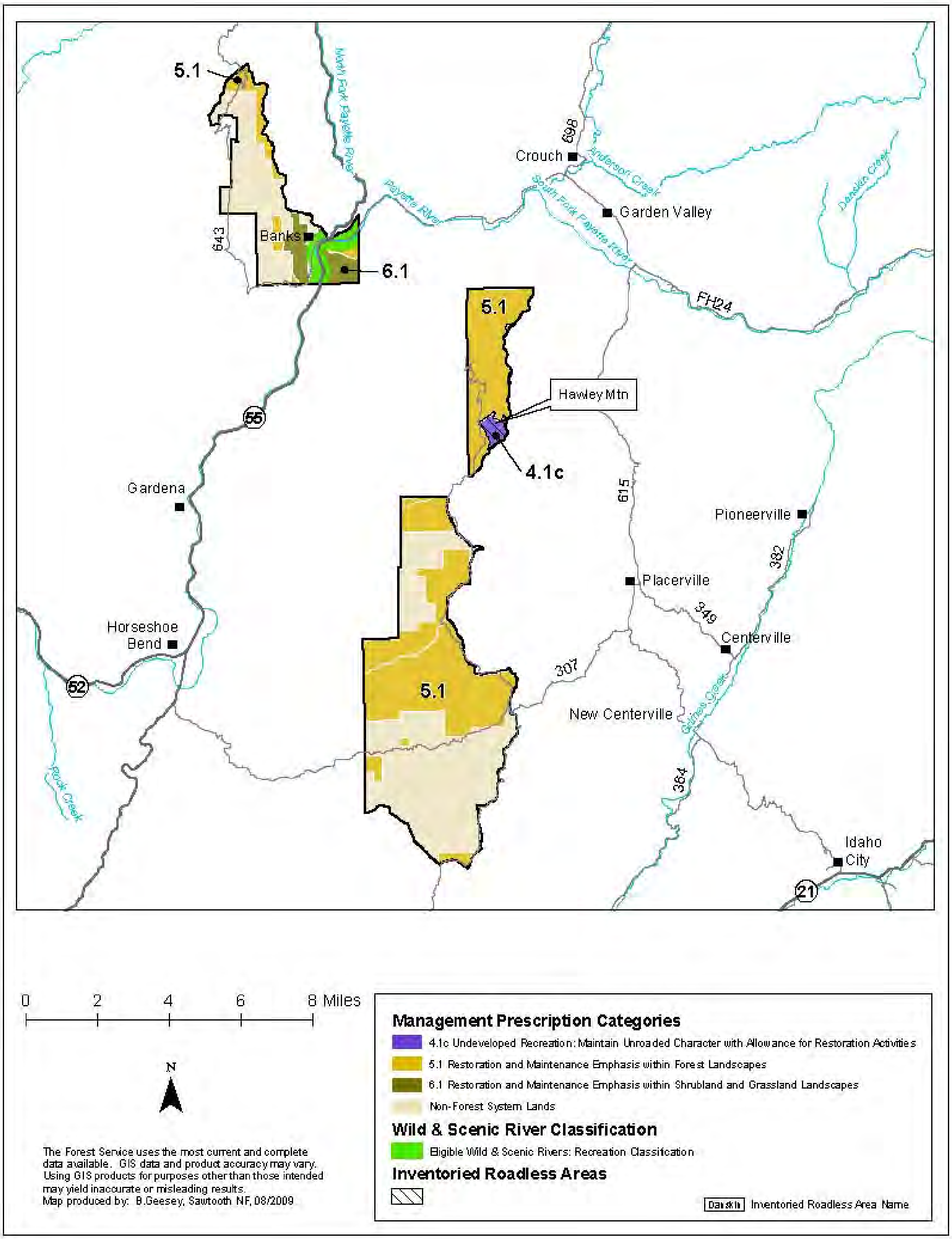
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	0862	Evaluate Quartzburg plantations to determine their genetic desirability, and design stand improvement or replacement activities to restore genetic integrity within tree species.
	Objective	0863	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Wild Goat-Deadhorse, Lower Granite Creek, Upper Granite Creek, Clear Creek, Lewis-Clay, Gregory-Johnny, Bannock-Thomas, Lower Elk Creek, Granite-Illinois, and Upper Mores Creek subwatersheds. Consider designated skid trails, winter skidding, minimal fireline construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	0864	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Wild Goat-Deadhorse, Lower Granite Creek, Upper Granite Creek, Clear Creek, Lewis-Clay, Gregory-Johnny, Bannock-Thomas, Lower Elk Creek, Granite-Illinois, and Upper Mores Creek subwatersheds.
Rangeland Resources	Objective	0865	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Upper Granite Creek, Lower Granite Creek, Lewis-Clay, Gregory-Johnny, Lower Elk Creek, Bannock-Thomas, and Granite-Illinois subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Mineral Resources	Objective	0866	Survey, evaluate, and, where appropriate, mitigate or restore areas of historic mining impacts.
	Objective	0867	Identify areas available to the public for recreational mining.
Fire Management	Objective	0868	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0869	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
Lands and Special Uses	Objective	0870	Pursue land adjustments to consolidate National Forest system lands in the vicinities of the Idaho City, Placerville, Centerville, Quartzburg, Pioneerville, and Old Placerville town sites.
Facilities and Roads	Objective	0871	Develop crew staging and storage facilities at the Idaho City airport to support fire suppression activities.
	Objective	0872	Continue to work with the State of Idaho to find suitable sites for the disposal of slough material.
	Objective	0873	Cooperate with landowners, counties and State of Idaho in road relocations and management of the road system.

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	0874	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Wild Goat-Deadhorse, Upper Mores Creek, Lower Granite Creek, Lewis-Clay, Gregory-Johnny, Lower Elk Creek, Bannock-Thomas, and Granite-Illinois subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Objective	0875	Provide for visual quality along the Highway 21 scenic byway corridor by developing a vegetation management plan for the corridor.
	Objective	0876	Design projects to provide for scenic values along the Highway 21 corridor.
	Standard	0877	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Highway 21	1	R	R	PR	R	PR	PR	R	PR	M
Grayback Gulch, Ten Mile Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Hayfork, Bad Bear Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Roads 203, 304, 307	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 316, 327, 364, 374	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 380 (south of Forest Road 314), 615	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 314, 382, 386, 380 (north of Forest Road 314)	2	M	M	M	M	M	M	M	M	MM
Bald Mountain	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 163, 169, 170	2	M	M	M	M	M	M	M	M	MM



Management Area 09. Harris Creek Location Map

Management Area 9
Harris Creek

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 9 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	2
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	89
6.1 – Restoration and Maintenance Emphasis within Shrubland & Grassland Landscapes	9

General Location and Description - Management Area 9 is comprised of lands administered by the Boise National Forest between Boise and Banks, Idaho (see map, opposite page). The area lies in Boise County, 5-25 miles northeast of Boise, and is administered by the Idaho City and Emmett Ranger Districts. The management area is an estimated 27,500 acres, of which 52 percent are managed by the Forest Service, 38 percent are private inholdings, and 10 percent are State of Idaho lands. The area is bordered by a mixture of private, BLM and State lands along the Payette River corridor. The primary uses and activities in this management area have been dispersed recreation, timber management, and livestock grazing.

Access - The main access to the southern portion of the management area is by State Highway 55 to Forest Road 307 up Harris Creek to Forest Road 374, the Boise Ridge Road, and then either north or south along the Boise Ridge. The main access to the northern portion of the area is by State Highway 55 to Banks and Forest Road 643 up Dry Buck Creek. The density of classified roads in the management area is an estimated 3.8 miles per square mile, and very little of this area is inventoried as roadless. Total road density for area subwatersheds ranges between 2.1 and 4.1 miles per square mile. A number of user-defined, non-system trails exist in the area.

Special Features - State Highway 55 has been designated as a state and federal scenic byway. A small portion of the Hawley Mountain Roadless Area comprises an estimated 1 percent of the management area. A short segment of the main Payette River within the management area is eligible as a Wild and Scenic River. The classification of this segment is Recreational. The North Fork is considered eligible because of its outstandingly remarkable recreational values.

Air Quality - Portions of this management area lie within Montana/Idaho Airsheds ID-15 and 14 and in Boise County. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located in Treasure Valley (Boise, Caldwell, Meridian, etcetera) and Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the county was fugitive dust from unpaved roads and agricultural activities such as tilling. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Boise County (less than 100 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 4,000 feet at the Forest boundary to 7,300 feet atop Hawley Mountain. Management Area 9 falls within portions of the Boise Ridge-Payette Canyonlands and Boise Foothills and Squaw Butte Subsections. The main geomorphic landforms associated with these subsections are strongly and moderately dissected fluvial lands, rolling fluvial slopes, and steep fluvial canyonlands. The dominant slope range is 30 to 75 percent in the dissected fluvial lands, 5 to 35 percent in the rolling fluvial slopes, and 60 to 80 percent in the steep canyonlands. The surface geology is primarily Idaho batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high (see table below).

Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below). Localized areas have impacts from roads, timber harvest, livestock grazing, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is in the Harris Creek Watershed and part of the Banks Watershed of the Payette River Subbasin. The major streams in the area are the Payette River and Harris Creek. There are no lakes or reservoirs in the management area. The Horseshoe Bend, Porter Creek, Gardena, Dry Buck Creek, Banks, and Hill Creek subwatersheds contribute to state-regulated public water systems for the community of Horseshoe Bend. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). Localized areas have accelerated sediment from roads, timber harvest, livestock grazing, and recreation. No water bodies are currently listed as impaired under Section 303(d) of the Clean Water Act, nor are there any TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
2	2	3	1	3	3	1	5	1	0	0	6

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. The Payette River is a migration corridor for several native and introduced species, however bull trout, redband, and native cutthroat trout are not found in the rest of this management area. Aquatic habitat is functioning at risk due to accelerated sediment. Native fish populations are at risk due to the presence of non-native species and habitat impacts noted above.

Vegetation—An estimated 15 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Montane Shrub and Perennial Grass Slopes. The main forested vegetation groups in the area are Cool Dry Douglas-fir (4 percent), Dry Ponderosa Pine/Xeric Douglas-fir (5 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (33 percent), Cool Moist Grand Fir (29 percent), and Warm Dry Subalpine Fir (7 percent). Aspen is a component of the Douglas-fir and subalpine fir groups.

The Montane Shrub group is functioning properly, but it is trending toward old age structure, dense canopies, and low levels of herbaceous ground cover due to fire exclusion. The Perennial Grass Slopes group is moving toward proper functioning condition but is still considered to be at risk due to an increase in introduced species.

The Cool Dry Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine, and Cool Moist Grand Fir groups are functioning at risk. Fire exclusion has resulted in high stand densities and fuel loadings that have moved these groups from a non-lethal to a lethal fire regime. Insect and disease infestations have increased tree mortality and the risk of uncharacteristic wildfire. These groups also lack young structural stages and seral ponderosa pine. The Banks (5th code HUC 1705012215) and Harris (5th code HUC 1705012216) watersheds are high priority for active management to restore the large tree size class.

The Warm Dry Subalpine Fir group is functioning low risk due to fire exclusion that has resulted in old stands without much structural diversity. Late seral subalpine fir is increasing, and seral Douglas-fir and aspen are decreasing.

Riparian vegetation is functioning at risk due to localized impacts from roads, livestock grazing, and recreation. Fire exclusion has resulted in longer fire return intervals, leading to increased fire intensity and severity. Exotic plant species have begun to encroach upon riparian areas, but recent prevention and control efforts have kept habitats intact.

Botanical Resources - Giant helleborine orchid, a Region 4 Sensitive species, is known from this management area. Kellogg's bitterroot and pale sedge, proposed Region 4 Sensitive species, are also known to occur in this management area. Buxbaum's sedge and swamp onion, Region 4 Watch species, also occur in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses, Spalding's silene, and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Spalding's silene, a Threatened species, may occur in fescue grassland habitats from 1,500 to 5,500 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants – Spotted knapweed, Scotch thistle, St. Johnswort, and rush skeletonweed occur in or near this management area, primarily along the main road corridors. An estimated 68 percent of the area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weeds of concern are spotted knapweed and Scotch thistle, which currently occur mainly on private land adjacent to the management area, but have a high likelihood of spreading onto the Forest.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a “yes” in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Dry Buck Creek	Yes	No	No	No	No
Harris Creek	Yes	Yes	No	No	No
Gardena	No	Yes	No	No	No

Wildlife Resources - Warm ponderosa and Douglas-fir forests provide habitat for white-headed woodpecker, flammulated owl, goshawk, and limited winter range for deer and elk. The entire area provides nesting and forage habitat for migratory landbirds, and general habitat for wide-ranging mammals such as elk, bear, and mountain lion. Bald eagle may winter along the Payette River corridor. Overall, terrestrial habitat is functioning properly, although structural diversity could be improved.

Recreation Resources - The Banks Beach Picnic Area and put in/take out on the Payette River is the only developed recreation site in the area. The Payette River corridor receives an increasing amount of river-related recreation use, including fishing, rafting, and canoeing. Dispersed recreation is popular in the rest of the management area, particularly hunting, ATV use, and snowmobiling. The area is in portions of Idaho Fish and Game Management Units 32A, 32, and 39. Some facilities in this area are part of a fee demonstration project. Recreation special uses include group permits and outfitter permits to float the Payette River, and for commercial photography.

Cultural Resources – Cultural themes in the area are Prehistoric Archaeology and Ranching. This management area contains prehistoric sites that indicate the Boise Ridge system was a transportation corridor used by prehistoric peoples traveling to and from the Payette River canyon to higher-elevation camps in the Forest. Historically, ranchers in Jerusalem Valley and other Payette River communities used the Harris Creek watershed to pasture livestock. In the 1870s and 1880s, cattle and sheep raised in this area fed miners in Boise Basin’s gold camps.

Timberland Resources—Of the estimated 11,200 tentatively suited acres in this management area, 8.700 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 2 percent of the Forest’s suited timberland acres. The suited timberland acres are found in MPCs 5.1 and 6.1 (see management area MPC map). Lands in MPC 4.1c have been identified as unsuited for timber production. The overall level of past timber management on these acres is moderate. Forest products such as fuelwood, posts, poles, and Christmas trees are also collected in designated areas.

Rangeland Resources - This area has portions of three cattle allotments. Management Area 9 provides an estimated 2,900 acres of capable rangeland. These acres represent less than 1 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open to mineral development and activities. The potential for locatable minerals is considered low to moderate. The potential for geothermal development is considered moderate, but the potential for other leasable minerals is either low or unknown. The potential for common variety mineral materials is also low or unknown.

Fire Management—Over the past 20 years there were about 30 fire starts in the management area, the majority of which were lightning-caused. However, acres burned have been relatively small since the majority of these fire starts are successfully suppressed during initial attack. Since 1988 only six percent of the Forest Service ownership in the management area has burned. However, areas adjacent to the Forest have burned in recent years.

In the past, all fires have been actively suppressed, and this policy will continue due to the occurrence of wildland-urban interface areas nearby. As such, fire use activities within this area will be limited to prescribed fire treatments. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated.

Banks is a National Fire Plan community and the area around Banks is considered wildland-urban interface areas due to private development adjacent to the Forest. Additionally, the subwatersheds surrounding Banks as well as Porter Creek are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be 51 percent mixed 1 or 2, and 49 percent non-lethal. An estimated 42 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 31 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - The Hawley Mountain designated communications site is located within the management area. There is a special-use authorization for the Banks store and café.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	0901	Manage the North Fork Payette River and Payette eligible corridors to their assigned Recreational classification standards, and preserve their ORVs and free-flowing status until the rivers undergo a suitability study and the study finds them suitable for designation by Congress, or releases them from further consideration as Wild and Scenic Rivers.

MPC/Resource Area	Direction	Number	Management Direction Description
	Vegetation Standard	0947	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	0902	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
MPC 2.1 Wild and Scenic Rivers	Fire Guideline	0903	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	0904	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	0905	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	0948	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Road Standard	0906	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	0907	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	0949	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[2]
	Vegetation Guideline	0908	The full range of treatment activities, except wildland fire use, may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0950	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0909	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0910	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0951	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	0911	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	0912	Deleted, as part of 2010 Forest Plan amendment for WCS.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes	Vegetation Standard	0952	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Vegetation Guideline	0913	The full range of treatment activities, except wildland fire use, may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	0953	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	0914	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	0915	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	0954	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
Vegetation	Objective	0916	Restore PVG1 (Dry Ponderosa Pine/Xeric Douglas-fir), PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine) and PVG6 (Cool Moist Grand Fir) as described in Appendix A emphasizing the large tree size class in the Banks (5th code HUC 1705012215) and Harris (5th code HUC 1705012216) watersheds.
Botanical Resources	Objective	0917	Maintain or restore for occupied habitat needs for TEPCS plant species, including giant helleborine orchid, Kellogg's bitterroot, and pale sedge, to contribute to the long-term viability of these species.
	Objective	0918	Reduce spotted knapweed and Scotch thistle within rare plant actual and potential habitat.

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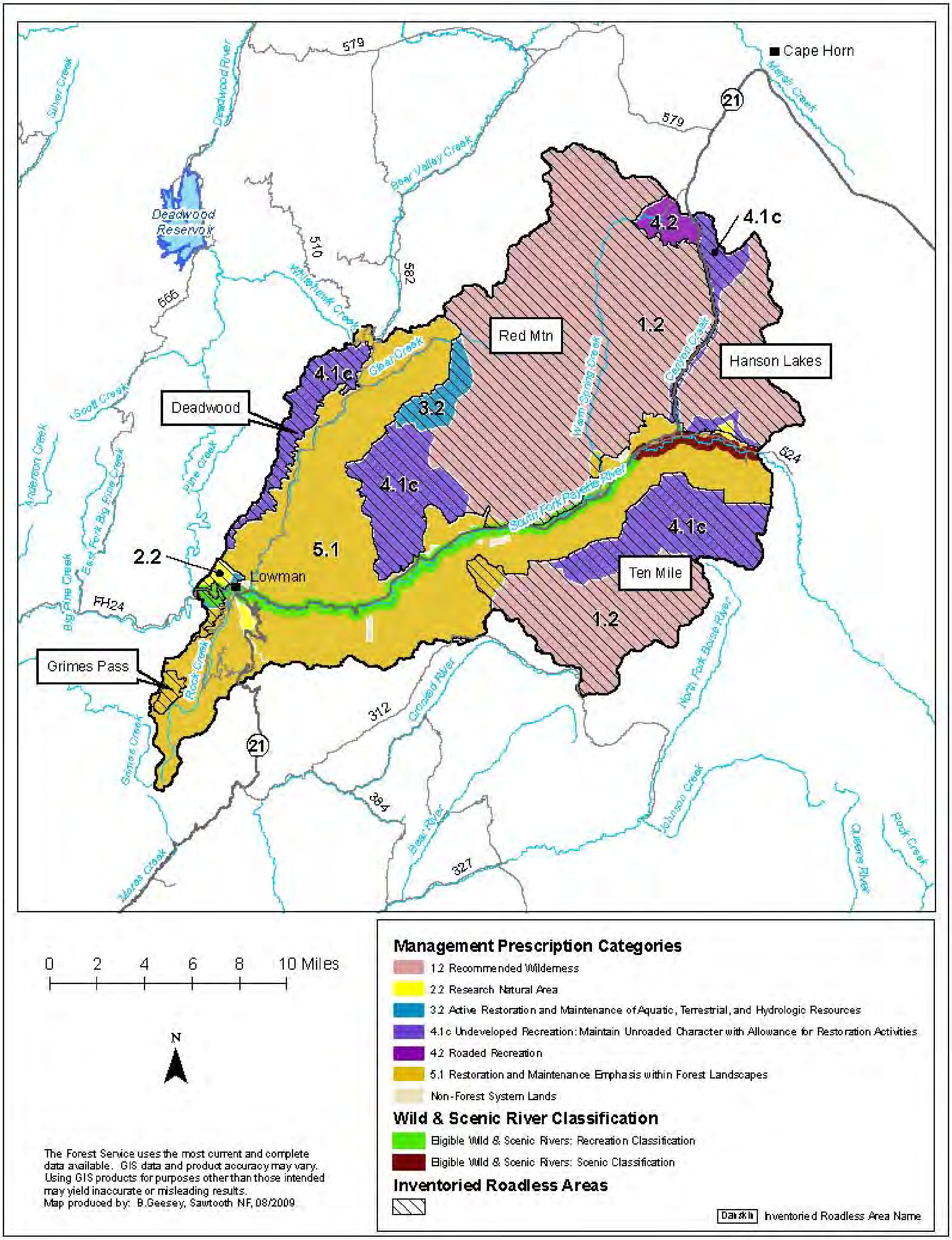
[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td>Non-native Plants</td><td>Objective</td><td>0919</td><td>Coordinate and cooperate with private landowners to treat spotted knapweed, Scotch thistle, and other undesirable plants. Contain spotted knapweed and Scotch thistle to private lands, and eradicate new infestations of these species.</td></tr>
<tr><td rowspan="2">Wildlife Resources</td><td>Objective</td><td>0920</td><td>Maintain or restore bald eagle wintering habitat along the Payette River corridor and other areas where potential habitat may exist.</td></tr>
<tr><td>Objective</td><td>0921</td><td>Improve big-game winter range by restoring Perennial Grass Slopes and Montane Shrub vegetation groups along the North Fork Payette River corridor. Emphasize increasing native plant forage by reducing noxious weeds.</td></tr>
<tr><td rowspan="10">Recreation Resources</td><td>Goal</td><td>0922</td><td>Emphasize river-related recreation opportunities and experiences in the management of recreation resources within the Payette River corridors.</td></tr>
<tr><td>Goal</td><td>0923</td><td>Emphasize dispersed recreation opportunities and experiences in the management of recreation resources outside of the Payette River corridors.</td></tr>
<tr><td>Objective</td><td>0924</td><td>Continue to coordinate management and operation of Recreation Fee Demo sites with the BLM.</td></tr>
<tr><td>Objective</td><td>0925</td><td>Improve river access near Banks by expanding parking areas and improving changing rooms to enhance recreation experiences and increase opportunities.</td></tr>
<tr><td>Objective</td><td>0926</td><td>Evaluate Banks Beach area for potential expansion and improvement to enhance river-related recreation opportunities and experiences. Expand existing facilities to accommodate increasing use if possible.</td></tr>
<tr><td>Objective</td><td>0927</td><td>Cooperate with the BLM to develop a river corridor management plan to guide management and development of river-related recreation resources.</td></tr>
<tr><td>Objective</td><td>0928</td><td>Evaluate the Erskine Cabin permit for continuance and type of permit.</td></tr>
<tr><td>Objective</td><td>0929</td><td>Complete vegetation management plans for Banks River Access, Banks Store and Café, Banks Beach, and high-use dispersed sites.</td></tr>
<tr><td>Objective</td><td>0930</td><td>Work with adjacent landowners and partners to develop a management strategy for off trail/road use.</td></tr>
<tr><td>Objective</td><td>0931</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Motorized</td><td>0%</td><td>83%</td></tr>
<tr><td>Roaded Natural</td><td>19%</td><td>17%</td></tr>
<tr><td>Roaded Modified</td><td>81%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="2">Timberland Resources</td><td>Objective</td><td>0932</td><td>Emphasize stocking control and fuels reduction in plantations.</td></tr>
<tr><td>Objective</td><td>0933</td><td>Reduce densities in overstocked stands. Promote early seral species and open stands that can be maintained in a low fire hazard condition in the future in areas where restoration is emphasized within suitable vegetation groups.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	0934	Restore and maintain species composition, structural diversity, and ecosystem processes in all vegetation groups at moderate to high hazard to uncharacteristic wildfire or insect epidemic to make them more resilient and resistant.
Rangeland Resources	Objective	0935	Continue to cooperate with BLM in the national Cooperative Resource Management Plan (CRMP).
	Objective	0936	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Harris Creek and Gardena subwatersheds. Methods to consider include changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Fire Management	Objective	0937	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	0938	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Objective	0939	Coordinate with adjacent land managers (e.g., BLM, state, and counties) to develop compatible wildland fire suppression strategies.
Lands and Special Uses	Objective	0940	Pursue road use cost-share agreement opportunities in the Boise Ridge area to improve recreational access where public and private lands are intermingled.
	Objective	0941	Use land exchange opportunities to convey isolated parcels along Harris Creek on the western edge of the Management Area within the Idaho City Ranger District to improve management efficiency.
	Objective	0942	Continue the authorized special use permit for the Banks Store.
	Objective	0943	Evaluate relocating the State of Idaho Maintenance shed to provide additional parking for recreation needs. If the evaluation identifies viable alternatives to the current location, develop a relocation plan.
Facilities and Roads	Objective	0944	Coordinate maintenance on Roads 634 and 374 with Boise County.
	Objective	0945	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Dry Buck Creek and Harris Creek subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	0946	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Highway 55	1	R	R	PR	R	PR	PR	R	PR	M
Banks to Lowman Highway	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 643	2	M	M	M	M	M	M	M	M	MM
Forest Road 307	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 615	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 374	2	PR	PR	M	PR	M	M	PR	M	MM



Management Area 10. Upper South Fork Payette River Location Map

Management Area 10
Upper South Fork Payette River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 1 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	45
2.2 – Research Natural Areas	1
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	2
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General Location and Description - Management Area 10 is comprised of lands administered by the Boise National Forest within the South Fork Payette River drainage between Lowman and Grandjean, Idaho (see map, opposite page). The area lies in Boise County, and is part of the Lowman Ranger District. The management area is an estimated 232,200 acres, of which the Forest Service administers 99 percent, and 1 percent are privately owned. Most of the private inholdings lie along the South Fork Payette River corridor. The area is bordered by the Boise National Forest to the north, west, and south, and by the Sawtooth National Forest to the east, including the Sawtooth National Recreation Area and Sawtooth Wilderness Area. The primary uses or activities in this management area have been dispersed and developed recreation, timber management, and livestock grazing.

Access - The main access to the area is by paved State Highway 21 from Lowman to Banner Summit. Other access routes include Forest Road 582 up Clear Creek, Forest Road 524 to Grandjean, and Forest Road 594 up Rock Creek. These roads are gravel-surfaced and well-maintained. The density of classified roads in the management area is an estimated 1.3 miles per square mile, and much of the area is roadless. Total road density for area subwatersheds ranges between 0 and 4.1 miles per square mile. The roadless areas have several trails, but large portions are relatively inaccessible.

An estimated 7 miles of the Grandjean Road (Forest Road 524) are scheduled for improvement during the next decade. Planning for this project is still in a very early stage of development so improvement details are not yet known. This road provides access to developed recreation sites in the Grandjean area as well as a major trailhead for the Sawtooth Wilderness.

Special Features – A portion of one eligible Wild and Scenic River, the South Fork Payette River, lies within the management area. The South Fork Payette River has one segment in this area with a Recreational classification, and one with a Scenic classification. The Recreational segment is an estimated 27,4 miles, with a river corridor area of 8,752 acres. The Scenic segment is an estimated 6.5 miles, with a river corridor area of 2,080 acres. The South Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, geologic, hydrologic, and cultural resource values.

The South Fork Payette River offers high-quality rafting and kayaking opportunities, bald eagle habitat, prehistoric and historic cultural resources, and hot springs. The town of Lowman and several summer home subdivisions lie along the river corridor. Highway 21 is the Ponderosa Pine State Scenic Byway, and a National Forest Scenic Byway. The Banks-to-Lowman Highway is also the Wildlife Canyon State Scenic Byway. This area lies adjacent to the Sawtooth National Recreation Area. An estimated 64 percent of the management area is inventoried as roadless, including portions of the Tenmile/Black Warrior, Red Mountain, Deadwood, Grimes Pass and Hanson Lakes Roadless Areas. The Forest has recommended the Tenmile/Black Warrior, Red Mountain, and Hanson Lakes areas for Wilderness designation.

The Monumental Creek Research Natural Area (678 acres) provides a good example of ponderosa pine/Douglas-fir habitat with bitterbrush understory. The Lowman Research Natural Area (380 acres), located one mile southwest of Lowman, preserves features of a ponderosa pine vegetative cover. The Bear Creek Research Natural Area (387 acres), located 3 miles west of Grandjean, exhibits undisturbed sagebrush-grass vegetative features. The Lowman and Bear Creek areas are also being considered as potential National Natural Landmarks.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Boise County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the county was fugitive dust, primarily from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Boise County (less than 100 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,700 feet on the South Fork Payette River to 8,876 feet at Bull Trout Point. Management Area 10 falls primarily within the South Fork Payette Canyon and Streamcut Lands Subsection. The main geomorphic landforms associated with this subsection are strongly and moderately dissected fluvial lands, canyonlands, and frost-churned slopes and canyonlands. Slope gradients average between 45 to 75 percent in the dissected fluvial lands and canyonlands, and 45 to 65 percent in the frost-churned uplands and canyonlands. The surface geology is predominantly Idaho batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from moderate to high, with the majority being high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being high (see table below). This area has naturally unstable slopes and localized impacts from roads, historic livestock grazing, wildfire, and recreation. Natural landslides are common, especially within burned areas. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is in the Lowman, Clear Creek, Warm Springs Creek, Canyon Creek, and Wapiti Watersheds (5th-order hydrologic units) of the South Fork Payette River Subbasin. The major streams in the area are the South Fork Payette River, Clear Creek, Warm Springs Creek, Rock Creek, Eightmile Creek, Canyon Creek, Tenmile Creek, and Wapiti Creek. High mountain lakes include Bull Trout Lake, Zumwalt Lake, and Red Mountain Lakes. The Grandjean subwatershed is part of a state-regulated public water system for the Sawtooth Lodge.

Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). Some areas have localized accelerated sediment from roads and recreation use. These impacts are exacerbated by relatively high rates of natural erosion in the area, including recent landslides. Sediment flushes during spring run-off and summer thunderstorms are common. Eight of the 16 subwatersheds in this area were listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Kirkham, Jackson-Fence, Blue Jay, Wolf, Bear-Camp, Grandjean, Lower Canyon Creek, and Warm Spring. The pollutant of concern for each listed subwatershed is sediment. There are currently no TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
11	5	0	10	3	3	3	12	1	8	0	1

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. The area does, however, have important habitat for threatened bull trout. Bull trout occur throughout this area except for the Rock Creek subwatershed. Strong local populations have been noted in the Upper Clear Creek, Grandjean, Canyon, Tenmile Creek, and Upper Canyon Creek subwatersheds. Fragmented populations of redband trout are also known to occur in this area. Red Mountain Lakes are managed as a high-quality, high-elevation fishery. Aquatic habitat is near proper functioning condition, although some accelerated sediment impacts are occurring from roads, historic livestock grazing, wildfire, and recreation. The Upper Canyon Creek and Lower Canyon Creek subwatersheds have been identified as important to bull trout recovery, and as high-priority areas for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen. Cold forest communities of subalpine fir are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 21 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, Perennial Grass Slopes, and Alpine and Dry Meadows. The main forested vegetation groups in the area are Dry Ponderosa Pine/Xeric Douglas-fir (9 percent), Warm Dry Subalpine Fir (18 percent), Cool Dry Douglas-fir (11 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (18 percent), Cool Moist Douglas-fir (7 percent), High Elevation Subalpine Fir (2 percent), and Persistent Lodgepole Pine (15 percent).

The Mountain Big Sagebrush and Montane Shrub groups are functioning properly, but they are trending toward old age structure, dense canopies, and low levels of herbaceous ground cover due to fire exclusion. Alpine and Dry Meadows are also functioning properly, with minor impacts from dispersed recreation. Perennial Grass Slopes are at moderate risk due to impacts from big game grazing that have altered structure and led to an increase in annual grasses and noxious weeds.

The Cool Moist Douglas-fir, Dry Ponderosa Pine/Xeric Douglas-fir, Warm Dry Douglas-fir/Moist Ponderosa Pine groups are not functioning properly in some areas. Large areas recently burned in high intensity wildfires, which removed many of the large trees and converted old and mid-aged stand structure to open and young stages. Stands that recently burned experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved these groups from non-lethal to lethal fire regimes. These high density and fuel conditions still exist in unburned stands, where fire frequency is occurring at less than historic intervals. In these areas, insect and disease infestations have increased tree mortality and the risk of uncharacteristic large wildfire. These areas also lack young structural stages and seral ponderosa pine.

The Cool Dry Douglas-fir, Warm Dry Subalpine Fir and Persistent Lodgepole Pine groups are functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Late seral subalpine fir is increasing, and seral Douglas-fir, lodgepole pine, and aspen are decreasing. Snags and large woody debris are at low levels in localized areas of the Persistent Lodgepole Pine group due to fuelwood gathering. High Elevation Subalpine Fir is also functioning at risk due to fire exclusion that has allowed natural succession to reach late seral conditions in most areas. Stands are generally old and dense, with increasing subalpine fir and decreasing whitebark pine. Whitebark pine is also being lost to blister rust in many areas. The Clear Creek (5th code HUC 1705012007) and Wapiti (5th code HUC 1705012008) watersheds are high priority for passive restoration to increase landscape and stand diversity. The Warm Spring (5th code HUC 1705012009) and Canyon Creek (5th code HUC 1705012010) watersheds are high priority for whitebark pine restoration particularly in the areas affected by recent wildland fires.

Riparian vegetation is not functioning properly in some areas due to a number of impacts. Fire exclusion in some areas has resulted in conifer trees replacing broadleaf shrubs and cottonwoods. Large wildfires in other areas have burned the tree component, removing shade, cover, and seed source. Introduced plant species and noxious weeds have increased with increasing roads and recreation use.

Botanical Resources – Region 4 Sensitive species known from this management area include Idaho Douglasia and giant helleborine orchid. Kellogg's bitterroot and pale sedge, proposed Region 4 Sensitive species, occur in the area. Swamp onion and Buxbaum's sedge, Region 4 Watch species, also occurs in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Dalmatian toadflax, rush skeletonweed, diffuse and spotted knapweed, Canada thistle, St. Johnswort, and tansy ragwort occur in the area, particularly along the main road corridors. An estimated 67 percent of the area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weeds of concern are rush skeletonweed, Dalmatian toadflax, and spotted knapweed, which currently occur in scattered small and large populations.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Kirkham Creek	Yes	No	Yes	No	No
Lower Clear Creek	Yes	No	Yes	No	No
Lick Creek	Yes	No	No	No	No
Jackson-Fence	No	No	Yes	No	No
Rock Creek	No	No	Yes	No	No

Wildlife Resources—Warm ponderosa pine and Douglas-fir forests along the South Fork Payette River provide habitat for white-headed woodpecker and flammulated owl, wintering habitat for bald eagles, and winter range for deer, elk, and mountain goat. Forests at lower and mid-elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl. Nesting habitat for peregrine falcon and golden eagles occurs in isolated areas with rocky bluffs. High-elevation forests provide habitat for great gray owls, fisher, boreal owls, and many migratory landbirds, as well as summer range for mammals such as deer, elk, black bear, and mountain goat. Wolves are present in this Management Area.

One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays the majority of this Management Area: Boise River. Terrestrial habitat is not functioning properly in areas that have been affected by recent large wildfires. Impacts include loss of large trees, old forest structure, hiding and thermal cover, and migration and travel corridors. The Lowman watershed (5th code HUC 1705012006) has been identified as important to the recovery of Forest sensitive species and other native wildlife utilizing late-seral forests with low canopy conditions, and has been identified as a short-term high-priority area for restoration. In addition, the Clear Creek watershed (5th code HUC 1705012007) has been identified as important to the sustainability of

Forest sensitive species and other native wildlife affected by human uses on the landscape. This watershed is identified as a short-term high priority area for subsequent site-specific investigations at a finer scale.

Recreation Resources - The Idaho State-designated Ponderosa Pine Scenic Byway lies partly within this management area. The South Fork Payette River corridor features river-oriented recreation, with rafting, kayaking, and fishing as the major uses. There are also four developed campgrounds in the corridor, one in the Clear Creek drainage, and one at Bull Trout Lake. Dispersed recreation in the rest of the management area includes hiking, hunting, camping, fishing, ATV use, snowmobiling, and horseback riding hiking. Trails in the Tenmile/Black Warrior and Red Mountain recommended wilderness areas feature non-motorized recreation in a semi-primitive setting. Much of the use in this area comes from the Treasure Valley, although recreationists come from around the country and world to raft and kayak the South Fork Payette River. A recreation fee for parking along the South Fork Payette River is now charged river users. This area is in Idaho Fish and Game Management Units 33 and 35. Recreation special uses include several river-running outfitter and guide operations and recreation residence tracts (Long Creek, Camp Creek, Bear Creek, and Wapiti Creek) found in the South Fork Payette River corridor and along Clear Creek.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Mining, Transportation, Forest Service History, Settlement, Timber Industry, and the CCC. This area contains prehistoric sites significant to our understanding of early Indian uses in the South Fork drainage. Salmon fishing was an important seasonal use of the river by groups such as the Northern Paiute and Shoshone. Radiocarbon dates from fire hearths excavated in Deadwood Campground indicate that the area was inhabited as early as two thousand years ago. Miners periodically worked and camped at the mouth of the Deadwood River between 1863 through the 1920s. Between 1900 and 1904, Idaho City miners improved the Clear Creek Road as their favorite route to the Thunder Mountain gold camps. Early ranger and guard stations were built at Lowman (1908) and Warm Springs (1913). Forest officers supervised settlement on South Fork Payette River terraces under the 1906 Forest Homestead Act, and logging in Clear Creek and other tributaries during the 1920s and 1930s. During the 1930s, CCC crews replaced log buildings at Warm Springs Guard Station with new structures, and built campgrounds along the river, including a bathhouse at Kirkham Hot Springs.

Timberland Resources—Of the estimated 156,300 tentatively suited acres in this management area, 43,900 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 8 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 4.2 and 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 1.2, 2.2, 3.2, and 4.1c are identified as not suited for timber production. Timber management has been emphasized in the Clear Creek and Rock Creek drainages. No management activities are planned for the three recommended wilderness areas. Past management activities have been relatively high in the Clear Creek and Rock Creek drainages, and low or non-existent elsewhere. Forest products such as fuelwood, posts, poles and Christmas trees are collected in designated areas.

Rangeland Resources - This area has portions of one cattle and four sheep allotments. All five allotments are vacant. Management Area 10 provides an estimated 15,700 acres of capable rangeland. These acres represent about 4 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open for mineral activities and exploration. The potential for locatable minerals is moderate to high, as is the potential for leasable geothermal resources. The potential for other leasable resources or common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels and enhance big game winter range. Over the past 20 years there have been approximately 320 fire starts in the management area, 75 percent of which are started by lightning. Large wildfires that have occurred in the last 20 years include the Lowman Complex (1989), Willis Gulch (1988), County Line (1992), Canyon Creek (2003) and Red Mountain (2006). Of these large fires, three of the five were human-caused. Since 1988, about 39 percent of the management area has been burned by wildfire. Portions of the management area are in the Forest's wildland fire use planning area.

Lowman is a National Fire Plan community and Highway 21 corridor from Lowman toward the Grandjean and including Grandjean and the surrounding summer home areas as well as the Long Creek Summer Home area are considered wildland-urban interface areas due to private development adjacent to and within the Forest. The subwatersheds that include these wildland-urban interface areas as well as Upper Clear Creek are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 19 percent lethal, 48 percent mixed1 or 2, and 33 percent non-lethal. An estimated 16 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 36 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special-use authorizations are issued for two utility corridors to private inholdings. The Jackson Peak and Lowman, Eugene T.V. designated communications sites are located within the area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	1001	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	1002	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	1003	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	1004	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	1005	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1006	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
Eligible Wild and Scenic Rivers	General Standard	1007	Manage the South Fork Payette River eligible river corridor to its assigned classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	1077	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1008	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as Outstandingly Remarkable Values (ORVs) are maintained within the river corridor.
	Fire Guideline	1009	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor
	Fire Guideline	1010	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/ResourceArea	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1011	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1012	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1078	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	1013	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1014	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/ResourceArea	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1015	Management actions—including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1079	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1016	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1017	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 4.2 Roaded Recreation Emphasis	Vegetation Standard	1080	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional smaller snags where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	1018	Vegetation management actions—including wildland fire use, prescribed fire, and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.
	Vegetation Guideline	1081	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/ResourceArea	Direction	Number	Management Direction Description
	Fire Guideline	1019	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1082	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional smaller snags where available to meet the maximum total number snags per acre depicted in Table A-6.[5]
	Road Standard	1020	New roads and landings shall be located outside of RCAs in the MPC 5.1 portions of the Upper Clear Creek, Grandjean and Tenmile subwatersheds unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, any new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, any new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	1021	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	1083	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1022	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

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[5] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/ResourceArea	Direction	Number	Management Direction Description
	Road Guideline	1023	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	1084	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Standard	1024	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1025	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1026	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1027	Initiate restoration of watershed conditions and fish habitat in the Canyon Creek, Tenmile Creek, Clear Creek, Bear Creek, Grand Jean, and Rock Creek subwatersheds to help strengthen listed fish species populations.
	Objective	1028	Maintain or improve migratory bull trout habitat in Clear Creek.
	Objective	1029	Maintain and restore habitat connectivity throughout the upper South Fork Payette drainage for bull trout, redband trout, and other fish species.
	Objective	1030	Work with Idaho State Transportation Department to reduce road-related sediment in order to protect the existing strong local bull trout population in Upper Canyon Creek subwatershed.
	Objective	1031	Evaluate riparian conservation areas within the Lowman burn to determine opportunities to restore the large wood component by planting hardwoods or conifers, or other means.
	Objective	1032	Survey roads and culverts to determine options to reduce sediment and restore fish passage. The highest priority survey areas are in the Clear Creek and Rock Creek drainages.
Vegetation	Objective	1033	Restore patch size and structural diversity in PVG4 (Cool Dry Douglas-fir), PVG7 (Warm Dry Subalpine Fir), PVG10 (Persistent Lodgepole Pine) and PVG11 (High Elevation Subalpine Fir) in the Clear Creek (5th code HUC 17050112007) and Wapiti (5th code HUC 17050112008) watersheds.

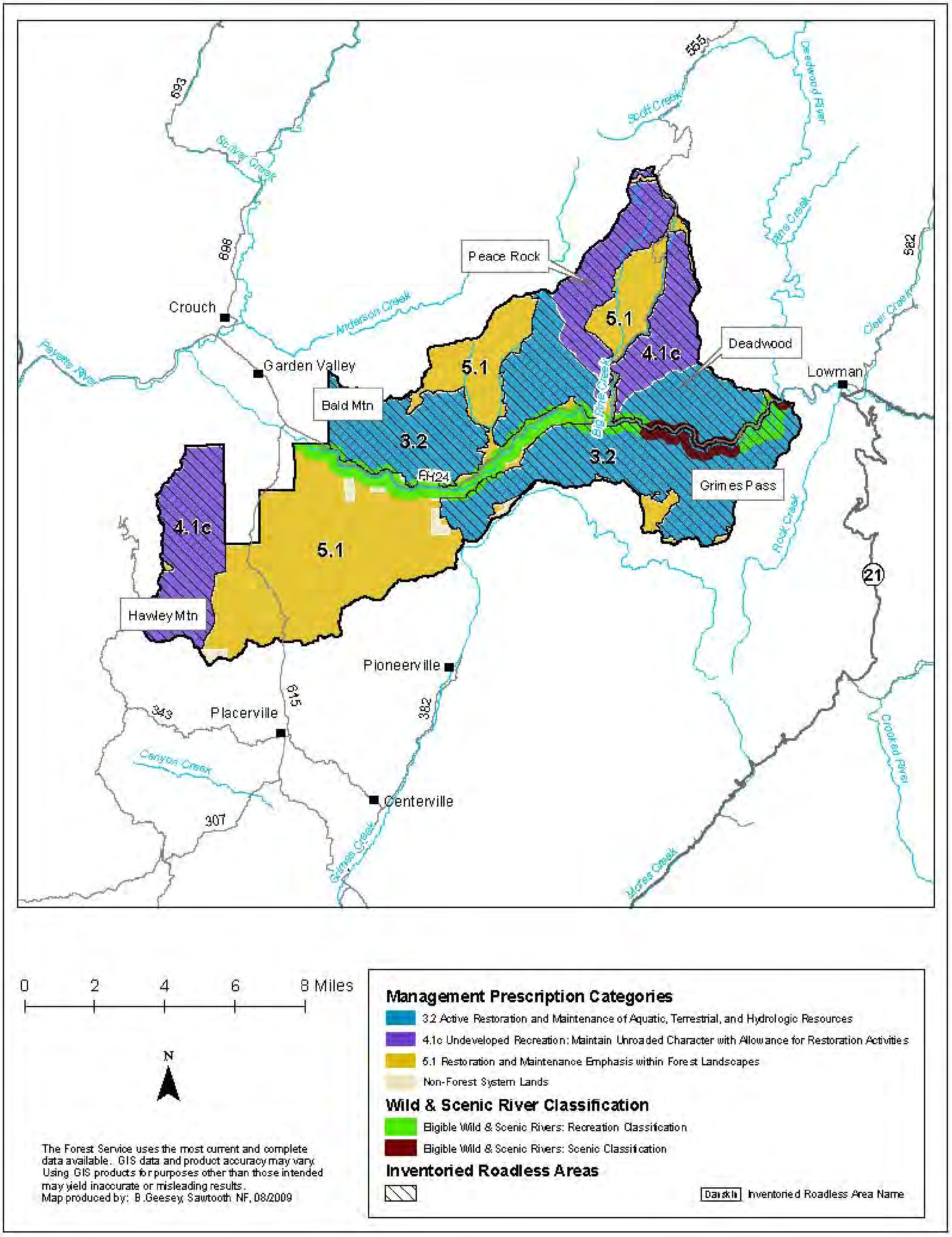
MPC/ResourceArea	Direction	Number	Management Direction Description
	Objective	1034	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group as described in Appendix A in the Warm Spring (5th code HUC 17050112009) and Canyon Creek (5th code HUC 17050112010) watersheds.
	Objective	1035	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1036	Maintain or restore riparian vegetation within selected areas along the South Fork Payette River to improve water quality, wildlife habitat, and the recreational setting. Where vegetation is trending toward climax in riparian areas, restore early seral components to improve regeneration and diversity.
Botanical Resources	Objective	1037	Consider establishing the Bull Trout Lake Fen as a Botanical Special Interest Area due to the presence of unique wetland habitats and plant species of concern.
	Objective	1038	Provide for and interpret sensitive wetland habitats and associated plant species of concern at the Bull Trout Lake Fen.
	Objective	1039	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, Kellogg's bitterroot, and pale sedge, to contribute to the long-term viability of these species.
	Standard	1040	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	1041	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
Wildlife Resources	Objective	1042	Maintain or restore bald eagle wintering habitat along the South Fork Payette River corridor, with emphasis on retaining or increasing large tree and snag components.
	Objective	1043	Improve big-game winter range by restoring Mountain Big Sage and Montane Shrub vegetation groups along the South Fork Payette River corridor. Emphasize increasing native plant forage by reducing noxious weeds.
	Objective	1044	Encourage recovery of conifer species in recently burned areas to restore wildlife habitat diversity and cover.
	Objective	1085	Focus source habitat restoration activities within the Lowman watershed (5th code HUC 17050112006) in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (Refer to Conservation Principles 2 and 3 in Appendix E).
	Objective	1086	Reduce open road densities in the Lowman watershed (5th code HUC 17050112006) where it is determined that they limit use of source habitats by wildlife species identified as TEPC or R4 Regionally Sensitive. (Refer to Conservation Principles 5 and 6 in Appendix E.)

MPC/ResourceArea	Direction	Number	Management Direction Description
	Guideline	1087	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Lowman watershed (5th code HUC 17050112006) should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (Refer to Conservation Principles 1, 4, and 5 in Appendix E.)
	Objective	1088	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the priority Clear Creek watershed (5th code HUC 17050112007). (Refer to Conservation Principle 6 in Appendix E.)
Recreation Resources	Objective	1045	Increase recreation opportunities for more diverse trail experiences to meet increasing demand for these experiences.
	Objective	1046	Provide trailhead access and information pertaining to the Sawtooth Wilderness to enhance recreation opportunities.
	Objective	1047	Where existing recreation facilities and dispersed recreation sites are adversely affecting riparian vegetation, restore or improve vegetation through site hardening or relocation, or other means.
	Objective	1048	Evaluate dispersed recreation uses in the Bear Creek area, and develop a management plan to reduce resource impacts and improve recreation experiences.
	Objective	1049	Evaluate and develop plans to create “day-use” picnic sites along the Highway 21 corridor to expand recreation opportunities in this high use corridor.
	Objective	1050	Continue the dispersed site management along the South Fork Payette River and Highway 21 corridor to maintain a range of recreation opportunities.
	Objective	1051	Rehabilitate the vegetation around the Tenmile fish pond site to enhance recreation experiences.
	Objective	1052	Evaluate ATV use in the Wapiti Creek area, and develop a plan to manage ATV use to reduce resource impacts.
	Objective	1053	Maintain current motorized and mechanized travel routes within the recommended wilderness areas.
	Objective	1054	Evaluate and develop a plan for a motorized trail extension of the Kirkham Trail that ties into the Deadwood trail system to enhance motorized recreation opportunities.
	Objective	1055	Continue use by recreation residences within established recreation residence tracts.

<table>
<tr><th>MPC/ResourceArea</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1056</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>41%</td><td>1%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>21%</td><td>88%</td></tr>
<tr><td>Roaded Natural</td><td>17%</td><td>11%</td></tr>
<tr><td>Roaded Modified</td><td>21%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td></td><td>Guideline</td><td>1057</td><td>Facilitate and participate in the development of a Scenic Byway Corridor Management Plan for the Ponderosa Pine Scenic Byway with local government agencies and other partners.</td></tr>
<tr><td>Cultural Resources</td><td>Objective</td><td>1058</td><td>Maintain the National Register status of eligible properties including the Warm Springs Guard Station, which is on the Forest’s cabin rental program. Consider nominating Warm Springs Guard Station to the NRHP.</td></tr>
<tr><td></td><td>Objective</td><td>1059</td><td>Conduct an inventory to identify historic properties on Canyon and Warm Springs Creeks.</td></tr>
<tr><td></td><td>Objective</td><td>1060</td><td>Develop a maintenance plan to protect the historic character of Warm Springs Guard Station, and provide interpretation for visitors using the facility.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>1061</td><td>Evaluate and schedule timber stand improvements within the Lowman Fire areas to maintain desired vegetation structures.</td></tr>
<tr><td></td><td>Objective</td><td>1062</td><td>Emphasize restoration treatments in the Rock Creek, Clear Creek, and Upper South Fork Payette River drainages, and adjacent to urban/interface areas along Highway 21.</td></tr>
<tr><td></td><td>Objective</td><td>1063</td><td>Continue to work with Idaho Department of Transportation to treat hazard trees along Highway 21 in the Canyon Creek area.</td></tr>
<tr><td></td><td>Objective</td><td>1064</td><td>Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Kirkham Creek, Jackson-Fence, Rock Creek, and Lower Clear Creek subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.</td></tr>
<tr><td></td><td>Guideline</td><td>1065</td><td>Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Kirkham Creek, Jackson-Fence, Rock Creek, and Lower Clear Creek subwatersheds.</td></tr>
<tr><td>Rangeland Resources</td><td>Objective</td><td>1066</td><td>Initiate and complete procedures to close the existing Bull Trout Sheep and Goat Allotment due to economic considerations.</td></tr>
</table>

MPC/ResourceArea	Direction	Number	Management Direction Description
Fire Management	Objective	1067	Identify areas appropriate for Wildland Fire Use, focusing on the Red Mountain Lakes area, Tenmile Creek, Hanson addition, and upper reaches of Bear and Wapiti Creeks. Use wildland fire in these areas to restore or maintain desired vegetative conditions and to reduce fuels.
	Objective	1068	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1069	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
	Guideline	1070	Coordinate with the Sawtooth National Forest to develop compatible wildland fire suppression and wildland fire use strategies.
Facilities and Roads	Objective	1071	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Kirkham Creek, Lower Clear Creek, and Wolf Creek subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
	Objective	1072	Improve substandard facilities at Warm Springs Guard Station to reduce health and safety concerns.
	Guideline	1073	Cooperate with Idaho Department of Transportation to keep Highway 21 open year-round north of Lowman, and to maintain Highway 21 corridor (e.g., waste sites, road maintenance, hazard tree removal, etc.). Continue to cooperate with the Transportation Department for avalanche detection and control within recommended wilderness areas.
Special Features	Objective	1074	Manage hot springs as recreational opportunities, while maintaining their natural integrity.
	Guideline	1075	Activities and developments adjacent to the Sawtooth National Recreation Area that would compromise its scenic and recreational values should be avoided.
Scenic Environment	Standard	1076	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Ten Mile-Black Warrior Recommended Wilderness	1	P	P	P	P	P	P	P	P	P
Red Mountain Recommended Wilderness	1	P	P	P	P	P	P	P	P	P
Highway 21	1	R	R	PR	PR	PR	PR	R	PR	M
South Fork Payette River	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 520, 025UB	1	R	R	PR	R	PR	PR	R	PR	M
Deadwood, Mountain View, Helende, Bonneville, Bull Trout Lake Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Kirkham and Park Creek Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 144, 145, 147, 149, 016, 018, 142, 143, 146, 148, 151, 157, 159, 160	2	PR	PR	M	PR	M	M	PR	M	MM
Camp Creek, Bear Creek, Long Creek, Wapiti, and Lowman summer homes	1	PR	PR	PR	R	PR	PR	R	PR	M
Jackson Peak Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 531, 582	2	PR	PR	M	PR	M	M	PR	M	MM



Management Area 11. Lower South Fork Payette River Location Map

Management Area 11
Lower South Fork Payette River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 11 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	39
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	22
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	39

General Location and Description - Management Area 11 is comprised of lands administered by the Boise National Forest in the South Fork Payette River drainage between Garden Valley and Lowman, Idaho (see map, opposite page). The area lies in Boise County, and is part of the Emmett Ranger District. The management area is an estimated 65,900 acres, of which the Forest Service administers 98 percent, and 2 percent are privately owned. Most of the private inholdings lie along the South Fork Payette River corridor. The area is bordered by Boise National Forest to the north, east, and south, and by a mix of private (Garden Valley), BLM, and State lands to the west. The primary uses or activities in this area have been dispersed and developed recreation, timber management, and livestock grazing.

Access - The main access to the area is by paved State Highway 17 from Banks to Lowman along the South Fork Payette River. Other access routes include Forest Road 555 up Big Pine Creek and Forest Road 382 from the South Fork Payette River to Pioneerville. These are well maintained and gravel-surfaced roads. The density of classified roads for the management area is 1.5 miles per square mile, and over half the area is inventoried as roadless. Total road density for area subwatersheds ranges between 0 and 4.1 miles per square mile. There are no major trails in the area.

Special Features – A portion of one eligible Wild and Scenic River, the South Fork Payette River, falls within the management area. The river has one segment in the area with a Recreational classification, and one with a Scenic classification. The Recreational segment is an estimated 16.8 miles, with a river corridor area or 5,390 acres. The Scenic segment is an estimated 3.1 miles, with a river corridor area of 988 acres. The South Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, geologic, and cultural resource values.

The Idaho-designated Wildlife Canyon Scenic Byway lies partly within this management area. The South Fork Payette River offers high quality rafting and kayaking opportunities, winter bald eagle habitat, prehistoric and historic cultural resources, and hot springs. An estimated 59 percent of the management area is inventoried as roadless, including most of the Bald Mountain, Hawley Mountain, and Grimes Pass Roadless Areas, and small portions of the Peace Rock and Deadwood Roadless Areas.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Boise County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the Airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the county was fugitive dust, primarily from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Boise County (less than 100 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 3,100 feet on the South Fork Payette River to 7,600 feet near Deadwood Lookout. Management Area 11 falls primarily within the South Fork Payette Canyon and Streamcut Lands Subsection. The main geomorphic landforms associated with this subsection are strongly and moderately dissected fluvial lands, canyon lands, and frost-churned slopes and canyonlands. Slope gradients average between 45 to 75 percent in the dissected fluvial lands and canyon lands, and 45 to 65 percent in the frost-churned uplands and canyon lands. The surface geology is predominantly Idaho Batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from moderate to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being low (see table below). Localized areas have impacts due to roads, timber harvest, livestock grazing, and recreation uses that have generated accelerated erosion, stream channel modification, and streambank degradation.

The management area is in the Garden Valley and Big Pine Creek Watersheds in the lower portion of the South Fork Payette River Subbasin. The major streams in the area are the South Fork Payette River, Big Pine Creek, Alder Creek, and Horn Creek. There are no lakes or reservoirs in this management area. The Lower South Fork Payette River subwatershed is part of a state-regulated public water system for the community of Horseshoe Bend. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below). Localized areas have impacts from roads, timber harvest, livestock grazing, and recreation that have increased sedimentation and nutrient levels. Two of the five subwatersheds in this area were listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Danskin-Poorman and Hole-In-The-Wall. Sediment was the pollutant of concern for both subwatersheds. There are currently no TMDL-assigned watersheds associated with this area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
2	3	0	0	4	1	1	3	1	2	0	1

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. The South Fork Payette River serves as an important over-wintering and migratory corridor for the threatened bull trout. Bull trout have been found in the Hole in the Wall subwatershed, redband trout in the Big Pine subwatershed, and both species in the Danskin-Poorman subwatershed. Aquatic habitat is functioning at risk in localized areas due to water quality impacts described above. Native fish populations are at risk due to the presence of non-native species.

Vegetation—Vegetation at lower elevations is typically grasslands, shrublands, ponderosa pine, and Douglas-fir on south and west aspects, and Douglas-fir forests on north and east aspects. Mid and upper elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of lodgepole pine and aspen.

An estimated 22 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes. The main forested vegetation groups in the area are Dry Ponderosa Pine/Xeric Douglas-fir (4 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (45 percent), Cool Moist Douglas-fir (11 percent), and Cool Dry Douglas-fir (11 percent).

The Mountain Big Sage and Montane Shrub groups are functioning properly, with only minor impacts from past livestock grazing. The Perennial Grass Slopes and Perennial Grass Montane groups are at or near properly functioning condition; however, past grazing impacts and introduced species have altered composition and structure in localized areas. Rush skeletonweed and other noxious weeds are increasing.

The Dry Ponderosa Pine/Xeric Douglas-fir, Cool Moist Douglas-fir, and the Cool Dry Douglas-fir groups are functioning at risk, and the Warm Dry Douglas-fir/Moist Ponderosa Pine group is not functioning properly due primarily to timber harvest and fire exclusion that have altered stand composition and structure. In managed areas, stands are dominantly young and mid-aged, with limited large trees, snags, and large woody debris. In unmanaged and unburned areas, stands have more Douglas-fir and less seral ponderosa pine and aspen than is desirable, and moderate to high levels of insect and disease infestations. Large-tree, single-storied stand structure is lacking. Noxious weeds and introduced species are increasing in the understory. Both watersheds in the management area are high priority for active management to restore the large tree size class.

Riparian vegetation is generally functioning properly, but localized impacts have occurred from timber harvest, roads, recreation, and livestock grazing. Noxious weeds and introduced plant species are increasing.

Botanical Resources – Giant helleborine orchid and Idaho douglasia, Region 4 Sensitive species, are known from this management area. Swamp onion, a Region 4 Watch species, also occurs in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Dalmatian toadflax, spotted knapweed, Canada thistle, rush skeletonweed, and purple loosestrife occur in the area, particularly along the main road corridors. An estimated 67 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weeds of concern are rush skeletonweed and Dalmatian toadflax, which currently occur in scattered populations.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Big Pine Creek	No	No	Yes	No	No
Lower South Fork Payette	Yes	Yes	Yes	No	No
Danskin-Poorman	Yes	Yes	Yes	No	No
Alder Creek	Yes	Yes	No	No	No

Wildlife Resources—The riparian corridor along the South Fork Payette River provides wintering habitat for bald eagles. Warm ponderosa pine and Douglas-fir forests along the South Fork Payette River provide habitat for white-headed woodpecker and flammulated owl, and extensive winter range for deer and elk. Low- to mid-elevation forests provide habitat for Region 4 sensitive species, goshawk and great gray owl. Nesting habitat for peregrine falcon and golden eagles occurs in isolated areas with rocky bluffs. High-elevation forests provide habitat for fisher and boreal owls, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. Wolves are present in this area. All habitats provide nesting and forage for migratory landbirds. Terrestrial wildlife habitat is functioning at risk due to habitat changes from timber harvest and fire suppression, fragmentation from roads and harvest, and disturbance from recreation uses. Winter range along the south slopes of the South Fork Payette River is in poor condition due to past livestock use and noxious weed infestations.

Recreation Resources - Recreation in this management area is largely river-oriented, with rafting, kayaking, recreation dredge mining, and fishing as the major uses. A recreation fee for parking along the South Fork Payette River is now charged at designated sites. Big-game hunting is popular in the fall. Developed sites include Hot Springs and Pine Flats Campgrounds, and the Danskin River Access area. Dispersed recreation includes river-running, hunting, fishing, ATV use, and snowmobiling. Much of the use in this area comes from the Treasure

Valley, although recreationists come from around the world for the rafting and kayaking experience. The area is in Idaho Fish and Game Management Unit 33. Recreation special uses include several river-running outfitter and guide operations, and trail-ride outfitter and guides.

Cultural Resources - Cultural themes in the area include Prehistoric Archaeology, Mining, Agriculture, Ranching, Timber, Forest Service History, and the CCC. This area contains prehistoric sites significant to our understanding of Indian uses of the Payette River system. In 1993 archaeologists excavated a fishing site at Big Falls Portage. Blood residue analysis from one of the stone points tested positive for trout antiserum that cross reacts with steelhead trout and chinook salmon. Historically, the lower South Fork area was an agricultural and livestock supply center for mining camps in Boise Basin. Commercial export loggers entered the drainage in the early 1900s. They transported timber from the area by driving the logs downstream. Between 1906 and 1943, the Grimes Pass Dam generated power for dredges in Boise Basin. Forest rangers established the Garden Valley Ranger Station in 1908, the Gallagher Flat Ranger Station in 1911, and extended the South Fork Payette River Road from Grimes Pass to Lowman in 1916. The CCC operated a large, year- round camp on Gallagher Flat from 1933 to 1939. They replaced the older structures at the ranger stations, and built a new ranger station where the Garden Valley Work Center is today. They improved the Banks-Lowman Road, and developed the Hot Springs and Pine Flat Campgrounds.

Timberland Resources - Of the estimated 47,100 tentatively suited acres in this management area, 15,800 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 3 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPCs 5.1 and 6.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 3.2 and 4.1c are identified as not suited for timber production. Timber management has occurred outside of the South Fork Payette River corridor. About half of these acres have received a fairly high level of timber management in the past. Fuelwood, posts, poles, and Christmas trees are collected in designated areas.

Rangeland Resources - This area has portions of two cattle and two sheep allotments. Management Area 11 provides an estimated 6,800 acres of capable rangeland. These acres represent about 2 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open for mineral activities and exploration. The potential for locatable minerals is moderate to high, as is the potential for leasable geothermal resources. The potential for other leasable resources or common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels and enhance big game winter range. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years there were approximately 100 fire starts, over 70 percent of which were lightning-caused. Since 1988, only two percent of the management area has been affected by wildfire. Garden Valley is a National Fire Plan community and the areas around Garden Valley along Highway 17, north toward Crouch and south toward Alder Creek and Grimes Pass are considered wildland-urban interface areas due to private development adjacent to the Forest. Subwatersheds that include the wildland-urban interface are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 3 percent lethal, 34 percent mixed1 or 2, and 63 percent non-lethal. An estimated 41 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 29 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special use authorizations include two utility corridors and numerous private water transmission lines.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	1101	Manage the South Fork Payette River eligible river corridor to its assigned classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	new	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1102	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as Outstandingly Remarkable Values (ORVs) are maintained within the river corridor.
	Fire Guideline	1103	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	1104	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1105	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1106	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	new	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6. [2]
	Road Standard	1107	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1108	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1109	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	new	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1110	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1111	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	new	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Vegetation Guideline	1112	The full range of treatment activities, except wildland fire use, may be used to restore or maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	new	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1113	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	1114	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	new	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	1115	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1116	Deleted, as pasrt of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1117	Improve water quality by reducing accelerated sediment from existing roads in the Big Pine Creek (Scott Mountain Road), Danskin Creek, and Alder Creek drainages.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

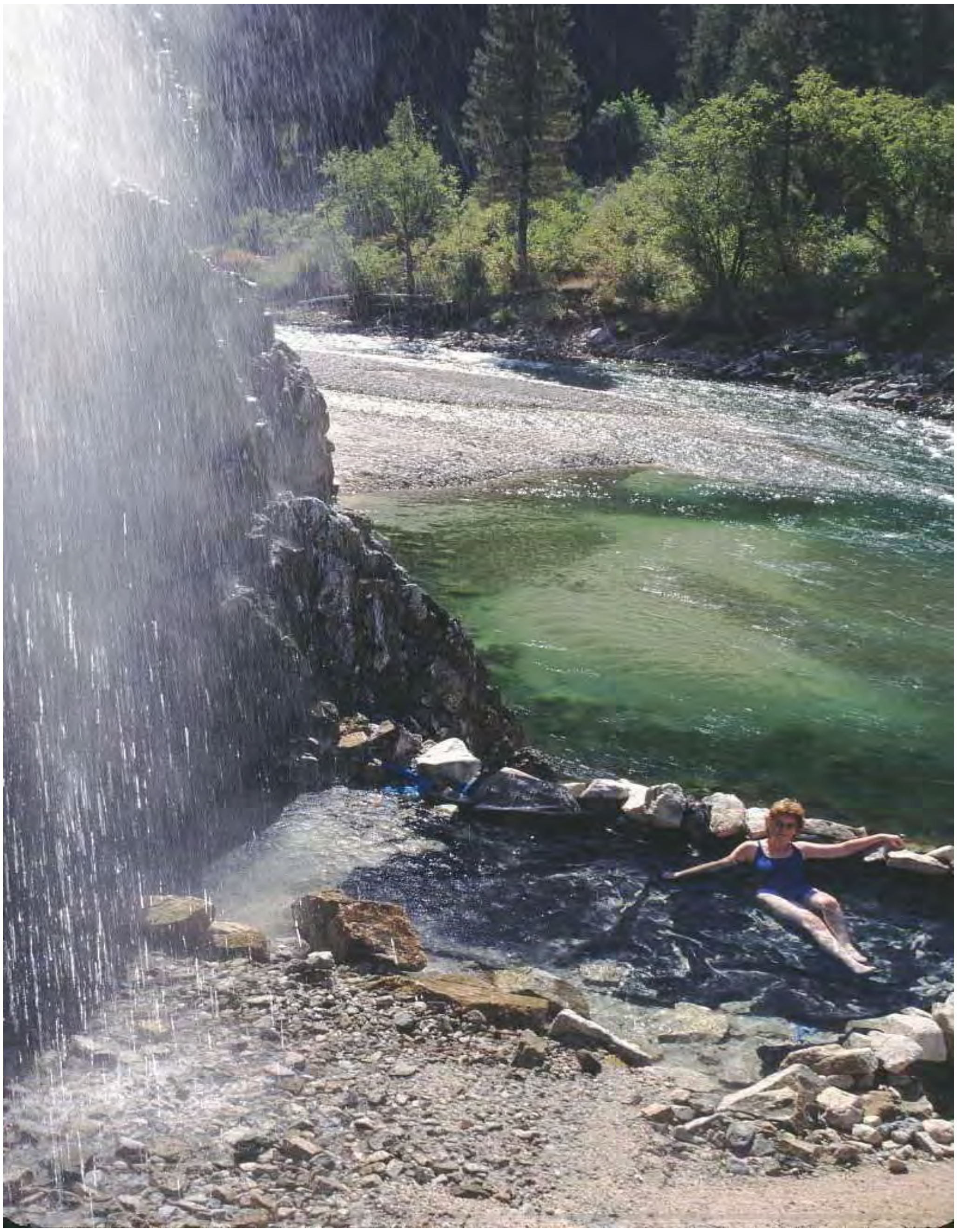
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1118	Evaluate opportunities to reduce accelerated erosion from natural and human-caused disturbance, initial focus should be in the Danskin area.
	Objective	1119	Work with Boise County to evaluate culvert on Forest Highway 17 at Danskin Creek to determine if there is a fish passage barrier and, if so, identify options for improvement.
	Objective	1120	Restore fish passage from the South Fork Payette River to Danskin Creek to restore connectivity of native fish populations.
	Objective	1121	Maintain the South Fork Payette River as a migratory corridor for bull trout.
Vegetation	Objective	1122	Restore PVG1 (Dry Ponderosa Pine/Xeric Douglas-fir), PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine) and PVG3 (Cool, Moist Douglas-fir) vegetation groups as described in Appendix A emphasizing the large tree size class in both watersheds in the management area.
	Objective	1123	Manage vegetation in riparian areas reduce the threat of uncharacteristic wildfire.
Botanical Resources	Objective	1124	Maintain or restore known populations and occupied habitats of TEPCS plant species, including giant helleborine orchid and Idaho douglasia, to contribute to the long-term viability of these species.
Non-native Plants	Objective	1125	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
Wildlife Resources	Objective	1126	Improve big-game winter range by restoring Mountain Big Sage and Montane Shrub vegetation groups along the South Fork Payette River corridor. Emphasize increasing native plant forage by reducing noxious weeds.
	Objective	1127	Improve wildlife habitat by increasing the aspen component.
	Objective	1128	Maintain or restore bald eagle wintering habitat along the South Fork Payette River corridor, with emphasis on retaining or increasing large tree and snag components.
Recreation Resources	Objective	1129	Manage the South Fork Payette River corridor to provide access for river users.
	Objective	1130	Develop a river corridor management plan that would address issues such as river access, sanitation facilities, effects on adjacent privately owned lands, dispersed recreation use impacts to other resources, and interpretive and educational signing.
	Objective	1131	Facilitate and participate in the development of a Scenic Byway Corridor Management Plan for the Wildlife Canyon Scenic Byway with local government agencies and other partners.
	Objective	1132	Work with outfitters and guides to improve river use ethics.
	Objective	1133	Complete vegetation management plans for developed sites and heavily used dispersed sites.
	Objective	1134	Continue to coordinate with groups, such as the Wildlife Corridor Group and Idaho Fish and Game, to enhance wildlife viewing opportunities and habitat.
	Objective	1135	Assess the Scott Mountain Road for needed improvement to enhance recreational travel.

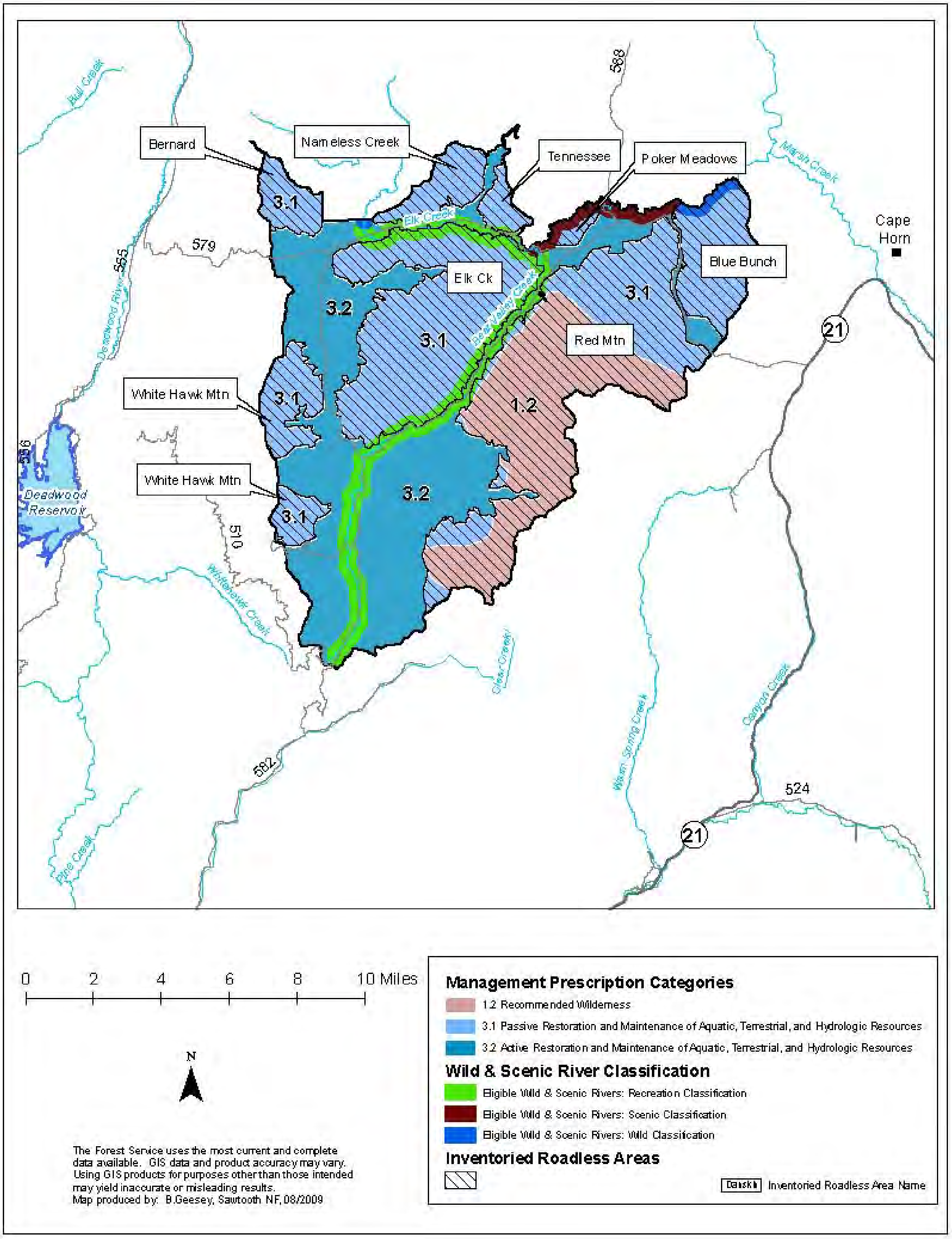
<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="4"></td><td>Objective</td><td>1136</td><td>Work with local landowners and groups to resolve conflicts with dispersed camping on the south side of the Payette River.</td></tr>
<tr><td>Objective</td><td>1137</td><td>Improve the portage trail around Big Falls to enhance recreation experiences enhance user safety.</td></tr>
<tr><td>Objective</td><td>1138</td><td>Develop management plans for the hot springs near Hot Springs Campground and Pine Flat Hot Springs to enhance recreation experiences at these popular sites.</td></tr>
<tr><td>Objective</td><td>1139</td><td>Develop trail management plans to guide trail maintenance activities.</td></tr>
<tr><td>Recreation Resources</td><td>Objective</td><td>1140</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>13%</td><td>24%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>9%</td><td>56%</td></tr>
<tr><td>Roaded Natural</td><td>27%</td><td>20%</td></tr>
<tr><td>Roaded Modified</td><td>51%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="4">Cultural Resources</td><td>Objective</td><td>1141</td><td>Maintain the National Register status of eligible properties. Monitor the conditions of Big Falls Portage and other National Register eligible properties in the management area.</td></tr>
<tr><td>Objective</td><td>1142</td><td>Work with outfitters and guides on the river to increase the public’s awareness of and appreciation for cultural resources protection. Provide outfitters and guides with interpretive information about the people and events that shaped the area’s history.</td></tr>
<tr><td>Objective</td><td>1143</td><td>Conduct a sample inventory to identify historic properties in tributary drainages feeding the South Fork Payette River.</td></tr>
<tr><td>Objective</td><td>1144</td><td>Develop a management plan and interpretation for Big Falls Portage to resolve adverse effects to the prehistoric site from erosion, unauthorized artifact collection, and the lack of sanitation facilities.</td></tr>
<tr><td rowspan="5">Timberland Resources</td><td>Objective</td><td>1145</td><td>Manage unsuited timberlands to restore and maintain big-game winter range conditions.</td></tr>
<tr><td>Objective</td><td>1146</td><td>Manage suited timberlands to provide tree densities that provide protection from uncharacteristic wildfire and insect epidemics, while contributing wood products and improving growth and vigor.</td></tr>
<tr><td>Objective</td><td>1147</td><td>Manage suited timberlands to emphasize stocking control and fuels reduction in older plantations.</td></tr>
<tr><td>Objective</td><td>1148</td><td>Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Lower South Fork Payette River, Danskin-Poorman, and Pig Pine Creek subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.</td></tr>
<tr><td>Guideline</td><td>1149</td><td>Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Lower South Fork Payette River, Danskin-Poorman, and Pig Pine Creek subwatersheds.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Rangeland Resources	Objective	1150	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Lower South Fork Payette, Danskin-Poorman, and Alder Creek subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Mineral Resources	Objective	1151	Evaluate the mill site in Big Pine Creek for restoration opportunities.
	Objective	1152	Survey, locate, and evaluate old mining sites for restoration and reclamation opportunities.
Fire Management	Objective	1153	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1154	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
Lands and Special Uses	Objective	1155	Develop a plan to reduce the backlog of known trespass cases throughout the management area.
	Objective	1156	Dispose of the dwelling and outbuildings on the former Ford property and rehabilitate the site to reduce public safety hazards.
	Objective	1157	Maintain Bureau of Reclamation electronic sites to monitor Deadwood Dam.
Facilities and Roads	Objective	1158	Bring Garden Valley work center up to standards for public safety. Provide for fire organizational needs during improvement.
	Objective	1159	Evaluate the transportation systems in Danskin and Wash Creek drainages to determine management of ATV use and identify ATV opportunities.
	Objective	1160	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Lower South Fork Payette, Danskin-Poorman, and Alder Creek subwatersheds. Methods to be considered include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Special Features	Objective	1161	Maintain public access to the firefighters memorial up Danskin Creek.
	Objective	1162	Improve access to hot springs of high interest.
Scenic Environment	Objective	1163	Manage for visual values immediately adjacent to State Highway 17 by increasing the seral tree (ponderosa pine and aspen) component, developing more open stand structure, and increasing the amount of large-trees in the Warm Dry Douglas-fir/Moist Ponderosa Pine potential vegetation group.
	Standard	1164	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Banks to Lowman Highway	1	R	R	PR	R	PR	PR	R	PR	M
South Fork Payette River	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 382	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 555	1	PR	PR	PR	PR	PR	PR	PR	PR	M
Hot Springs, Pine Flats Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Deadwood Lookout	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 615	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 029, 152	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 555EC	2	PR	PR	M	PR	M	M	PR	M	MM

Pine Flats Hot Springs – South Fork Payette River





Management Area 12. Bear Valley Creek Location Map

Management Area 12
Bear Valley Creek

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 12 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	17
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	45
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	38

General Location and Description - Management Area 12 is comprised of lands administered by the Boise National Forest in the vicinity of Bear Valley (see map, opposite page). The area lies in Valley County, and is part of the Lowman Ranger District. The management area is an estimated 85,100 acres. The area is bordered by the Boise National Forest to the west and south, the Salmon-Challis National Forest to the east, and the Frank Church - River of No Return Wilderness to the north. The primary uses or activities in this area have been dispersed recreation, watershed restoration, livestock grazing, and timber management.

Access - The main access to the area is by either the Landmark-Stanley Road (Forest Road 579) or the Lowman-Bear Valley Road (Forest Road 582). Both of these roads are well maintained and gravel-surfaced. The density of classified roads for the entire area is an estimated 1.1 miles per square mile. Total road density for area subwatersheds ranges between 0.1 and 1.7 miles per square mile. A few trails provide access to the northeastern portion of the area.

Special Features - The management area lies adjacent to the Frank Church - River on No Return Wilderness, and trailheads in the area access trails that lead to Upper Elk Creek, Mountain Meadow, Blue Bunch Mountain, and the Middle Fork Salmon River. Prominent landmarks in this area include Bear Valley and Cape Horn Mountain. This area has important spawning and rearing habitat for threatened chinook salmon and steelhead trout. An estimated 62 percent of the area is inventoried as roadless, including all of the Blue Bunch, Poker Meadows, Nameless Creek, Tennessee, and Elk Creek Roadless Areas, and portions of the Red Mountain, Whitehawk Mountain, and Bernard Roadless Areas. The Forest Service has recommended the Red Mountain area for Wilderness designation.

Portions of two eligible Wild and Scenic Rivers fall within the management area, Bear Valley Creek and Elk Creek. Bear Valley Creek has three segments in this area with classifications of Recreational, Scenic, and Wild. It is considered eligible for Wild and Scenic River status because of its outstandingly remarkable cultural resource value. Elk Creek has two segments in this area with classifications of Recreational and Wild. It is considered eligible for Wild and Scenic River status because of its outstandingly remarkable wildlife value.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth Wilderness is the closest Class I area. Visibility monitoring has been expanded for this area.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were wildfire, prescribed fire, and fugitive dust from unpaved roads,. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was low within Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 6,300 feet at Bear Valley Creek to 9,526 feet atop Cape Horn Mountain. Management Area 12 falls primarily within the Bear Valley-Landmark Basin Uplands Subsection. The main geomorphic landforms associated with this subsection are glaciated mountains and rolling uplands and broad valley bottomlands. Slope gradients average between 15 to 40 percent. The surface geology is dominated by granitics of the Idaho batholith. Soils generally have low to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings are all low in this area (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). There are localized impacts from roads, past timber harvest, past livestock grazing, and recreation that have resulted in accelerated sediment, stream channel modification, and streambank degradation in some locations. Due to the relatively gentle terrain in this area, landslides are not common.

The management area is in the Bear Valley and Elk Creek Watersheds of the Upper Middle Fork Salmon River Subbasin. The major streams in the area are Bear Valley Creek, Elk Creek, Fir Creek, Bearskin Creek, Cache Creek, Sack Creek, and Little Beaver Creek. Several small, high mountain lakes occur in the upper reaches of Bear Valley Creek. Water Quality Integrity ratings for the subwatersheds are all moderate (functioning at risk) (see table below).

Water quality is functioning at risk due to sedimentation impacts in some locations from roads, historic mining, past livestock grazing, recreation use, and high naturally occurring sedimentation. Significant recovery from past impacts is occurring due to reduction or elimination of many of the past management activities that contributed to sedimentation (e.g. grazing, mining, and timber harvest). All of the subwatersheds within this area have water bodies that were listed in 1998 as impaired under Section 303(d) of the Clean Water Act. These water bodies are within the Lower Elk, Wyoming, Fir Creek, Upper Bear Valley, Bearskin, Upper Elk, and Cache Creek subwatersheds. The pollutant of concern is sediment for all water bodies. There are currently no TMDL-assigned watersheds associated with this area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	0	7	2	4	1	0	7	0	7	0	0

This area is designated critical habitat for chinook salmon, and is considered an aquatic stronghold for three Threatened fish species; chinook salmon, steelhead trout, and bull trout. It has spawning, rearing, and migratory habitat for all three species. Important habitat streams include Bear Valley, Elk, Fir, Cub, Cook, Cold, Bearskin, Sheep Trail, Wyoming, Sack, Cache, and Little Beaver Creeks. Bull trout and native cutthroat occur throughout this area, with strong local populations of bull trout existing in Cache, Wyoming, and Bearskin subwatersheds. Native redband trout have not been documented to occur here. Aquatic habitat is functioning at risk due to the introduction of non-native fish species and habitat conditions related to sedimentation, limited pools, and low bank stability as a result of past management activities and wildland fires. However, streams in Bear Valley are improving from past impacts. The Upper Bear Valley Creek and Upper Elk Creek subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for restoration.

Vegetation—This high-elevation area largely consists of lodgepole and subalpine fir forests, interspersed with extensive meadow systems. An estimated 8 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Alpine and Dry Meadows. The main forested vegetation groups are Warm Dry Subalpine Fir (39 percent), and Persistent Lodgepole Pine (43 percent). Though High Elevation Subalpine Fir makes up only a small portion of the management area, whitebark pine is an important early seral species that has been declining across the area, particularly due to the impact of wildland fires, insects and disease. Whitebark pine restoration is a high priority particularly in areas affected by recent disturbances.

The Alpine and Dry Meadows groups are at low risk due to localized impacts from sheep grazing, lodgepole pine encroachment, and lack of fire.

The Warm Dry Subalpine Fir group is functioning properly. Persistent Lodgepole Pine is functioning at risk due to the exclusion of fire and the associated lack of seedling/sapling stages, and the high risk of mountain pine beetle attacking the large even-aged stands that are older and lack vigor.

Riparian vegetation is functioning properly.

Botanical Resources – Blandow's helodium moss, a proposed Region 4 Sensitive species, is found inside the wilderness boundary at Poker Meadows. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas up to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Few noxious weeds and exotic plants have been found within the management area. A few small populations of Dalmatian toadflax and Canada thistle exist in the area. Only about 1 percent of the management area has high susceptibility to invasion by noxious weeds and exotic plant species of concern.

Wildlife Resources—Extensive meadows and lodgepole forests in Bear Valley provide summer range habitat for elk. Forests provide habitat for Region 4 Sensitive species, including goshawk, great gray owl, boreal owls, three-toed woodpeckers, and wolverine. The large lodgepole pine and subalpine fir stands provide some of the best potential snowshoe hare and lynx habitat on the Forest. Habitat exists for many migratory landbirds, and there is summer range for mammals such as deer, elk, black bear, and mountain lion. Wolves are present in this area.

This Management Area lies entirely within the following Idaho Comprehensive Wildlife Conservation Strategy focal area: Upper Middle Fork Salmon. Terrestrial wildlife habitat is functioning at risk primarily due to a deficiency of snags and large woody debris in managed areas, and the exclusion of fire creating dense stands at lower elevations. In managed areas, corridors, routes, and patterns have been altered by roads and harvest units; and are influencing use of habitat. The Bear Valley (5th code HUC 1706020508) and Elk Creek (5th code HUC 1706020509) watersheds have been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. These two watersheds are identified as short-term high priority areas for subsequent site-specific investigations at a finer scale.

Recreation Resources - Recreation in the roadless areas is predominantly non-motorized and undeveloped, with high visual sensitivity. Use is primarily trail-oriented and includes hiking, backpacking, and horseback riding. The Bear Valley area is popular for hunting, fishing, camping, snowmobiling, and cross-country skiing. Bear Valley Creek provides popular canoeing and kayaking opportunities. Developed sites include the Bear Valley and Fir Creek Campgrounds, and the Bruce Meadows Rest Area. Most users in this area come from Boise and Treasure Valley, although visitors from around the country and world pass through this area on their way to float the Middle Fork Salmon River. Recreation special uses include two outfitter and guide operations. The area is in Idaho Fish and Game Management Unit 34.

Cultural Resources - Cultural themes in the area include Prehistoric Archaeology, Ethnic History, Ranching, Forest Service History, and Mining. Archaeologists have documented prehistoric sites in Bear Valley significant for their information about Indian uses of the Forest. Blood residue analysis of stone points from two excavated sites indicate that the valley was an important area for hunting as well as fishing. The Shoshone-Bannock Tribes still consider the chinook salmon in this area as a culturally important species. The sheep and cattle industries entered Bear Valley in the late 1890s. The Forest Service regulated grazing in the area from Elk Creek Ranger Station, established in 1907. The compound's structures date to the 1920s; the CCC constructed the ranger's house and a few other buildings in the 1930s. Bear Valley Lookout, which is the only steel tower lookout on the Forest, was built in 1936. Miners explored Bear Valley in 1863; in the early 1900s the valley was the favorite route for Idaho City miners on their way to Thunder Mountain. Between 1953 and 1959, dredges recovered over twelve million dollars of rare earth minerals such as columbium, tantalum, and uranium.

Timberland Resources - Of the estimated 75,600 tentatively suited acres in Management Area 12 there are no identified suited timberlands. Forest vegetation management actions may be undertaken to support the achievement of vegetation desired conditions and other resource objectives in areas allocated to MPCs 3.1 and 3.2. Any timber production that may result from forest vegetation management actions will not count toward the allowable sale quantity but will contribute toward the Forest's Total Sale Program Quantity (TSPQ). Timber management activity has been low to moderate in the past. Forest products such as fuelwood, posts, and poles are collected in designated areas. No timber program is planned for inventoried roadless areas.

Rangeland Resources – Management Area 12 provides an estimated 5,500 acres of capable rangeland. These acres represent about 1 percent of the capable rangeland on the Forest. There is currently no cattle or sheep livestock grazing in this management area because the allotments were recently purchased by the Bonneville Power Administration and removed from the Forest's allotment system.

Mineral Resources - As stipulated in the Frank Church--River of No Return Wilderness Act, no dredge or placer mining is allowed in much of this management area. Locatable mineral potential is moderate to high in much of the area. Potential for leasable geothermal resources is moderate. Potential for other leasable minerals is unknown. Potential for common variety mineral materials is moderate to unknown.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. Over the past 20 years, there have been approximately 110 fire starts in the management area. Of these, the majority were lightning-caused. Portions of the Deadwood, Cub Creek, County Line, Red Mountain and Sheep-Trail Fires have burned in this area within the last 20 years. In total about 46 percent of the management area has burned since 1988. This management area is in the Forest's wildland fire use planning area. There are no National Fire Plan communities or wildland-urban interface areas in this management area. Historical fire regimes for the area are estimated to be 46 percent lethal and 54 percent mixed1 or 2. None of the area regimes has vegetation conditions that are highly departed from their historical range. However, 42 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity.

Lands and Special Uses – See the Recreation Resources section for recreation special uses. There is potential for a major east-west power transmission corridor in the Cold Creek area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	1202	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	1203	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	1204	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	1205	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	1206	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1207	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
Eligible Wild and Scenic Rivers	General Standard	1208	Manage the Bear Valley Creek and Elk Creek eligible river corridors to their assigned classification standards, and preserve their ORVs and free-flowing status until the segments undergo a suitability study and the study finds them suitable for designation by Congress, or releases them from further consideration as Wild and Scenic Rivers.
	Vegetation Standard	1259	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1209	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1210	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	1211	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize the impacts of suppression activities on river classifications and ORVs.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1212	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years).
	Vegetation Standard	1213	Mechanical vegetation treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
	Vegetation Standard	1260	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Fire Standard	1214	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
	Road Standard	1215	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1216	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1217	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1218	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1261	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1219	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1220	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
Soil, Water, Riparian, and Aquatic Resources	Objective	1221	Implement opportunities identified in the Bear Valley Watershed Analysis.
	Objective	1222	De-list Bear Valley Creek and Elk Creek from the State of Idaho's impaired water bodies list by applying appropriate vegetation manipulation, road management, and active watershed restoration to reduce sediment, which is the identified pollutant source.
	Objective	1223	Remove barriers that are impeding migration of anadromous and resident native fish in Upper Bear Valley Creek subwatershed. Restore channel integrity from past land management activities.
	Objective	1224	Reconstruct or relocate Forest Road 582 in Upper Bear Valley Creek subwatershed to reduce impacts to fish habitat and water quality.

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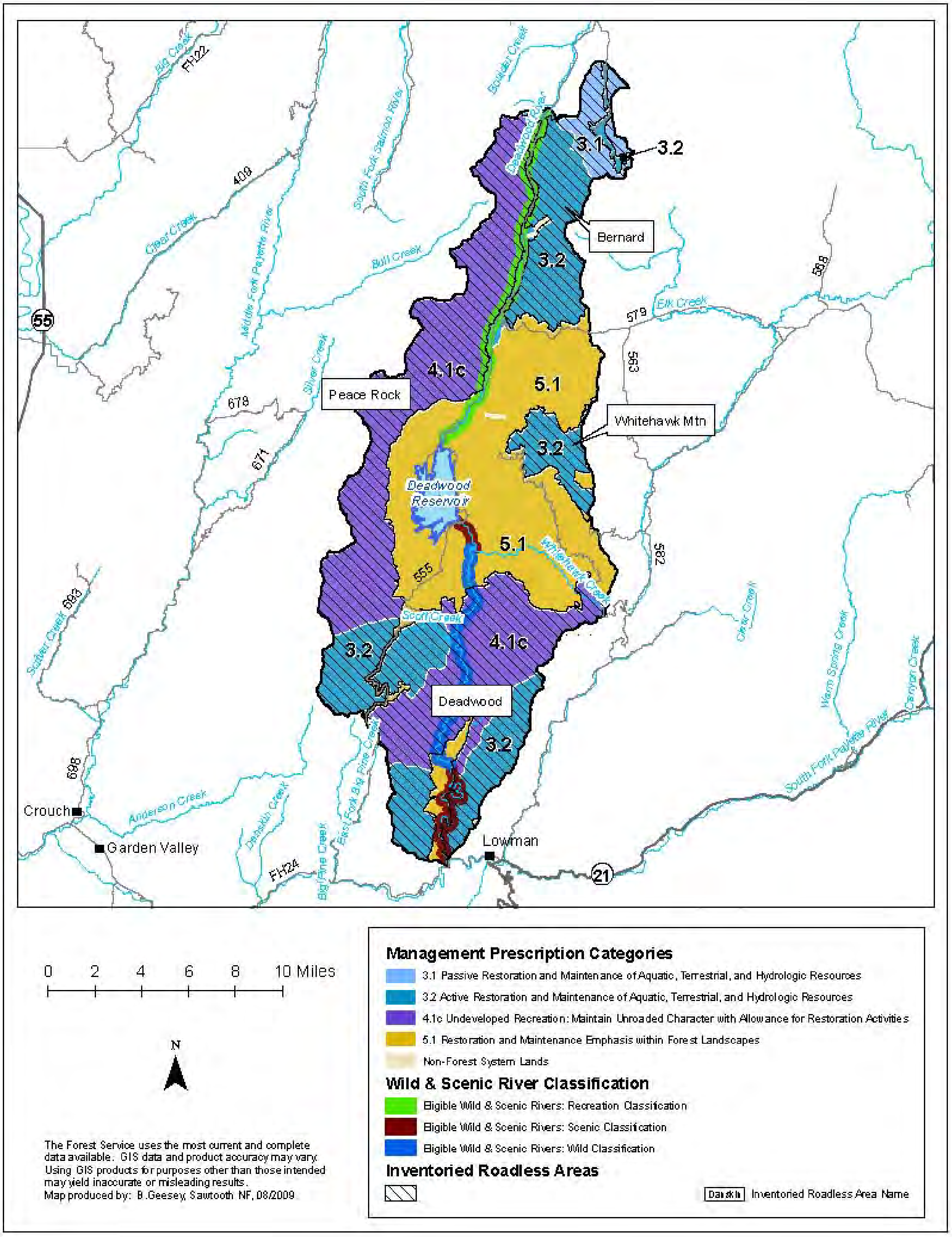
[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1225	Restore and maintain riparian function and allow the stream channels to return to their natural condition. Prioritize restoration where impacts to chinook salmon, steelhead trout, and bull trout spawning/rearing habitats can be quickly reduced, and benefits to water quality and fish species can be maximized.
	Objective	1226	Restore and maintain habitat connectivity for all species of native fish throughout the Bear Valley drainage.
	Objective	1227	Work with Idaho Department of Fish and Game to maintain the genetic integrity of native trout populations in the high mountain lakes at the headwaters of Cache Creek.
	Objective	1228	Maintain habitat conditions to contribute to the strong bull trout populations in the Wyoming, Cache, and Bearskin subwatersheds.
	Objective	1229	Reduce sediment by improving road alignment, drainage, and surface materials.
Vegetation	Objective	1230	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1231	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group as described in Appendix A.
Botanical Resources	Objective	1232	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Blandow's helodium, to contribute to the long-term viability of these species.
Non-native Plants	Objective	1233	Eradicate existing infestations of noxious weeds, and prevent new infestations from occurring.
Wildlife Resources	Objective	1234	Cooperate with the Idaho Department of Fish and Game to promote a Watchable Wildlife Program related to the high-elevation mountain meadow complexes.
	Objective	1235	Restore wildlife habitat and wildlife forage by reducing lodgepole pine density in meadows that is occurring due to the lack of fire and natural disturbance processes.
	Objective	1262	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within priority Bear Valley (5th code HUC 1706020508) and Elk Creek (5th code HUC 1706020509) watersheds. (*Refer to Conservation Principle 6 in Appendix E.*)
Recreation Resources	Objective	1236	Improve Fir Creek and Bear Valley Campgrounds to protect fisheries resources.
	Objective	1237	Improve Fir Creek, Wyoming Creek, and Lost Lake trailheads to enhance trail access and recreation opportunities, while reducing current resource impacts.
	Objective	1238	Inventory and evaluate dispersed sites to determine whether there is a need to close them or improve them through hardening, barrier placement, or other means.
	Objective	1239	Maintain the current motorized access on the trail system.
	Objective	1240	Continue the permit system to the use the Cook Ridge and Wilson Creek road network for disabled hunting.
	Objective	1241	Evaluate the need to restore the existing Sack Creek motorized trail. If the evaluation determines that restoration is needed, develop a plan to complete trail restoration.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1242</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>32%</td><td>8%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>7%</td><td>92%</td></tr>
<tr><td>Roaded Natural</td><td>30%</td><td>0%</td></tr>
<tr><td>Roaded Modified</td><td>31%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="5">Cultural Resources</td><td>Objective</td><td>1243</td><td>Identify, protect, and interpret historic properties in the management area, specifically prehistoric sites in Bear Valley.</td></tr>
<tr><td>Objective</td><td>1244</td><td>Maintain the National Register status of Elk Creek Guard Station, which is on the Forest’s cabin rental program, Bear Valley Lookout, and other eligible properties in the area. Monitor the conditions of National Register eligible properties in the management area.</td></tr>
<tr><td>Objective</td><td>1245</td><td>Conduct an inventory to identify the camas meadows and associated prehistoric sites in Bear Valley.</td></tr>
<tr><td>Objective</td><td>1246</td><td>Nominate Elk Creek Guard Station and Bear Valley Lookout to the NRHP. Develop maintenance plans for these facilities, and interpretive materials for visitors using the guard station.</td></tr>
<tr><td>Objective</td><td>1247</td><td>Provide interpretation at Bruce Meadows Rest Area and campgrounds about the people and events that shaped Bear Valley’s history.</td></tr>
<tr><td rowspan="2">Tribal Rights And Interests</td><td>Objective</td><td>1248</td><td>Cooperate with the Shoshone/Bannock Tribe for habitat restoration of aquatic and wildlife species.</td></tr>
<tr><td>Objective</td><td>1249</td><td>Continue to consult with the Shoshone/Bannock Tribe during project development, design, and implementation.</td></tr>
<tr><td>Mineral Resources</td><td>Objective</td><td>1250</td><td>Complete the reclamation of the Casner Creek mining ditch to reduce impacts to other Forest resources.</td></tr>
<tr><td rowspan="2">Fire Management</td><td>Objective</td><td>1251</td><td>Identify areas appropriate for wildland fire use, focusing on the Inventoried Roadless Areas, particularly those assigned MPC 1.2. Use wildand fire to restore or maintain vegetative desired conditions and to reduce fuel loadings.</td></tr>
<tr><td>Guideline</td><td>1252</td><td>Coordinate with the Salmon-Challis National Forest to develop compatible wildland fire suppression and wildland fire use strategies.</td></tr>
<tr><td>Lands and Special Uses</td><td>Objective</td><td>1253</td><td>Maintain Bear Valley Mountain Lookout as a communication site.</td></tr>
<tr><td rowspan="3">Facilities and Roads</td><td>Objective</td><td>1254</td><td>Reduce unauthorized ATV use and enforce existing travel restrictions to reduce recreation impacts to wildlife, soil, and water resources.</td></tr>
<tr><td>Objective</td><td>1255</td><td>Cooperate with the State of Idaho on maintenance of the Bruce Meadows airfield to efficiently maintain this transportation facility.</td></tr>
<tr><td>Objective</td><td>1256</td><td>Evaluate vehicle-related impacts to help determine the level and type of vehicle use appropriate for the area, both on and off the existing network of roads and trails.</td></tr>
<tr><td>Special Features</td><td>General Standard</td><td>1201</td><td>Defer implementation of any development within the Bluebunch Inventoried Roadless Area pending re-evaluation for wilderness recommendation by the Salmon-Challis National Forest.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Scenic Environment	Objective	1257	Maintain the scenic values of high-elevation meadow complexes.
	Standard	1258	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Red Mountain recommended wilderness	1	P	P	P	P	P	P	P	P	P
Bear Valley, Fir Creek Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 579 (Fir Ck to Dagger Ck)	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 579 (west of Dagger Ck)	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 582	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 563	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 005, 015, 017	2	PR	PR	M	PR	M	M	PR	M	MM



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 13. Deadwood River Location Map

Management Area 13
Deadwood River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 13 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	3
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	26
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	36
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	35

General Location and Description - Management Area 13 is comprised of lands administered by the Boise National Forest in the Deadwood River drainage north of Lowman, Idaho (see map, opposite page). The area lies in Valley and Boise Counties, and is part of the Lowman Ranger District. The management area is an estimated 157,200 acres, with 246 acres of private inholdings. The area is surrounded by lands administered by the Boise National Forest, and a small portion of the Frank Church - River of No Return Wilderness, administered by the Salmon-Challis National Forest. The primary uses or activities in this management area have been timber management, dispersed and developed recreation, and livestock grazing.

Access - The main access to the area is by either the Landmark-Stanley Road (Forest Road 579) or the Deadwood-Scott Mountain Road (Forest Road 555). Both of these roads are well maintained and gravel-surfaced. The density of classified roads for the entire management area is an estimated 0.9 mile per square mile, as over half the area is inventoried as roadless. Total road density for area subwatersheds ranges between 0.2 and 2.8 miles per square mile. Trails access portions of the roadless areas.

Special Features - The northern portion of the management area lies adjacent to the Frank Church--River on No Return Wilderness. Prominent landmarks in this area include Peace Rock, and Scott Mountain, Rice Peak, and Whitehawk Mountain Lookouts. Deadwood Reservoir is a popular recreation area for camping and fishing. An estimated 63 percent of the management area is inventoried as roadless, including portions of the Peace Rock, Deadwood, Bernard, and Whitehawk Mountain Roadless Areas.

One eligible Wild and Scenic River, Deadwood River, falls within the management area. Deadwood River has four segments with classifications of Recreational, Scenic (2 segments), and Wild. The Recreational segment is an estimated 21.7 miles, with a river corridor area of 6,950 acres. The Scenic segments are a combined 10.5 miles, with a river corridor area of 3,360 acres. The Wild segment is an estimated 13 miles, with a river corridor area of 4,160 acres. The

Deadwood River is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, geologic, and hydrologic values

Air Quality - This management area lies primarily within Montana/Idaho Airshed ID-15 and Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth and Hells Canyon Wildernesses are the closest Class I areas. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were wildfire, prescribed fire, and fugitive dust from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 3,600 feet where the Deadwood River enters the South Fork Payette River, to 8,696 feet atop Rice Peak. Management Area 13 falls primarily within the South Fork Payette Canyon and Streamcut Lands Subsection. The main geomorphic landforms within this subsection are strongly and moderately dissected fluvial lands, canyonlands, and frost-churned slopes and canyonlands. Slope gradients average between 45 to 75 percent in the dissected fluvial lands and canyonlands, and 45 to 65 percent in the frost-churned uplands and canyonlands. The surface geology is Idaho batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high, with the majority being moderate (see table below). Subwatershed Geomorphic Integrity ratings vary from high (functioning appropriately) to moderate (functioning at risk) (see table below). Some areas have localized impacts from roads, historic livestock grazing, timber harvest, and recreation. Impacts include accelerated erosion, upland compaction, and stream channel modification.

The management area is in the Upper Deadwood, Lower Deadwood, and Whitehawk Watersheds of the Upper South Fork Payette River Subbasin. The major streams in the area are Deadwood River and its tributaries: Stevens, Scott, Ninemile, Trail, Whitehawk, Warm Springs, Wilson, and Basin Creeks. There are no natural lakes, but Deadwood Reservoir (5,000 surface acres) lies roughly in the middle of the management area, impounding the waters of the Upper Deadwood watershed. Flows on the Deadwood River below the Deadwood Dam are regulated for irrigation purposes. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk), with the majority being moderate (see table below). Some areas above the dam due to localized accelerated sediment from roads, historic livestock grazing, and recreation use. Of the 10 subwatersheds in this area, only the Lower Deadwood subwatershed was listed in 1998 as having an impaired water body under Section 303(d) of the Clean Water Act. The pollutant of concern is sediment. There are currently no TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
1	6	3	5	5	0	1	9	0	1	0	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. The area does, however, have important habitat for threatened bull trout. Bull trout are distributed throughout this area, with strong local populations occurring within the Scott Creek and Deer Creek subwatersheds. Redband trout are found in the Deadwood Reservoir and Lower Deadwood subwatersheds. Deadwood Reservoir provides habitat for kokanee salmon, rainbow trout, and westslope cutthroat trout. Aquatic habitat above the dam is functioning at risk in some areas due to accelerated sediment impacts from roads, livestock grazing, and recreation use. The lower Deadwood River is functioning at risk due to altered temperature and flow patterns created by the dam. The dam also creates a migration barrier to upstream movement of bull trout and other species, resulting in genetic isolation of fish populations above and below the dam. Native fish populations are at risk due to the presence of non-native species and habitat impacts described above. The Deer Creek and Upper Deadwood River, and Deadwood Reservoir subwatersheds have been identified as important to bull trout recovery, and as high-priority areas for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands and shrublands and dry ponderosa pine and Douglas-fir on south and west aspects, and moist Douglas-fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir and subalpine fir, with pockets of persistent lodgepole pine and aspen. Cold forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 13 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Montane Shrub, Perennial Grass Slopes, and Alpine and Dry Meadows. The main forested vegetation groups are Cool Moist Douglas-fir (12 percent), Warm Dry Subalpine Fir (19 percent), Cool Dry Douglas-fir (16 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (13 percent), High Elevation Subalpine Fir (1 percent), and Persistent Lodgepole Pine (24 percent).

The Montane Shrub group is functioning properly, but is trending toward old age structure, dense canopies, and low levels of herbaceous ground cover due to fire exclusion. Alpine and Dry Meadows are functioning properly, with minor impacts from dispersed recreation. Perennial Grass Slopes are functioning at risk due to impacts from big-game grazing that have altered structure and led to an increase in annual grasses and noxious weeds.

The Warm Dry Douglas-fir/Moist Ponderosa Pine, and Cool Moist Douglas-fir groups are functioning at risk because past timber harvest and the 1989 Lowman Fire removed large trees and converted old and mid-aged stand structure to open and young stages in some areas. Stands that recently burned experienced high mortality because decades of fire exclusion resulted in high stand densities and fuel loadings that moved these groups from non-lethal to lethal fire regimes. In addition, high stand densities and fuel conditions still exist in unburned stands, where fire frequency is occurring at less than historic intervals. In these areas, insect and disease infestations have increased tree mortality and the risk of uncharacteristic wildfire. These areas also lack young structural stages and seral ponderosa pine and aspen.

The Cool Dry Douglas-fir, Warm Dry Subalpine Fir and Persistent Lodgepole Pine groups are functioning at risk due to fire exclusion that has resulted in old stands without much structural diversity. Late seral subalpine fir is increasing, and early seral Douglas-fir, lodgepole pine, and aspen are decreasing. Snags and large woody debris are at low levels along the road corridors of the Persistent Lodgepole Pine group due to fuelwood gathering. High Elevation Subalpine Fir is functioning at risk due to fire exclusion that has allowed natural succession to reach late seral conditions in most areas. Stands are generally old and dense, with increasing subalpine fir and decreasing whitebark pine. Whitebark pine is also being lost to blister rust in many areas. The Whitehawk watershed (5th code HUC 1705012004) is high priority for passive restoration to increase landscape and stand diversity. Both watersheds in the management area are high priority for whitebark pine restoration particularly in the areas affected by recent wildland fires.

Riparian vegetation is functioning at risk in localized areas due to a number of impacts. Fire exclusion in some areas has resulted in conifer trees replacing woody shrubs and cottonwoods. Wildfire in localized areas has burned the tree component, removing shade, cover, and seed source. Introduced plants and noxious weeds have increased with increasing roads and recreation use.

Botanical Resources – Idaho douglasia, a current Region 4 Sensitive species, occurs in this management area. Also, Kellogg's bitterroot and Mt. Shasta sedge, proposed Region 4 Sensitive species, occur within the area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/ wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Spotted knapweed and rush skeletonweed occur in the area, particularly along the main road corridors. An estimated 29 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weeds of concern are rush skeletonweed and spotted knapweed, which are currently found in small, scattered populations throughout the management area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Trail Use	ATV Off-Road Use
Ninemile Creek	Yes	No	No	No	No
Warm Springs Creek	Yes	No	No	No	No
Deadwood Reservoir	Yes	No	No	No	No

Wildlife Resources—The lower Deadwood River area provides big-game winter range, winter habitat for bald eagles, and nesting and foraging habitat for white-headed woodpeckers and flammulated owls. Low and mid-elevation forests provide habitat for Region 4 sensitive species, goshawk and great gray owl, and summer range for elk. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, lynx, and many migratory landbirds, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. Wolves are present in the area.

One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays portions of this Management Area: Deadwood. Overall, terrestrial habitat is functioning at risk in localized areas due to impacts to winter range forage from introduced species and noxious weeds. Forested habitats adapted to non-lethal fire regimes are at risk due to changes in both stand densities and tree species composition that have made them more vulnerable to uncharacteristic fire activity. The Lower Deadwood watershed (5th code HUC 1705012003) in this Management Area has been identified as a short-term high-priority area for restoration important to the recovery of Forest sensitive species and other native wildlife utilizing late-seral forests with low canopy conditions.

Within this Management Area four watersheds have been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape due to the high elevation habitats within these watersheds. These four watersheds: Lower Deadwood (5th code HUC 1705012003), Whitehawk (5th code HUC 1705012004), Upper Deadwood (5th code HUC 1705012005) and Sulpher Creek (5th code HUC 1706020510); are identified as short-term high priority areas for subsequent site-specific investigations at a finer scale.

Recreation Resources - Recreation in the roadless areas is predominantly undeveloped and trail-oriented, with both motorized and non-motorized opportunities and high visual sensitivity. The roaded portions offer dispersed recreation in the form of hunting, fishing, camping, snowmobiling, and driving for pleasure. Both trail and cross-country snowmobiling are especially popular in the Tyndall Ridge, Pilgrim Mountain, and non-wilderness portions of the Bernard Creek drainage. Deadwood Reservoir provides high quality fishing and four developed campgrounds. The Deadwood River below the reservoir is popular for kayaking and whitewater canoeing during high-water periods. Most users in this area come from Boise and Treasure Valley. The area is in Idaho Fish and Game Management Units 33 and 34. Recreation special use authorizations include two outfitter and guide operations and the Deadwood Resort.

Cultural Resources - Cultural themes in this area include Prehistoric Archeology, Mining, Ethnic History, Ranching, Forest Service History, CCC, Reclamation, and Recreation. Stone tools recovered along Deadwood River indicate that prehistoric Indians camped in the area as long as ten thousand years ago. In 1867, a short-lived gold rush developed in Deadwood Basin. Miners built Deadwood City, now inundated by the reservoir, and the Chinese ran large placer operations in tributary drainages. Mining revived in the 1920s with the establishment of the Hall-Interstate Mill and the nearby Pilgrim Mountain mines. These lode mines operated through the late 1940s, and produced over a million dollars in lead and zinc. The livestock industry was also an important, historic use of the area. In 1911, the FS used Deadwood Basin to conduct one of its first grazing studies in Idaho. The Forest Service and Bureau of Reclamation built Deadwood Guard Station in the 1930s, and CCC troops built the Scott Mountain Road (FR 555), and Deadwood and Whitehawk Mountain Lookouts. Deadwood Dam, built in 1931, increased the area's attractiveness to recreationists. The Bureau of Reclamation manages the dam.

Timberland Resources - Of the estimated 131,700 tentatively suited acres in this management area, 38,100 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 7 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 3.1, 3.2, and 4.1c are identified as not suited for timber production. The level of past management activity has been high in roaded areas, and is increasing in roadless areas. Forest products such as fuelwood, posts, and poles are also collected in designated areas.

Rangeland Resources - This area has portions of seven vacant sheep allotments and one active cattle allotment. Management Area 13 provides an estimated 15,800 acres of capable rangeland. These acres represent about 4 percent of the capable rangeland on the Forest.

Mineral Resources - As stipulated in the Frank Church-River of No Return Wilderness Act, no dredge or placer mining is allowed in the Bernard IRA. Locatable mineral potential is moderate or unknown in much of the area. Potential for leasable geothermal resources is moderate in the northern half of the area, and high in the southern half. Potential for other leasable minerals is unknown. Potential for common variety mineral materials is moderate to high in the southern portion of the area, and unknown in the northern portion.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. Portions of the 2006 Rattlesnake and 2007 Cascade Complex fires occurred in recent years. Over the past 20 years there have been approximately 240 fire starts in the management area, most of which were caused by lightning. Since 1988, about 16 percent of the area has been burned by wildfires. This management area is in the Forest's wildland fire use area. There are no National Fire Plan communities or wildland-urban interface areas in this management area. Historical fire regimes for the area are estimated to be: 28 percent lethal, 56 percent mixed1 or 2, and 16 percent non-lethal. An estimated 12 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 33 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses – See the Recreation Resources section for recreation special uses.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	1301	Manage the Deadwood River eligible river corridor to its assigned classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	1368	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1302	In Scenic or Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1303	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	1304	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1305	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years).
	Vegetation Standard	1306	Mechanical vegetation treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
	Vegetation Standard	1369	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Standard	1307	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
	Road Standard	1308	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1309	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1310	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1311	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1370	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	1312	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	1313	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1314	Management actions—including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1371	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1315	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1316	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1372	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Road Standard	1317	New roads and landings shall be located outside of RCAs in the MPC 5.1 portions of the Scott Creek and Deer Creek subwatersheds unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	1318	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	1373	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Road Guideline	1374	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
	Fire Guideline	1319	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

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[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	1320	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To meet access and travel management objectives.
Soil, Water, Riparian, and Aquatic Resources	Objective	1321	Improve water quality by reducing accelerated sediment from existing road in the watershed by improving drainage, hardening the surface, or other means. Decommission, obliterate, or close roads no longer needed for long-term management.
	Objective	1322	Initiate restoration of watershed conditions and fish habitat in the Deer Creek, Upper Deadwood River, and Deadwood Reservoir subwatersheds to help strengthen bull trout populations.
	Objective	1323	Cooperate with Fish and Game on fish management in the Deadwood Reservoir and adjacent streams.
	Objective	1324	Coordinate with the Bureau of Reclamation on the temperatures and flow regimes of water released from Deadwood Dam to improve conditions for bull trout and other native fish in lower Deadwood River.
	Objective	1325	Replace the Scott Creek culvert on Forest Road 555 if it is determined to be a fish passage barrier.
	Objective	1326	Stabilize the Julie Creek Road from the terminus to near Pigeon Flat.
	Objective	1327	Restore potential stronghold (adjunct) habitat for bull trout in the Whitehawk, Ninemile, and Deadwood Reservoir Subwatersheds by reducing accelerated sediment, and by removing migration barriers where genetic contamination is not a concern.
Vegetation	Objective	1328	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1329	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group, as described in Appendix A in both watersheds in the management area.
	Objective	1330	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1331	Restore patch size and structural diversity in PVG4 (Cool Dry Douglas-fir), PVG7 (Warm Dry Subalpine Fir), PVG10 (Persistent Lodgepole Pine) and PVG11 (High Elevation Subalpine Fir) in the Whitehawk watershed (5th code HUC 1705012004).
	Objective	1332	Maintain or restore riparian vegetation within selected areas along the Deadwood River to improve water quality, wildlife habitat, and the recreational setting. Where vegetation is trending toward climax in riparian areas, restore early seral components to improve regeneration and diversity.
Botanical Resources	Objective	1333	Maintain or restore known populations and occupied habitats of TEPSC plant species, including Idaho douglasia, Kellogg's bitterroot, and Mt. Shasta sedge, to contribute to the long-term viability of these species.
	Objective	1334	Emphasize reducing rush skeletonweed within rare plant actual and potential habitat.
	Standard	1335	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.

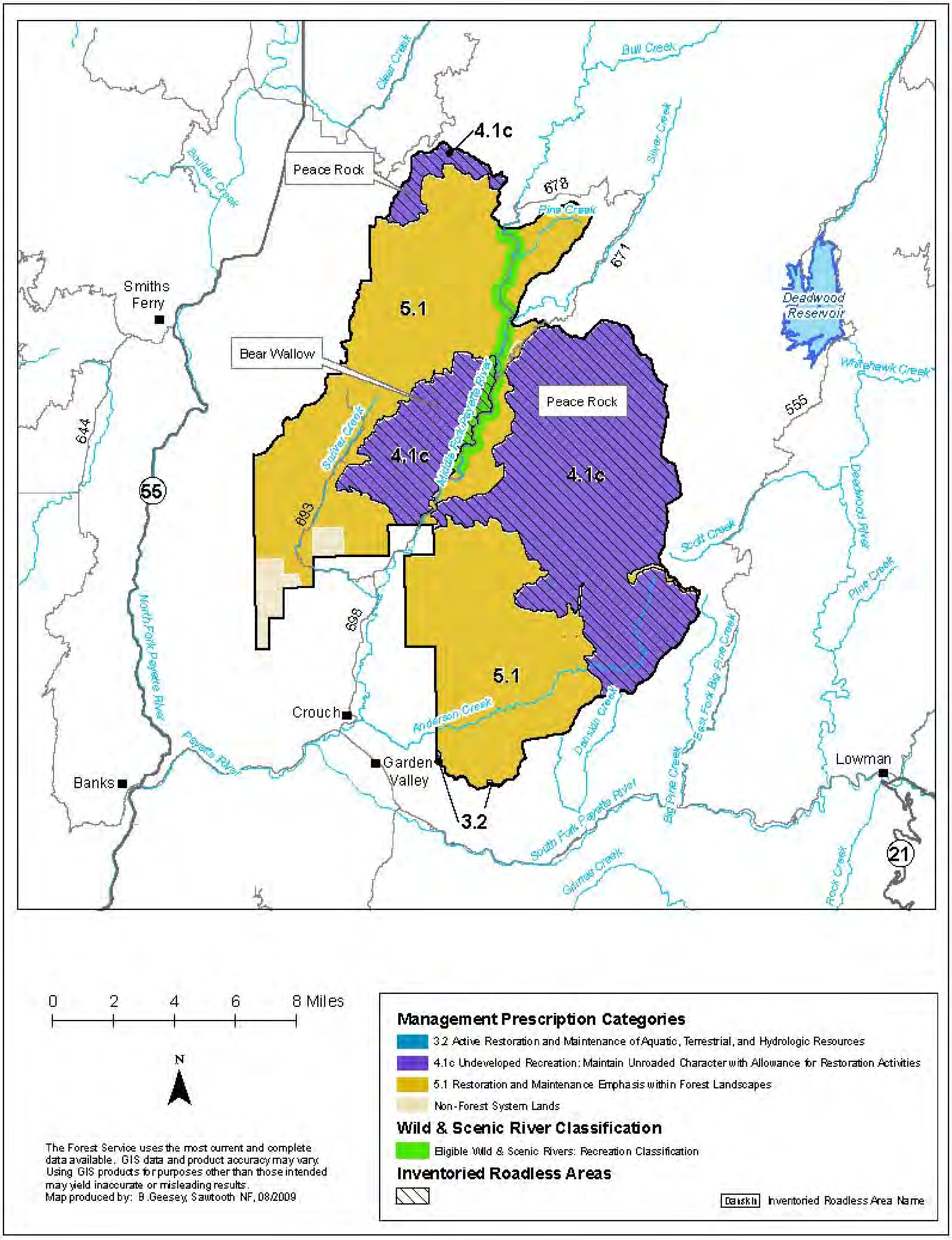
MPC/Resource Area	Direction	Number	Management Direction Description
Non-native Plants	Objective	1336	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
	Objective	1337	Emphasize contain and control strategies in the lower portions of the management area, focusing on spotted knapweed and rush skeletonweed. Emphasize prevention and eradication in the upper Deadwood River area.
Wildlife Resources	Objective	1338	Maintain or restore bald eagle wintering habitat along the Deadwood River corridor, with emphasis on retaining or increasing large tree and snag components.
	Objective	1339	Develop a bald eagle habitat management plan for the area surrounding Deadwood Reservoir.
	Objective	1340	Improve big-game winter range by restoring Mountain Big Sage and Montane Shrub vegetation groups along the Deadwood River corridor. Emphasize reducing noxious weeds and increasing native plant forage.
	Objective	1341	Evaluate and develop opportunities for watchable wildlife around Deadwood Reservoir.
	Objective	1375	Focus source habitat restoration activities within the Lower Deadwood (5th code HUC 1705012003) watershed in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E.*)
	Objective	1376	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Lower Deadwood (5th code HUC 1705012003), Whitehawk (5th code HUC 1705012004), Upper Deadwood (5th code HUC 1705012005) and Sulpher Creek (5th code HUC 1706020510) priority watersheds. (*Refer to Conservation Principle 6 in Appendix E.*)
	Guideline	1377	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Lower Deadwood (5th code HUC 1705012003) watershed should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (*Refer to Conservation Principles 1, 4, and 5 in Appendix E.*)
Recreation Resources	Objective	1342	Improve substandard facilities around Deadwood Reservoir and enlarge existing campgrounds or develop new campgrounds to improve the quality of recreation experiences and meet the increasing demand for these experiences.
	Objective	1343	Evaluate the need for an ATV trail around Deadwood Reservoir. If the evaluation determines a need, develop a plan for trail development.
	Objective	1344	Evaluate existing trail and road crossings along the Deadwood River, and the need for any additional crossings. Based on the results of this evaluation, develop a plan for improving existing crossings or adding new crossings to improve recreational access and reduce impacts to other resources.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="9"></td><td>Objective</td><td>1345</td><td>Improve sanitation facilities at Deer Creek facility, but manage as a primitive/reduced service campground.</td></tr>
<tr><td>Objective</td><td>1346</td><td>Provide over-the-snow recreation access and emphasize user education to reduce the potential for adverse social or environmental effects.</td></tr>
<tr><td>Objective</td><td>1347</td><td>Continue to provide high-quality snowmobiling opportunities, both trail and cross-country, in the Tyndall Ridge and Pilgrim Mountain areas, and in the non-wilderness portions of Bernard Creek drainage.</td></tr>
<tr><td>Objective</td><td>1348</td><td>Continue to cooperate with Valley and Custer Counties for grooming over-snow trails to maintain that winter recreation opportunity.</td></tr>
<tr><td>Objective</td><td>1349</td><td>Determine special use needs for water supply to outfitter camps.</td></tr>
<tr><td>Objective</td><td>1350</td><td>After stabilization of the Julie Creek Road is complete, maintain as a motorized trail. Develop a trailhead at the landing north of Pigeon Flats.</td></tr>
<tr><td>Objective</td><td>1351</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>37%</td><td>16%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>18%</td><td>84%</td></tr>
<tr><td>Roaded Natural</td><td>18%</td><td>Trace</td></tr>
<tr><td>Roaded Modified</td><td>27%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Standard</td><td>1352</td><td>Prohibit ORV use in the draw-down area of the Deadwood Reservoir to reduce impacts on soil-hydrologic, riparian, and aquatic resources.</td></tr>
<tr><td>Standard</td><td>1353</td><td>Prohibit commercial river outfitting on the lower Deadwood River to reduce impacts to bull trout populations and habitat.</td></tr>
<tr><td rowspan="3">Cultural Resources</td><td>Objective</td><td>1354</td><td>Maintain the National Register status of Deadwood Guard Station, and Whitehawk Mountain Lookout. Monitor the conditions of National Register eligible properties in the management area.</td></tr>
<tr><td>Objective</td><td>1355</td><td>Inventory the historic properties contributing to the Deadwood Historic Mining District. Nominate the Deadwood Historic Mining District and Deadwood Lookout to the NRHP.</td></tr>
<tr><td>Objective</td><td>1356</td><td>Provide interpretation about Deadwood Basin’s history at high use areas such as campgrounds and trailheads.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>1357</td><td>Evaluate previously harvested areas for needed timber stand improvement designed to achieve desired conditions. Develop and schedule treatment plans for these harvested areas.</td></tr>
<tr><td>Rangeland Resources</td><td>Objective</td><td>1358</td><td>Initiate and complete procedures to close existing vacant sheep allotments (Deadwood East, Deadwood West, Tranquil Basin, and Whitehawk Sheep and Goat Allotments).</td></tr>
<tr><td>Fire Management</td><td>Objective</td><td>1359</td><td>Identify areas appropriate for wildland fire use, focusing on the Inventoried Roadless Areas. Use wildland fire to restore or maintain vegetative desired conditions or to reduce fuel loadings.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1360	Use prescribed fire and mechanical treatments to reduce fuel loadings and to protect investments along Highway 21 corridors and the lower Rock Creek area. Emphasize prescribed fire in the vegetative groups that support ponderosa pine from Julie Creek north to Scott Creek, and the west side of Deadwood Reservoir.
Lands and Special Uses	Objective	1361	Evaluate and, if necessary, obtain an easement for the Porter Creek Trail to maintain recreation access, or move the trail if an easement is not possible.
Facilities and Roads	Objective	1362	Improve substandard facilities at Deadwood Guard Station and Whitehawk Lookout to reduce health and safety concerns.
	Objective	1363	Improve substandard conditions by pursuing funding opportunities and cooperation for rehabilitation of Lower Deadwood Road.
	Objective	1364	Continue maintenance of the Deadwood airstrip to maintain air transportation access.
	Objective	1365	Evaluate roads that access Deadwood Reservoir for improvement opportunities.
	Objective	1366	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Ninemile Creek, Warm Springs Creek, and Deadwood Reservoir subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	1367	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Deadwood Reservoir and recreation sites	1	PR	PR	PR	PR	PR	PR	PR	PR	M
Forest Road 555	1	PR	PR	PR	PR	PR	PR	PR	PR	M
Deadwood River (south)	2	PR	PR	M	PR	M	M	PR	M	MM
Deadwood Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
Whitehawk Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 579	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 555 (north of 579)	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 008, 009, 010, 013	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 019, 020, 022, 025, 028	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 030, 034, 095, 199	2	PR	PR	M	PR	M	M	PR	M	MM
Deer Flat Campground	2	PR	PR	M	PR	M	M	PR	M	MM

Mine Ruins in Upper Deadwood River Drainage



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 14. Lower Middle Fork Payette River Location Map

Management Area 14
Lower Middle Fork Payette River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 14 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	Trace
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	43
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	57

General Location and Description - Management Area 14 is comprised of lands administered by the Boise National Forest in the lower portion of the Middle Fork Payette River drainage (see map, opposite page). The area lies in Valley and Boise Counties, just above the communities of Crouch and Garden Valley. It is part of the Emmett Ranger District. The management area is an estimated 109,600 acres, which includes 2,268 acres of State lands. The area is bordered by the Boise National Forest to the north and east, by primarily State land to the west, and by primarily private land (Crouch) to the south. The primary uses or activities in this management area have been timber management, dispersed and developed recreation, and livestock grazing.

Access - The main access to the area is by Forest Road 698 from Crouch to Boiling Springs. This road is well maintained and gravel-surfaced to West Fork Creek. The density of classified roads for the entire management area is an estimated 2.2 miles per square mile, although part of the area is roadless. Total road density for area subwatersheds ranges between 0 and 4.1 miles per square mile. Trails provide access to portions of the roadless areas.

An estimated 7 miles of the Middle Fork Payette River Road (Forest Road 698) are scheduled for improvement work in the next decade. This road provides access to the upper reaches of the Middle Fork drainage and popular recreation sites in the Silver Creek and Boiling Springs areas. This project is in a very early stage of development so improvement details are not yet known.

Special Features - A portion of one eligible Wild and Scenic River, the Middle Fork Payette River, falls within the management area. The Middle Fork has one segment in this area, with Recreational classification. This segment is an estimated 10.8 miles, with a river corridor area of 3,466 acres. The Middle Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreation, and cultural resource values.

The Middle Fork corridor is a popular recreation area and has a number of hot springs. A prominent landmark in the area is Scott Mountain Lookout. An estimated 42 percent of the management area is inventoried as roadless, including all of the Bear Wallow Roadless Area, and portions of the Peace Rock, and Bald Mountain Roadless Areas.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth and Hells Canyon Wildernesses are the closest Class I areas. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10 while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were wildfire, prescribed fire, and fugitive dust from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 3,100 feet on the Middle Fork Payette River to 8,215 feet atop Scott Mountain. Management Area 14 falls primarily within the Middle Fork Payette Canyon and Streamcut Lands Subsection. The main geomorphic landforms associated with this subsection are strongly dissected fluvial lands, glaciated trough lands, and cold uplands. Slope gradients average between 45 to 75 percent in strongly dissected fluvial lands and glaciated trough lands, and 20 to 40 percent in the uplands. The surface geology is predominantly Idaho Batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate to high productivity. Subwatershed vulnerability ratings range from moderate to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below). In some locations, roads, timber harvest, livestock grazing, and recreation uses have resulted in accelerated erosion, stream channel modification, and streambank degradation.

The management area is in the Crouch and Bulldog Watersheds and part of the Boiling Springs Watershed of the Middle Fork Payette River Subbasin. The major streams in the area are the Middle Fork Payette River and its tributaries: Anderson, Pyle, Lightning, Bulldog, Scriver, Six Mile, West Fork and Rattlesnake Creeks. There are no natural lakes or reservoirs in the management area, but there are hot springs along the Middle Fork Payette River corridor. All of the major subwatersheds in this area are part of the state-regulated public water systems for the communities in and around Crouch and Garden Valley.

Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). In some locations, impacts from roads, timber harvest, livestock grazing, and recreation use have increased sedimentation and nutrient levels. High levels of natural sediment from erodible granitic parent material exacerbate these impacts. Only one of the eight subwatersheds in this MA was listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act—Rocky Canyon. The pollutant of concern is sediment. The entire management area is within a TMDL-assigned subbasin.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
5	3	0	2	3	3	0	5	3	1	8	8

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Bull trout can be found within the Plye, Anderson Creek, Rattlesnake, Sixmile, and Rocky Canyon subwatersheds, and in the Middle Fork Payette River, which serves as an important overwintering and migratory corridor for this Threatened fish. Native redband streams include the Middle Fork Payette River and Anderson, Pyle, Lightning, Bulldog, Scriver, and Rattlesnake Creeks. Aquatic habitat is functioning at risk in some locations due to accelerated sediment from road management, livestock grazing, and recreation use. Native fish populations are at risk due to the presence of non-native fish species and water quality impacts described above. The Anderson Creek subwatershed has been identified as important to bull trout recovery, and as a high-priority area for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands and shrublands and dry ponderosa pine and Douglas-fir on south and west aspects, and Douglas-fir and grand fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir, grand fir, and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 11 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage and Montane Shrub. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (41 percent), Cool Moist Douglas-fir (8 percent), Dry Grand Fir (7 percent), Cool Moist Grand Fir (14 percent), and Warm Dry Subalpine Fir (4 percent).

The Mountain Big Sage and Montane Shrub groups are functioning properly, with only minor impacts from past livestock grazing.

The Warm Dry Douglas-fir/Moist Ponderosa Pine, Dry Grand Fir, and Cool Moist Grand Fir groups are not functioning properly, and the Cool Moist Douglas-fir is functioning at risk due to timber management and fire exclusion that have altered stand composition and structure. In managed areas, stands are dominantly young and mid-aged, with relatively few large trees, snags, and large woody debris. In unmanaged areas, stands have more late seral grand fir and less early seral ponderosa pine than desirable and moderate-to-high levels of insect and disease infestations. Large-tree, single-storied stand structure is mostly absent. Noxious weeds and introduced species are increasing in the understory. All the watersheds in the management area are high priority for active management to restore the large tree size class.

Warm Dry Subalpine Fir is functioning at risk due to localized impacts from timber harvest and fire exclusion. Late seral subalpine fir is increasing, and early seral Douglas-fir and aspen components are decreasing.

Riparian areas are functioning at risk in some locations due to impacts from past timber harvest, roads, and recreation. Noxious weeds and introduced plant species are increasing. Impacts from recreation use are increasing along the Middle Fork Payette River.

Botanical Resources – Idaho douglasia and giant helleborine orchid, current Region 4 Sensitive species, occur in this management area. Also, Kellogg's bitterroot, a proposed Region 4 Sensitive species, occurs within the area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - An estimated 55 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weed of concern is spotted knapweed, a highly invasive species that is currently found in small, scattered populations throughout the area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Trail Use	ATV Off-Road Use
Pyle Creek	Yes	No	Yes	No	Yes
Scriver Creek	No	No	Yes	No	Yes
Anderson Creek	Yes	No	Yes	No	Yes
Sixmile Creek	Yes	Yes	Yes	No	Yes
Rocky Canyon	No	No	No	Yes	No

Wildlife Resources—The lower elevations provide nesting and foraging habitat for white-headed woodpeckers and flammulated owls. Potential bald eagle wintering habitat is found along the lower Middle Fork Payette River. Mixed conifer forests at mid elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl, and summer range for elk and deer. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, and lynx, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. Wolves are present in this Management Area. All habitats provide nesting and forage for migratory landbirds. Wild turkeys are also present.

There are no Idaho Comprehensive Wildlife Conservation Strategy focal areas overlaying this Management Area. High road densities influence use of habitat by wildlife species that are negatively influenced by road-associated factors such as disturbance, poaching, spread of noxious weeds, loss of snags, etc. Terrestrial wildlife habitat is functioning at risk due to habitat changes from timber harvest and fire exclusion, fragmentation from roads and harvest, and disturbance from recreation uses. The Bulldog (5th code HUC 1705012102) and Boiling Springs

(5th code HUC 1705012103) watersheds have been identified as important to the recovery of Forest sensitive species and other native wildlife utilizing old forest habitat with low canopy conditions, and are identified as short-term high-priority areas for restoration.

Recreation Resources - Recreation in the roadless areas is predominantly undeveloped and trail-oriented, with both motorized and non-motorized opportunities, and high visual sensitivity. The roaded corridor of the Middle Fork Payette River has four developed campgrounds and offers dispersed recreation in the form of hunting, fishing, camping, snowmobiling, and driving for pleasure. This area features a system of groomed snowmobile trails that receive heavy winter use. Most users in the area come from either Crouch or Garden Valley, or from Boise and the Treasure Valley. The area is in Idaho Fish and Game Management Unit 33. Four campgrounds along the Middle Fork of the Payette are under special use permit.

Cultural Resources - Cultural themes in this area include Prehistoric Archeology, Ranching, Transportation, Forest Service History, and the CCC. This management area contains prehistoric sites important to our understanding of Indian uses of the Payette River drainage. The hot springs along the river were especially attractive to Indians and Garden Valley settlers. One site excavated by archaeologists yielded artifacts that show Great Basin and Columbia Plateau cultural affiliations. Blood residue analysis of stone tools recovered indicates that bighorn sheep were once in the drainage. Historically, ranchers from eastern Oregon and Long Valley moved livestock across the mountain trails on of the North Fork and Salmon River range to summer pasture in Deadwood Basin, Bear Valley, and the Thunder Mountain Mining District. Early Forest rangers such as Elmer Ross spent much of their time supervising the livestock crossings in this area. The Middle Fork Payette River Road was built in 1902 by Garden Valley and Placerville residents as a quicker, albeit more dangerous route to the Thunder Mountain gold rush. During the 1930s, CCC troops stationed at a spike camp on Tie Creek reconstructed the road into Peace Valley. They also replaced the 1920s era log cabin on Scott Mountain Lookout with the building that exists today.

Timberland Resources—Of the estimated 91,000 tentatively suited acres in this management area, 40,900 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 8 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 3.2 and 4.1c are identified as not suited for timber production. Outside of the roadless area, timber management has been one of the major uses in this management area. The level of timber management has been relatively high in the roaded areas, and low elsewhere. Forest products such as fuelwood, posts, and poles are also collected.

Rangeland Resources - This area has portions of two sheep allotments. Management Area 14 provides an estimated 32,800 acres of capable rangeland. These acres represent about 8 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open to mineral activities and prospecting. Locatable mineral potential is low or unknown. Potential for leasable geothermal resources is moderate in most of the area, and high in the Middle Fork Payette River corridor. Potential for other leasable minerals and common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years, there have been approximately 180 fire starts, 90 percent of which were lightning-caused. Since 1988 28 percent of the management area has burned, most of which occurred in 2006 and 2007. Prescribed fire has been extensively used from since 1995 in Rattlesnake, Bulldog, Little Bulldog, Pyle, Smith, Lightning and Anderson Creek drainages.

Crouch and Garden Valley are nearby National Fire Plan communities and the areas surrounding these communities along the southwestern boundary of the management area is considered wildland-urban interface areas due to private development adjacent to the Forest. The subwatersheds that include the wildland-urban interface are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 10 percent lethal, 34 percent mixed1 or 2, and 56 percent non-lethal. An estimated 47 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 24 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses – See the Recreation Resources section for recreation special uses.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	1401	Manage the Middle Fork Payette River eligible river corridor to its Recreational classification standards, and preserve its ORVs and free-flowing status until it undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	1463	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Vegetation Guideline	1402	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1403	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	1404	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1405	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1406	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1464	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	1407	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1408	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1409	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1465	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1410	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1411	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1466	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	1412	The full range of treatment activities, except wildland fire use, may be used to restore or maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	1467	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1413	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	1414	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	1468	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	1415	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1416	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1417	Maintain or restore migratory habitat in the Middle Fork of the Payette River for bull trout and other resident native fish.
	Objective	1418	Maintain or improve headwater streams for spawning and rearing habitats of native fish.
	Objective	1419	Initiate restoration of watershed conditions and fish habitat in the Anderson Creek subwatershed to help strengthen the local bull trout population.
	Objective	1420	Cooperate and participate with the State of Idaho for implementation of the TMDL for the Middle Fork of the Payette River.
	Objective	1421	Evaluate stream crossings for fish passage and overall condition in Wetfoot Creek drainage and other areas as projects are proposed.
	Objective	1422	Continue to coordinate with partners on the monitoring of the 319 roads project in Scriver Creek.
Vegetation	Objective	1423	Restore PVG1 (Dry Ponderosa Pine/Xeric Douglas-fir), PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine), PVG3 (Cool, Moist Douglas-fir), PVG5 (Dry Grand Fir) and PVG6 (Cool Moist Grand Fir) vegetation groups as described in Appendix A emphasizing the large tree size class in all watersheds in the management area.
	Objective	1424	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1425	Where riparian vegetation is trending toward a climax community, restore early seral components to improve regeneration and diversity.
Botanical Resources	Objective	1426	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, giant helleborine orchid, and Kellogg's bitterroot, to contribute to the long-term viability of these species.
	Standard	1427	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia, to help maintain or restore populations or habitat of this species.

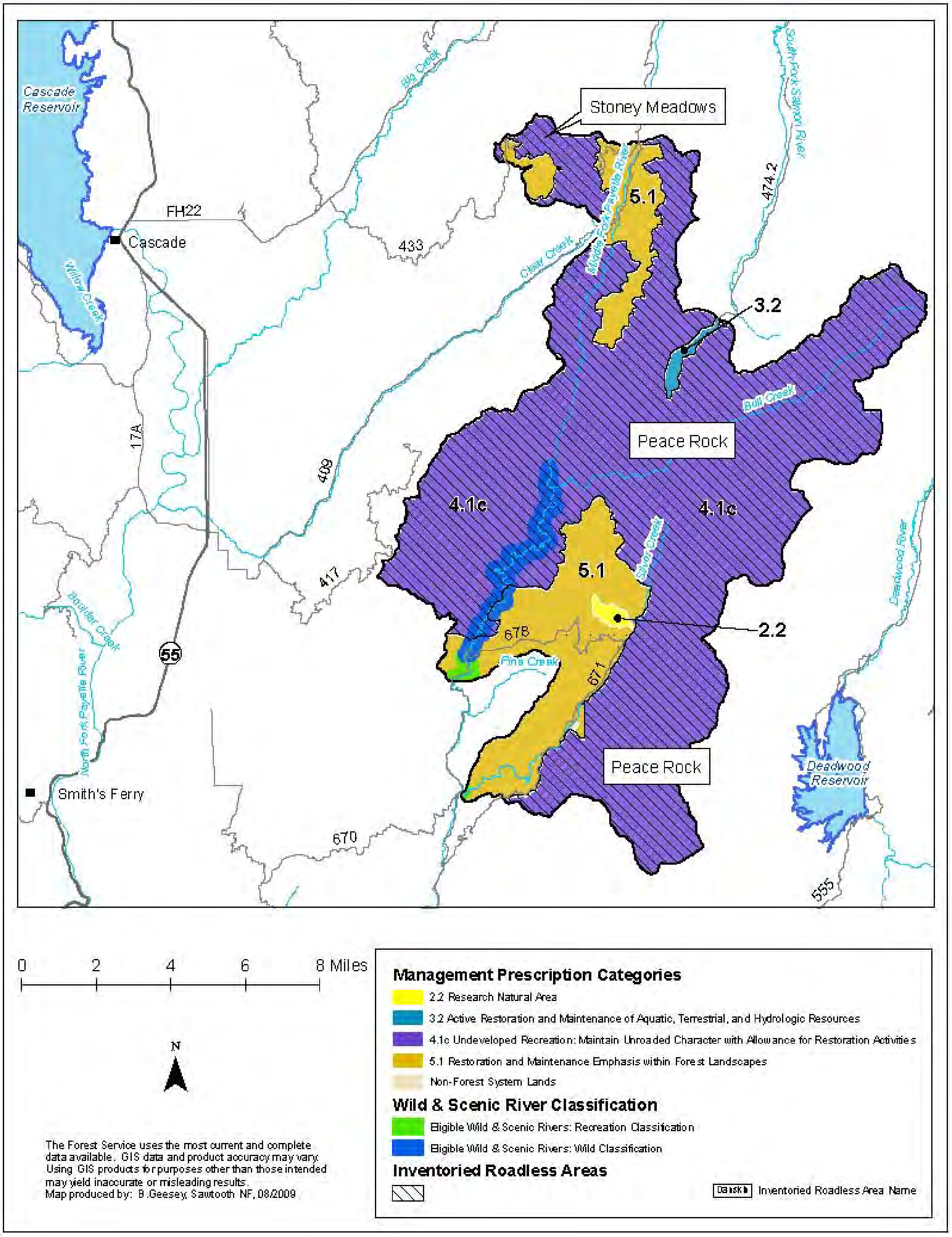
MPC/Resource Area	Direction	Number	Management Direction Description
Non-native Plants	Objective	1428	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
Wildlife Resources	Objective	1429	Improve big-game winter range by restoring the Mountain Big Sage and Montane Shrub vegetation groups. Emphasize increasing native plant forage by reducing noxious weeds.
	Objective	1430	Maintain or restore bald eagle wintering habitat along the Middle Fork Payette River corridor, with emphasis on retaining or increasing large tree and snag components.
	Objective	1469	Focus source habitat restoration activities within the Bulldog (5th code HUC 1705012102) and Boiling Springs (5th code HUC 1705012103) watersheds and in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E.*)
	Objective	1470	Reduce open road densities within the Bulldog (5th code HUC 1705012102) and Boiling Springs (5th code HUC 1705012103) watersheds and where it is determined that they limit use of source habitats by wildlife species identified as TEPC or R4 Regionally Sensitive. (*Refer to Conservation Principles 5 and 6 in Appendix E.*)
	Guideline	1471	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Bulldog (5th code HUC 1705012102) and Boiling Springs (5th code HUC 1705012103) watersheds should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (*Refer to Conservation Principles 1, 4, and 5 in Appendix E.*)
Recreation Resources	Objective	1431	Continue to coordinate with Boise County on grooming snowmobile trails to enhance winter recreation opportunities and experiences.
	Objective	1432	Improve the snowmobile trailhead at Tie Creek to allow for additional parking and provide needed sanitation facilities.
	Objective	1433	Assess and mitigate impacts from dispersed and developed recreation sites on water quality along the Middle Fork Payette. Where recreation sites are adversely affecting riparian vegetation, restore vegetation by relocating or hardening sites, or other methods.
	Objective	1434	Re-construct Hardscrabble campgrounds to improve services and facilities while reducing impacts to riparian areas.
	Objective	1435	Identify opportunities throughout the area for development of new group camping and picnic sites and expansion of existing sites to provide for expected increases in group camping and picnicking use.
	Objective	1436	Develop a river management plan for the Middle Fork of the Payette River to identify opportunities to provide for increasing recreation use.
	Objective	1437	Identify and provide OHV opportunities on designated roads throughout the management area to enhance motorized recreation opportunities and experiences.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1438</td><td>Monitor the effectiveness of dispersed recreation management efforts in the Silver Creek/Peace Valley area using photo points, dispersed site inventories and surveys, and visitor contacts. If efforts are determined to not be effective, develop a plan to further reduce resource impacts and increase visitor satisfaction.</td></tr>
<tr><td></td><td>Objective</td><td>1439</td><td>Coordinate with the Lowman Ranger District to resolve inconsistent access management of the Lightning Ridge Trail.</td></tr>
<tr><td></td><td>Objective</td><td>1440</td><td>Develop trail management plans to guide trail maintenance activities.</td></tr>
<tr><td></td><td>Objective</td><td>1441</td><td>Evaluate the 6-mile project campsite to determine if use for group camping should be continued or if another use is more appropriate.</td></tr>
<tr><td></td><td>Objective</td><td>1442</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from off-road ATV/motorbike use in the Pyle Creek, Scriver Creek, Anderson Creek, and Sixmile Creek subwatersheds. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td></td><td>Objective</td><td>1443</td><td>Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Rocky Canyon subwatershed. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.</td></tr>
<tr><td>Recreation Resources</td><td>Objective</td><td>1444</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>0%</td><td>Trace</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>36%</td><td>99%</td></tr>
<tr><td>Roaded Natural</td><td>8%</td><td>1%</td></tr>
<tr><td>Roaded Modified</td><td>56%</td><td>Trace</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Cultural Resources</td><td>Objective</td><td>1445</td><td>Maintain the National Register status of eligibly properties, including Rocky Canyon Hot Springs, Scott Mountain Lookout, and Deadwood Lookout. Monitor conditions of National Register eligible properties in the area, specifically prehistoric sites located along the river.</td></tr>
<tr><td></td><td>Objective</td><td>1446</td><td>Conduct sample inventories to identify historic properties in the area, specifically along Lightning Ridge Trail and other known historic trails.</td></tr>
<tr><td></td><td>Objective</td><td>1447</td><td>Nominate the Rocky Canyon archaeological site to the NRHP. Provide interpretation at Rocky Canyon Hot Springs that encourages the public to help protect the area’s cultural history.</td></tr>
<tr><td></td><td>Objective</td><td>1448</td><td>Develop a management plan to protect the historic character of Scott Mountain Lookout.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1449	Develop a management plan to protect the historic character of the Deadwood Lookout. List the lookout on the Forest's cabin rental program, and provide visitors with interpretive materials about its association with Gallagher CCC Camp F-66.
Timberland Resources	Objective	1450	Manage stand density through thinning and other appropriate silvicultural treatments on suited timberlands to promote growth, to provide timber products, and to reduce hazards from uncharacteristic fire, insects, and diseases. Use thinning also to reduce the spread and intensification of dwarf mistletoe.
	Objective	1451	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Lower South Fork Payette, Danskin-Poorman, and Big Pine Creek subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	1452	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Lower South Fork Payette, Danskin-Poorman, and Big Pine Creek subwatersheds.
Rangeland Resources	Objective	1453	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Sixmile Creek subwatershed. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Fire Management	Objective	1454	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1455	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
Lands and Special Uses	Objective	1456	Evaluate Lightning Creek ditch under Public Law 99-545 (commonly called the "Ditch Bill").
	Objective	1457	Develop a plan to reduce the backlog of known trespasses throughout the management area.
Facilities and Roads	Objective	1458	Reduce road-related impacts to wildlife, fish, soil, and water resources through road reconstruction and rehabilitation, or decommissioning, with emphasis on the Anderson Creek, Cow Creek, Wetfoot, Sixmile, and Scriver Creek drainages.
	Objective	1459	Pave Forest Road 698 along the Middle Fork Payette River to reduce maintenance costs and enhance visitor driving experiences.
	Objective	1460	Construct a vehicle turnaround at the Lightning Basin undeveloped trailhead, or sign the site to warn of "No Turnaround Past This Point".

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1461	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Pyle Creek, Anderson Creek, and Sixmile Creek subwatersheds. Methods to consider include: ➤ When decommissioning roads, treat weeds before roads are made impassable. ➤ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➤ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➤ Periodically inspect road systems and rights of way. ➤ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	1462	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Middle Fork Payette River	1	R	R	PR	R	PR	PR	R	PR	M
Trail Creek, Rattlesnake Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM
Tie Creek, Hardscrabble Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 671, 698	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 025, 029, 031, 032 035	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 036, 038, 041, 099, 605	2	PR	PR	M	PR	M	M	PR	M	MM



Management Area 15. Upper Middle Fork Payette River Location Map

Management Area 15
Upper Middle Fork Payette River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 15 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	Trace
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	1
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	80
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	19

General Location and Description - Management Area 15 is comprised of lands administered by the Boise National Forest in the upper portion of the Middle Fork Payette River drainage (see map, opposite page). The area lies in Valley County, and is part of the Emmett and Cascade Ranger Districts. The management area is an estimated 82,700 acres, with 20 acres of private inholdings. Lands administered by the Boise National Forest surround the area. The primary uses or activities in this management area has been dispersed and developed recreation.

Access - The main access to the area is by Forest Road 698 from Crouch to Boiling Springs, and by Forest Road 671 along Silver Creek. These roads are well maintained, and gravel and native-surfaced. The density of classified roads for the entire management area is an estimated 0.7 miles per square mile, and over half the area is roadless. Total road density for area subwatersheds ranges between 0.1 and 1.3 miles per square mile. A good network of trails provides access to portions of the roadless areas.

Special Features – A portion of one eligible Wild and Scenic river, the Middle Fork Payette River, falls within the management area. The Middle Fork has two segments in this area, with classifications of Recreational and Wild. The Recreational segment is an estimated 1.4 miles, with a river corridor area of 438 acres. The Wild segment is an estimated 9 miles, with a river corridor area of 2,870 acres. The Middle Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, and cultural resource values.

The Middle Fork Payette River and Silver Creek corridors are popular recreation areas that have a number of hot springs. Prominent landmarks in the area include Rice Peak, and Silver Creek Lookouts. Portions of the Peace Rock and Stony Meadows Roadless Areas comprise an estimated 80 percent of the management area. The Silver Creek Experimental Area, located in the headwaters area of Silver Creek, is 2,300 acres that was used to evaluate the environmental impacts of alternative timber harvesting and road construction practices on granitic soils of the Idaho Batholith. The experimental research has been concluded. The Eggers Creek RNA (325 acres) contains grand fir and Douglas-fir habitat types, and was a control area for Idaho Batholith research in the Silver Creek Experimental Area.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth and Hells Canyon Wildernesses are the closest Class I areas. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were wildfire, prescribed fire, and fugitive dust from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from around 4,000 feet on the Middle Fork Payette River to 8,696 feet atop Rice Peak. Management Area 15 falls primarily within the Middle Fork Payette Canyon and Streamcut Lands Subsection. The main geomorphic landforms associated with this subsection are strongly dissected fluvial lands, glaciated trough lands, and cold uplands. Slope gradients average between 45 to 75 percent in strongly dissected fluvial lands and glaciated trough lands, and 20 to 40 percent in the uplands. The surface geology is predominantly Idaho batholith granitics. Soils generally have moderate to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from moderate to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk), with majority being moderate (see table below). Some locations have impacts from roads, timber harvest, livestock grazing, and recreation uses that have resulted in minor amounts of accelerated erosion, stream channel modification, and streambank degradation.

The management area is in the Upper Middle Fork Payette Watershed and part of the Boiling Springs Watershed of the Middle Fork Payette River Subbasin. The major streams in the area are the Middle Fork Payette River and its tributaries, Silver and Bull Creeks. There are no natural lakes or reservoirs in the management area, but there are many hot springs along the Middle Fork Payette River corridor. The Silver Creek subwatershed is part of the state-regulated public water system for the community around Crouch. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk), with the majority being moderate (see table below). Some locations have localized impacts from roads, timber harvest, livestock grazing, and recreation use that have increased sedimentation. High levels of natural sediment in the area exacerbate these impacts. There are no water bodies listed as impaired under Section 303(d) of the Clean Water Act; however, the entire management area is within a TMDL-assigned subbasin.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
2	2	0	1	3	0	1	3	0	0	4	1

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Federally listed bull trout are present in Bull, Sixteen-to-One, and the Upper Middle Fork streams. Silver Creek provides potential spawning and rearing habitat, and the Middle Fork Payette River serves as an important over-wintering and migratory corridor for this Threatened species. Redband and native cutthroat trout are not known to presently occur in this area. Aquatic habitat is functioning at risk due to accelerated sediment from localized roads, timber management, and recreation use. Native fish populations are at risk due to the presence of non-native fish species and water quality and habitat impacts described above. The Bull Creek and Upper Middle Fork Payette River subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for restoration.

Vegetation—Vegetation at lower elevations is typically grasslands and shrublands, with Douglas-fir and grand fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of Douglas-fir, grand fir, and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 9 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage and Montane Shrub. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (15 percent), Dry Grand Fir (7 percent), Cool Moist Grand Fir (20 percent), Persistent Lodgepole Pine (17 percent), and Warm Dry Subalpine Fir (19 percent).

The Mountain Big Sage and Montane Shrub groups are functioning properly, with only minor impacts from past livestock grazing.

The Warm Dry Douglas-fir/Moist Ponderosa Pine, Dry Grand Fir and Cool Moist Grand Fir groups are not functioning properly in some locations due primarily to fire exclusion that has altered stand composition and structure. In managed areas, which make up a small portion of the management area, stands are dominantly young and mid-aged, with relatively few large trees, snags, and large woody debris. In unmanaged areas, stands have more late seral grand fir and less early seral ponderosa pine than desirable and moderate to high levels of insect and disease infestations. Large-tree, single-storied stand structure is mostly absent. The Boiling Springs watershed (5th code HUC 1705012103) is a high priority for active management to restore the large tree size class.

Warm Dry Subalpine Fir is functioning at risk due to localized impacts from timber harvest and fire exclusion. Late seral subalpine fir is increasing, and early seral Douglas-fir and aspen components are decreasing.

Riparian vegetation is functioning at risk in some locations due to impacts from past timber harvest, roads, and recreation use. Noxious weeds and introduced plant species are increasing.

Botanical Resources – Idaho Douglasia, a Region 4 Sensitive species, is known from this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Few noxious weeds and exotic plants have been found within the management area. An estimated 31 percent of the management area has high susceptibility to invasion by noxious weeds and exotic plants. The main weeds of concern are spotted knapweed, rush skeletonweed, and Canada thistle.

The Silver Creek subwatershed has an inherently high risk of weed establishment and spread. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from recreation and trail use in this area.

Wildlife Resources—The lower elevations provide nesting and foraging habitat for white-headed woodpeckers and flammulated owls. Mixed conifer forests at mid elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl, and summer range for elk and deer. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, and lynx, as well as summer range for mammals such as deer, elk, black bear, wolves and mountain lion. All habitats provide nesting and foraging habitat for migratory landbirds. Terrestrial wildlife habitat is functioning at risk due to minimal habitat changes from fire exclusion, minor fragmentation from roads and timber harvest, and low to moderate disturbance from recreation uses. The Upper Middle Fork Payette watershed (5th code HUC 1705012104) has been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. This watershed is identified as a short-term high priority area for subsequent site-specific investigations at a finer scale. This same watershed has lower elevation habitat that has been identified as important to the sustainability of Forest sensitive species and other native wildlife utilizing large tree and old forest habitat with low canopy conditions. As such, it is a short-term high-priority area for maintenance and restoration treatments of old forest habitat.

Recreation Resources - Recreation in the Peace Rock Roadless Area is predominantly undeveloped and trail-oriented, with both motorized and non-motorized opportunities, and high visual sensitivity. The road corridors of the Middle Fork Payette River and Silver Creek have three developed campgrounds and offer dispersed recreation in the form of hunting, fishing, camping, snowmobiling, and driving for pleasure. Motorcycle use on area trails is fairly heavy. The Boiling Springs Guard Station is a Forest Service Rental Cabin that can be reserved from May through October. Most users in this area come from either Crouch or Garden Valley, or from Boise and the Treasure Valley. The area is in Idaho Fish and Game Management Unit 33.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ranching, Mining, Forest Service History, CCC, Timber, and Recreation. The Upper Middle Fork Payette River and its tributaries were popular transportation corridors affording Indians easy access to the South Fork Salmon River drainage, including areas like Warm Lake and Pen Basin. The hot springs in the area were especially attractive to Indians and weary stockmen wanting a hot bath. Sheep grazing was the dominant historical use of this area, especially in Peace Valley, and the primary concern of early Forest rangers at Boiling Springs and Silver Creek Guard Stations, established in 1906. The Forest Service conducted the first range management studies on the Forest in Peace Valley from 1911 to 1914. Occasionally miners prospected in the area. The most serious mineral development occurred at Silver Creek Plunge beginning in 1917. During the 1930s, CCC troops constructed Silver Creek Lookout, new buildings at the guard stations, and campgrounds in Peace Valley. Commercial export logging in this area began in the 1950s, and used innovative techniques such as hot air balloons. In 1959, the Forest Service and Intermountain Research Station selected Peace Valley as a watershed research area to study the effects of logging in the Idaho batholith. It was during this time that private owners developed Silver Creek Plunge as recreational hot springs resort.

Timberland Resources—Of the estimated 70,300 tentatively suited acres in this management area, 11,700 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 2 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 2.2, 3.2 and 4.1c are identified as not suited for timber production. The level timber management has been relatively high in the small portion of roaded areas and low elsewhere. Forest products such as fuelwood, posts, and poles are collected in designated areas. The Silver Creek Experimental Area has been used to evaluate environmental impacts of timber harvesting and road construction practices on granitic soils.

Rangeland Resources - This area has a portion of one active sheep allotment. Management Area 15 provides an estimated 12,300 acres of capable rangeland. These acres represent about 3 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open to mineral activities and prospecting. Locatable mineral potential is low or unknown. Potential for leasable geothermal resources is moderate in most of the area, and high in the Middle Fork Payette River and Silver Creek corridors. Potential for other leasable minerals and common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. Over the past 20 years, there have been approximately 180 fire starts in the management area, over 90 percent of which are caused by lightning. This management area has the third highest number of fire starts relative to its size, likely due to its proximity to storms coming up from the south and west and the complex topography relative to the flow of weather. Thirty percent of the management area has been affected by wildland fire since 1988, mostly from fires in 2006 and 2007. This management area is in the Forest's wildland fire use planning area. There are no National Fire Plan communities in the area, but the Silver Creek Plunge area is considered a wildland-urban interface area due to private development adjacent to the Forest. Historical fire regimes for the area are estimated to be: 19 percent lethal, 53 percent mixed1 or 2, and 28 percent non-lethal. An estimated 25 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 34 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses – See the Recreation Resources section for recreation special uses.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	1501	Manage the Middle Fork Payette River eligible river corridor to its classification standards, and preserve its outstandingly remarkable values and free-flowing status, until it undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	1577	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1502	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1503	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	1504	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	1505	Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1506	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	1507	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1508	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1509	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1578	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	1510	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1511	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1512	Management actions—including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1579	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1513	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1514	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1580	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Vegetation Guideline	1515	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	1581	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1516	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Guideline	1517	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	1582	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Standard	1518	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1519	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1520	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1521	Identify stream ford crossings to close to reduce erosion, stabilize stream banks, and improve water quality and fish habitat.
	Objective	1522	Identify restoration activities through mid- or project-scale analysis to reduce management-related sediment.
	Objective	1523	Restore riparian conditions, such as bank stability and deep-rooted vegetation, where degraded in lower-gradient stream reaches.
	Objective	1524	Maintain or improve bull trout habitat within Bull Creek and the Upper Middle Fork Payette River subwatersheds to help promote recovery of this species.
	Objective	1525	Provide for connectivity of bull trout and other native fish populations in Silver Creek and Bridge Creek by removing fish passage barriers.
	Objective	1526	Continue to work with partners such as Trout Unlimited to improve fish habitat in Silver Creek by such measures as adding large woody debris to create pool habitat.
	Objective	1527	Maintain or improve headwater stream spawning and rearing habitat for native fish.
	Objective	1528	Continue to coordinate and collaborate with the State of Idaho Department of Environment Quality (DEQ) and other partners in implementing the Total Maximum Daily Load (TMDL) requirements for the Middle Fork of the Payette River.
	Objective	1529	Adjust management practices as needed in the Stoney Meadows area to reduce impacts to the meadows and provide for desired wetlands conditions.
Vegetation	Objective	1530	Restore PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine), PVG3 (Cool, Moist Douglas-fir), PVG5 (Dry Grand Fir) and PVG6 (Cool Moist Grand Fir) vegetation groups as described in Appendix A emphasizing the large tree size class in the Boiling Springs watershed (5th code HUC 1705012103).

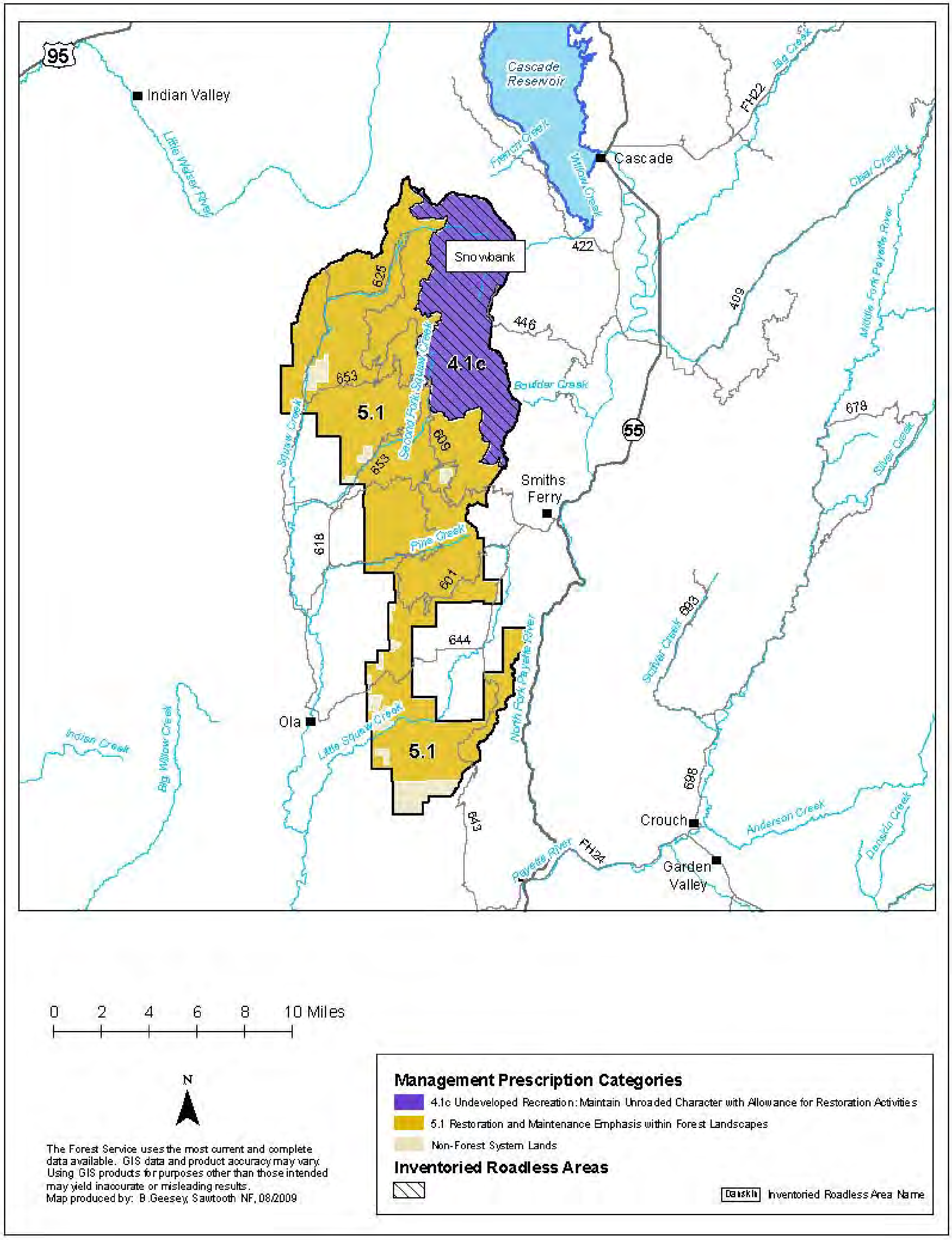
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1531	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1532	Reduce conifer density into meadow complexes to restore meadow conditions, with emphasis in the Stoney Meadows area.
	Objective	1533	Restore and maintain riparian vegetation along Silver Creek to improve water quality, wildlife habitat, and the recreational setting. Where riparian vegetation is trending towards a climax community, restore early seral components to improve regeneration and diversity.
Botanical Resources	Objective	1534	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, to contribute to the long-term viability of these species.
	Standard	1535	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	1536	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
Wildlife Resources	Objective	1537	Provide for east/west habitat connectivity corridors to improve security for big game.
	Objective	1583	Focus source habitat restoration activities within the Upper Middle Fork Payette watershed (5th code HUC 1705012104) in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E.*)
	Objective	1584	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Upper Middle Fork Payette priority watershed (5th code HUC 1705012104). (*Refer to Conservation Principle 6 in Appendix E.*)
	Guideline	1585	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Upper Middle Fork Payette watershed (5th code HUC 1705012104) should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (*Refer to Conservation Principles 1, 4, and 5 in Appendix E.*)
Recreation Resources	Objective	1538	Continue to coordinate with Boise County, Valley County, and Idaho Department of Parks and Recreation on the grooming of snowmobile trails to maintain winter recreation opportunities.
	Objective	1539	Improve Bull Creek, Liggett Creek, Sixteen-to-one Creek, Middle Fork, Fool Creek, and Middle Fork Cutoff Trails to reduce sediment delivery to streams.
	Objective	1540	Provide opportunities for off-road motorized travel that are not detrimental to resources. Identify and develop off-road motorized use opportunities, where appropriate, on the west side of Silver Creek to enhance motorized recreation opportunities.
	Objective	1541	Evaluate cross-country travel routes to Curtis Lake to determine if rehabilitation measures are needed to reduce dispersed recreation impacts to soil, water, and fisheries resources. If rehabilitation measures are needed, analyze alternatives and implement appropriate management actions to reduce recreation impacts.

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1542	Where dispersed recreation is degrading riparian vegetation in Silver Creek, restore sites by relocating, hardening, or other methods.
	Objective	1543	Complete a dispersed recreation management plan that provides for dispersed recreation opportunities that minimize impacts to riparian zones, including heavy use areas in the backcountry.
	Objective	1544	Monitor the effectiveness of dispersed recreation management efforts in the Silver Creek/Peace Valley area using photo points, dispersed site inventories and surveys and visitor contacts. If efforts are determined to not be effective, develop a plan to further reduce resource impacts and increase visitor satisfaction.
	Objective	1545	Improve facilities at the Silver Creek Plunge campground by constructing new toilets and fire rings to improve sanitation facilities, accessibility, and to reduce impacts to other resources.
	Objective	1546	Reconstruct Silver Creek campground to focus visitor camping further from Silver Creek, to improve camping facilities, and to provide additional camping opportunities in the Silver Creek area.
	Objective	1547	Continue to operate Silver Creek Plunge Campground in conjunction with the Silver Creek Plunge Resort.
	Objective	1548	Reconstruct the Boiling Springs Campground to reduce impacts to aquatic and riparian resources of the Middle Fork of the Payette River, as well as to enhance visitor experiences.
	Objective	1549	Provide a potable water system, an accessible trail to the river, and accessible toilet facilities at the Boiling Springs Guard Station rental cabin to improve recreation experiences for cabin renters.
	Objective	1550	Improve trailheads for the Middle Fork, Silver Creek Summit, and Long Fork of Silver Creek trails by expanding parking, constructing loading ramps and providing sanitation facilities where needed to enhance trail experiences.
	Objective	1551	Relocate portions of the Silver Creek Summit and Bull Creek trails to avoid wet areas and reduce maintenance needs.
	Objective	1552	Evaluate the need and location of the Middle Fork Trail from Fool Creek Trail bridge to the Middle Fork Road bridge.
	Objective	1553	Maintain foot travel access to hot springs on the Middle Fork of the Payette River.
	Objective	1554	Develop trail management plans to guide trail maintenance activities.
Recreation Resources	Objective	1555	Assess impacts from motorized uses across the management area. If the assessment determines a need, restrict motorized use to locations that reduce impacts to acceptable levels
	Objective	1556	Work with the Idaho Department of Parks and Recreation to develop solutions to reducing ATV intrusion on the Peace Creek Trail.
	Objective	1557	Continue use of the Egger Creek recreation residence.
	Objective	1558	Evaluate and incorporate methods to help prevent weed establishment and spread from concentrated recreation and trail use in the Silver Creek subwatershed. Consider annual weed inspection and treatment of trailheads, campgrounds, and other high-use areas; and posting educational notices in these areas to inform the public of areas that are highly susceptible to weed invasion and measures they can take to help prevent weed establishment and spread.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1559</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>1%</td><td>0%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>63%</td><td>98%</td></tr>
<tr><td>Roaded Natural</td><td>12%</td><td>0%</td></tr>
<tr><td>Roaded Modified</td><td>24%</td><td>2%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="5">Cultural Resources</td><td>Objective</td><td>1560</td><td>Maintain the National Register status of eligible properties, including the Peace Valley archaeological site, Silver Creek Lookout, and Boiling Springs and Silver Creek Guard Stations.</td></tr>
<tr><td>Objective</td><td>1561</td><td>Conduct an inventory to identify historic trails and properties contributing to a heritage trails system, specifically in the Clear Creek Summit and Stony Meadow areas. Provide interpretive materials for the public using these trails.</td></tr>
<tr><td>Objective</td><td>1562</td><td>Monitor the conditions of National Register eligible properties in the area, specifically prehistoric sites in high use areas along the Middle Fork Payette River and Silver Creek.</td></tr>
<tr><td>Objective</td><td>1563</td><td>Nominate Silver Creek Lookout, Boiling Springs GS, and Silver Creek Guard Station to the NRHP, and develop maintenance plans to protect the historic character of these facilities.</td></tr>
<tr><td>Objective</td><td>1564</td><td>Provide interpretation for visitors using the Boiling Springs Guard Station, which is on the Forest’s cabin rental program.</td></tr>
<tr><td>Tribal Rights And Interests</td><td>Objective</td><td>1565</td><td>Continue operating under and update as needed the Memorandum of Understanding with the Nez Perce Tribe.</td></tr>
<tr><td rowspan="2">Timberland Resources</td><td>Objective</td><td>1566</td><td>Reduce the hazard from uncharacteristic wildfire and insect epidemics, with emphasis on forestlands supporting ponderosa pine.</td></tr>
<tr><td>Objective</td><td>1567</td><td>Emphasize stocking control and fuels reduction in plantations on suited timberlands.</td></tr>
<tr><td>Rangeland Resources</td><td>Objective</td><td>1568</td><td>Reduce or eliminate livestock/developed recreation conflicts, particularly around developed recreation areas.</td></tr>
<tr><td rowspan="3">Fire Management</td><td>Objective</td><td>1569</td><td>Identify areas appropriate for wildland fire use, focusing on Inventoried Roadless Areas. Use wildland fire to restore or maintain vegetative desired conditions or to reduce fuel loadings. Develop and prioritize vegetation treatment plans for wildland-urban interface in coordination with local and tribal governments, agencies, and landowners.</td></tr>
<tr><td>Objective</td><td>1570</td><td>Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.</td></tr>
<tr><td>Objective</td><td>1571</td><td>Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	1572	Reduce sediment from the Bridge Creek Road (676) to reduce impacts to water quality and fish habitat.
	Objective	1573	Evaluate closing or decommissioning Forest Road 671I road on the south side of Silver Creek to prevent motorized vehicles from crossing the creek.
	Objective	1574	Upgrade Forest Road 671 from Trail Creek over to Silver Creek. Consider paving this road.
	Objective	1575	Remove all unneeded facilities and other research-installed improvements at the Silver Creek Watershed Research Project site to reduce resource concerns.
Scenic Environment	Standard	1576	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Boiling Springs rental cabin/hot springs	1	R	R	PR	R	PR	PR	R	PR	M
Silver Creek, Boiling Springs Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 671, 678	2	PR	PR	M	PR	M	M	PR	M	MM
Silver Creek Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
East Mountain Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 028, 032, 033, 034, 044, 077, 078, 099, 102, 104, 110, 605	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 078, 101, 106, 107, 110 within HU 170501210401	2	M	M	M	M	M	M	M	M	MM
Forest Road 409	2	PR	PR	M	PR	M	M	PR	M	MM
Middle Fork Payette River (Railroad Pass to Road 409 crossing)	2	PR	PR	M	PR	M	M	PR	M	MM
Middle Fork Payette River (Boiling Springs area to Road 409 crossing)	1	R	R	PR	R	PR	PR	R	PR	M



Management Area 16. Sage Hen Reservoir Location Map

Management Area 16
Sage Hen Reservoir

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 16 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	23
5.1—Restoration and Maintenance Emphasis within Forested Landscapes	77

General Location and Description - Management Area 16 is comprised of lands administered by the Boise National Forest in the Payette River drainage, west of State Highway 55 from Banks to Smiths Ferry (see map, opposite page). The area lies in Valley, Gem, and Washington Counties, and is part of the Emmett Ranger District. The management area is an estimated 90,300 acres, of which 95 percent are managed by the Forest Service, 3 percent are private lands, and 2 percent are State of Idaho lands. The area is bordered by the Payette National Forest to the north, the Boise National Forest to the northeast, and by a mix of private, State, and federal lands elsewhere. The primary uses or activities in this management area have been timber management, dispersed and developed recreation, and livestock grazing.

Access - The main access to the area is by FDR 618 up Squaw Creek, and FDR 626 from Smiths Ferry to Sage Hen Reservoir. Both of these roads are well maintained and gravel-surfaced. The density of classified roads in the management area is an estimated 3.1 miles per square mile, although the northern portion of the area is inventoried as roadless. Total road density for area subwatersheds ranges between 0.5 and 6.0 miles per square mile. A good network of trails provides access to the roadless portion of the area.

Special Features - Prominent landmarks in this area include Tripod Peak and Snowbank Mountain Lookouts, and Sage Hen Reservoir. Sage Hen Reservoir is a popular recreation destination with five developed campgrounds. A portion of the Snowbank Inventoried Roadless Area comprises an estimated 22 percent of Management Area 16.

Air Quality - This management area lies within Montana/Idaho Airshed ID-14 and in portions of Gem and Valley Counties. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the Airshed in Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The closest Class I areas are the Sawtooth, Hells Canyon, and Eagle Cap Wildernesses. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common source of particulate matter in the counties was fugitive dust from unpaved roads, wildfire, and prescribed fire. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within Gem and Valley Counties (600 to 1,000 acres). There were no point sources within Valley County. In Gem County (near Emmett) point sources may have contributed to particulate matter emissions.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 4,000 feet at the Forest boundary to 8,322 feet atop Snowbank Mountain. Management Area 16 falls within portions of multiple subsections, including High Valley, Long Valley Basin, Weiser Valley and Foothills, and Council Mountain Uplands. The main geomorphic landforms associated with these subsections are structurally controlled basalt lands, frost-churned uplands and mountain slopes, and fluvial lands. The dominant slope range is 35 to 65 percent in the fluvial lands, 30 to 50 percent in the structurally controlled basalt lands, and 15 to 40 percent in the frost-churned uplands. The surface geology is primarily Idaho batholith granitics in the east and volcanic basalts in the west. Soils generally have moderate to high surface erosion potential, and moderate to high productivity. Subwatershed vulnerability ratings in this area are all low (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being low (see table below). In some locations, roads, timber harvest, livestock grazing, and recreation uses have resulted in accelerated erosion, stream channel modification, and streambank degradation.

The management area is in portions of the Upper Squaw, Little Squaw, Second Fork Squaw, Cottonwood, Ola Valley and Banks Watersheds of the Payette River Subbasin. The major streams in the area are Squaw Creek, Little Squaw Creek, Second Fork Squaw Creek, Third Fork Squaw Creek, and Shirts Creek. Sage Hen Reservoir is the largest body of standing water in the area. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). Some areas have impacts from roads, timber harvest, livestock grazing, and recreation that have increased sedimentation and nutrient levels. No water bodies within the management area were listed in 1998 as impaired under Section 303(d) of the Clean Water Act. There are no TMDL-assigned subwatersheds associated with this area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	0	9	0	3	6	2	6	1	0	0	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Focal and adjunct habitats for threatened bull trout are found in this area. Bull trout occur within streams of the Squaw-Pole, Dodson, and Third Fork subwatersheds, with strong populations occurring in the latter subwatershed. Redband trout are presently found in streams within the Kennedy and Dodson subwatersheds. Sage Hen Reservoir is a popular fishery with both native and introduced fish species. Aquatic habitat is functioning at risk in some locations due to accelerated sediment from timber management, livestock grazing, and recreation use. Native fish populations are at risk due to the presence of non-native fish species and habitat impacts noted above. The Third Fork and Squaw-Pole subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for active restoration.

Vegetation—An estimated 19 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, Perennial Grass Slopes, and Perennial Grass Montane. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (33 percent), Dry Grand Fir (7 percent), Cool Moist Grand Fir (26 percent), and Warm Dry Subalpine Fir 9 percent).

The Mountain Big Sage and Montane Shrub groups are functioning properly, with only minor impacts from past livestock grazing. The Perennial Grass Slopes and Perennial Grass Montane groups are at or near properly functioning condition; however, past grazing impacts and introduced species have altered composition and structure in localized areas. Rush skeletonweed and other noxious weeds are increasing.

The Warm Dry Douglas-fir/Moist Ponderosa Pine, Dry Grand Fir, and Cool Moist Grand Fir groups are not functioning properly in some areas due primarily to timber management and fire exclusion that have altered stand composition and structure. In managed areas, stands are dominantly young and mid-aged, with relatively few large trees, snags, and large woody debris. In unmanaged areas, stands have more late seral grand fir and less early seral ponderosa pine and western larch than is desirable, and moderate to high levels of insect and disease infestations. Large-tree, single-storied stand structure is mostly absent. Noxious weeds and introduced species are increasing in the understory. All the watersheds in the management area are a high priority for active management to restore large tree size class as well as seral western larch.

Riparian vegetation is functioning at risk due to localized impacts from timber harvest, roads, recreation, and livestock grazing. Noxious weeds and introduced plant species are increasing.

Botanical Resources - Tolmie's onion, a Region 4 Sensitive species, occurs in this management area. Swamp onion, a Region 4 Watch species, also occurs in this area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses, Spalding's silene, and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Spalding's silene, a Threatened species, may occur in fescue grassland habitats from 1,500 to 5,500 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Dalmatian toadflax, rush skeletonweed, and diffuse knapweed occur in the area, particularly along the main road corridors. An estimated 51 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weed of concern is Dalmatian toadflax, which occurs in scattered populations throughout the area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Kennedy Creek	Yes	Yes	Yes	No	No
Cottonwood-Pine	Yes	Yes	Yes	No	No
Sagehen	Yes	No	No	No	No
Third Fork Squaw Creek	Yes	No	No	No	No
High Valley	Yes	Yes	Yes	No	No
Shirts Creek	No	Yes	No	No	No

Wildlife Resources—Ponderosa pine and Douglas-fir forests at lower elevations provide habitat for white-headed woodpecker and flammulated owl, and winter range for deer and elk. Higher elevation forests provide habitat for Region 4 sensitive species such as goshawk, boreal owls, and three-toed woodpeckers, and summer range for mammals such as deer, elk, black bear, and mountain lion. Wolves have recently been documented in this part of the Forest. Bald eagles nest at Sagehen Reservoir. All habitats provide nesting and forage for migratory landbirds. High road densities affect use of habitat by wildlife species negatively influenced by road-associated factors such as disturbance, spread of noxious weeds, vulnerability to poaching, and loss of snags. Terrestrial wildlife habitat is functioning at risk in some areas due to habitat changes from timber harvest and fire exclusion, fragmentation from roads and harvest, and disturbance from recreation uses. The Little Squaw (5th code HUC 1705012214) and Lower North Fork Payette (5th code HUC 1705012301) watersheds have been identified as important to the recovery of Forest sensitive species and other native wildlife utilizing late-seral forests with low canopy conditions, and are identified as short-term high-priority areas for restoration.

Recreation Resources - The Snowbank IRA features undeveloped recreation with non-motorized trail opportunities and high visual sensitivity. Dispersed recreation in the rest of the area includes hunting, fishing, ATV use, snowmobiling, horseback riding, and hiking. Both trail and cross-country snowmobiling is very popular in the West Mountains area. Sage Hen Reservoir provides water-oriented recreation along with four developed campgrounds, two boat ramps, and a picnic area. About half the use in this management area is local, originating from Emmett, and much of the rest comes from the Treasure Valley. The area is in Idaho Fish and Game Management Units 32 and 32A. Recreation special uses include commercial campground operations at Sage Hen Reservoir and the Third Fork Guard Station cabin rental.

Cultural Resources - Cultural themes in the area include Prehistoric Archaeology, Ethnic History, Ranching, Timber, Transportation, Forest Service History, and the CCC. This area contains one of the highest densities of prehistoric sites on the Forest because of its proximity to Timber Butte, the largest known obsidian source in Idaho. West Mountain Ridge was a popular transportation corridor between Shoshonean winter villages on the Payette and Weiser Rivers and summer camps in the Long Valley area. Eagle Eye, his family, and other Indian families established homesteads in the Dry Buck area in the 1880s. The wagon road following Squaw Creek and Little Squaw Creek, over Ola Summit and through High Valley to Smiths Ferry, was the major route to Long Valley until the State funded construction of a new road up the North Fork Payette River in 1911. Ranching was an important industry in this management area, and the focus of early Forest rangers at Third Fork Guard Station, established in 1908. CCC crews constructed new buildings on the compound during the 1930s.

Timberland Resources—Of the estimated 64,100 tentatively suited acres in this management area, 40,500 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 8 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands in MPC 4.1c have been identified as unsuited for timber production. Outside of the Snowbank IRA and the Sage Hen Reservoir area, intensive timber activities have occurred in Management Area 16. This area includes the Third Fork Progeny Test Area, used to test and evaluate the growth and development of trees from different genetic sources. Forest products such as fuelwood, posts, and poles are also collected in designated areas.

Rangeland Resources - This area has portions of nine cattle allotments and features a large number of range structural improvements. Management Area 16 provides an estimated 30,100 acres of capable rangeland. These acres represent about 8 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open for mineral activities and prospecting. The potential for locatable minerals is low to unknown. The potential for geothermal resources is moderate to unknown. The potential for other leasable minerals is low. The potential for common variety mineral materials is moderate or unknown in most of the area, but high in the Snowbank IRA.

Fire Management—Over the past 20 years, there have been approximately 130 fire starts in the management area, about 75 percent of which are caused by lightning. Prescribed fire has been used to reduce activity-generated and natural fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. This management area has had only a few small fires since 1988 less than one percent of the area has been affected by wildfire.

Ola is a nearby National Fire Plan community and the area around Ola as well as around High Valley, Second Fork and Third Fork are considered wildland-urban interface areas due to private development adjacent to the Forest. Shirts Creek is also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 1 percent lethal, 46 percent mixed1 or 2, and 53 percent non-lethal. An estimated 46 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 25 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special-use authorizations include a designated utility corridor containing the Emmett-Stibnite power transmission line.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration	General Standard	1601	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the Management Area ROS objectives in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c Roads standards, below.
	Vegetation Standard	1666	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Road Standard	1602	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1603	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the ROS settings in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Road Standard	1667	There shall be no net increase in road densities in the MPC 5.1 portion of the Third Fork Squaw Creek subwatershed unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the increase in road densities shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the increase in road densities shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitat are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitat. An exception to this standard is where additional roads are required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1668	New roads and landings shall be located outside of RCAs in the MPC 5.1 portion of the Third Fork Squaw Creek subwatershed unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Standard	1669	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[2]
	Vegetation Guideline	1670	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Road Guideline	1671	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Road Standard	1604	Deleted, as part of 2010 Forest Plan amendment for WCS.

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[2] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1605	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1606	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1607	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Goal	1608	Maintain or restore bull trout habitat in Third Fork and Squaw-Pole Subwatersheds.
	Objective	1609	Initiate restoration of watershed conditions and fish habitat in the Squaw-Pole subwatershed to help strengthen the local bull trout population. Maintain habitat conditions for the strong local bull trout population in the Third Fork subwatershed.
	Objective	1610	Identify subwatersheds for restoration activities to remove major sources of management-related fine sediment.
	Objective	1611	Develop a plan to restore the upper Squaw Creek stream channel where numerous in-stream structures have degraded the stream's function and condition. The plan should promote large pool development where in-stream structures have reduced pool quality.
	Objective	1612	Maintain and improve headwater streams for spawning and rearing habitat for native fish.
	Objective	1613	Work with water users to maintain minimum flows in Sage Hen Creek.
	Objective	1614	Improve watershed conditions along Van Wyck livestock driveway.
	Objective	1615	Restore fish passage in Gabes Creek and Rammage Creek.
	Objective	1616	Coordinate with private landowners to evaluate presence/absence of bull trout in Little Squaw and Shirts Creeks and to improve fish passage downstream to the Payette River.
	Objective	1617	Reduce sediment from the roads in the Little Squaw Creek drainage by improving maintenance and surfacing as needed.
	Objective	1618	Repair or restore beaver pond area in the Little Squaw Creek drainage.
	Objective	1619	Identify impacts to fisheries in Beal Dam backwaters and connected waterways, and develop, if needed, a restoration plan to address impacts.
	Objective	1620	Coordinate with Idaho Department of Fish and Game on removal of brook trout from Wilson Meadows area.
Vegetation	Objective	1621	Restore and maintain western larch as an early seral species component in PVG6 (Cool Moist Grand Fir) vegetation group, as described in Appendix A in all the watersheds in the management area.
	Objective	1622	Restore PVG2 (Warm Dry Douglas-fir/Moist Ponderosa Pine), PVG5 (Dry Grand Fir) and PVG6 (Cool Moist Grand Fir) vegetation groups as described in Appendix A emphasizing the large tree size class in all the watersheds in the management area.
	Objective	1623	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1624	Manage vegetation in riparian areas to reduce the threat of uncharacteristic wildfire.
Botanical Resources	Objective	1625	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Tolmie's onion, to contribute to the long-term viability of these species.

MPC/Resource Area	Direction	Number	Management Direction Description
Non-native Plants	Objective	1626	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area participants.
Wildlife Resources	Objective	1627	Manage to provide for unique wild turkey habitat by using mechanical prescriptions and prescribed fire that promote shrub regeneration.
	Objective	1628	Coordinate with Idaho Department of Fish and Game on Moose re-introduction and management.
	Objective	1672	Focus source habitat restoration activities within Little Squaw (5th code HUC 1705012214) and Lower North Fork Payette (5th code HUC 1705012301) watersheds in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E.*)
	Objective	1673	Reduce open road densities within Little Squaw (5th code HUC 1705012214) and Lower North Fork Payette (5th code HUC 1705012301) watersheds where it is determined that they limit use of source habitats by wildlife species identified as TEPC or R4 Regionally Sensitive. (*Refer to Conservation Principles 5 and 6 in Appendix E.*)
	Objective	1674	Develop a bald eagle habitat management plan for the area surrounding Sagehen Reservoir.
	Objective	1675	Evaluate and develop opportunities for watchable wildlife around Sagehen Reservoir.
	Guideline	1629	Project design and implementation should provide for maintenance and restoration of habitat for elk calving in the area.
	Guideline	1676	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Little Squaw (5th code HUC 1705012214) and Lower North Fork Payette (5th code HUC 1705012301) watersheds should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals.. (*Refer to Conservation Principles 1, 4, and 5 in Appendix E.*)
Recreation Resources	Objective	1630	Emphasize developed recreation opportunities and experiences in the Sage Hen Reservoir area. Reduce conflicts between recreation and grazing in the Sage Hen Basin.
	Objective	1631	Improve the Sagehen nature trail through site hardening and development of interpretive facilities to enhance wheelchair access and recreation experiences at the site.
	Objective	1632	Assess impacts from dispersed recreation sites and off-road motorized use to soil and water resources throughout the management area. Reduce identified impacts through site hardening, relocation, decommissioning, travel management, or other appropriate means.
	Objective	1633	Evaluate the need for additional developed recreation facilities to accommodate increased use and demand.
	Objective	1634	Develop a vegetation management plan for the Sage Hen Recreation complex and foreground scenic areas to guide vegetation management in these developed recreation areas.

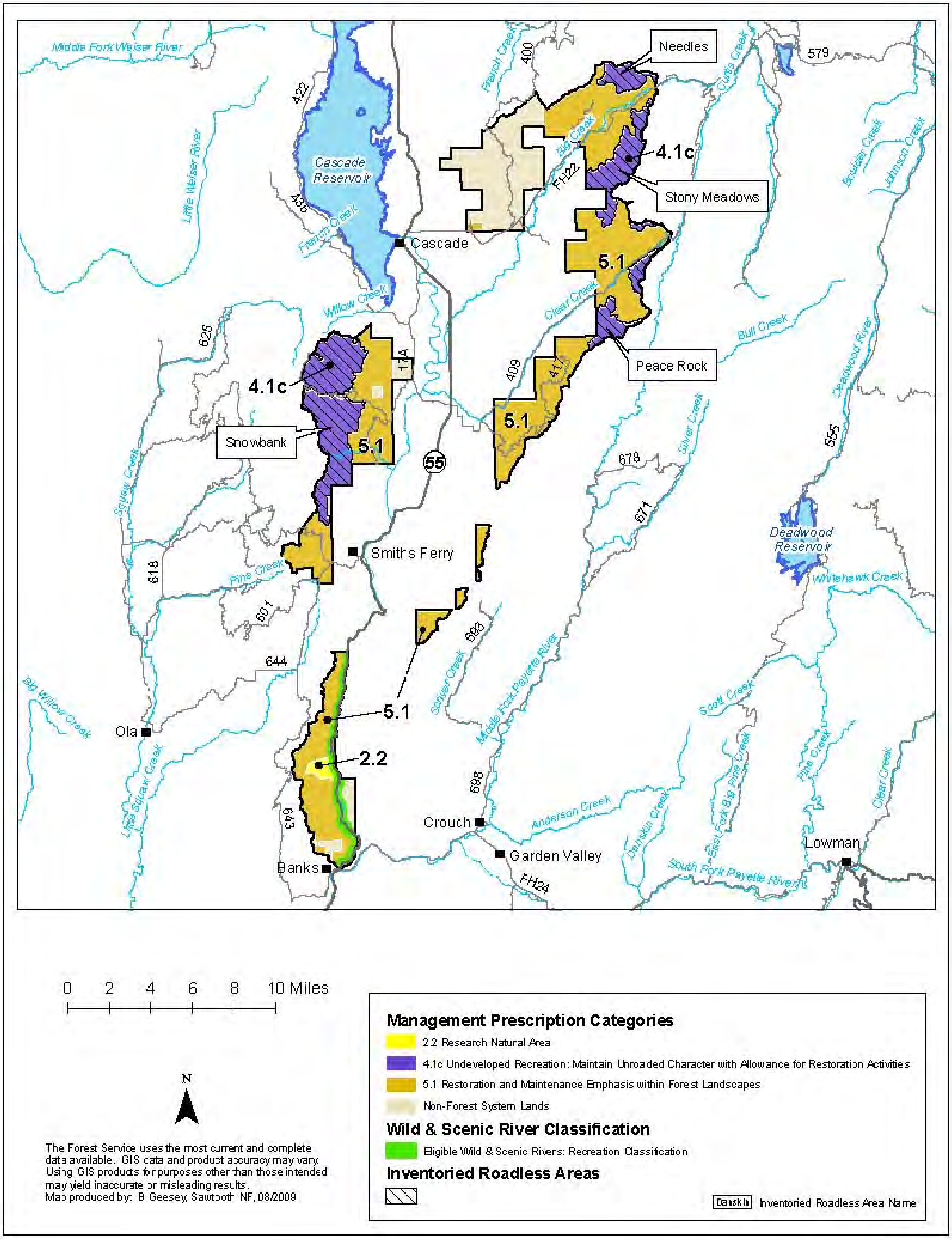
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1635	Continue cooperation with counties on grooming trails to maintain over-snow recreation opportunities.
	Objective	1636	Maintain Snowbank Inventoried Roadless Area (IRA) as non-motorized use during the snow-free recreation season. Develop parking areas for access to Snowbank IRA.
	Objective	1637	Provide over-snow recreation access and emphasize user education to minimize the potential social or environmental impacts.
	Objective	1638	Continue to provide high-quality snowmobiling opportunities, both trail and cross-country, in the Snowbank portion of the area.
	Objective	1639	Develop trail management plans to guide trail maintenance activities.
	Objective	1640	Provide for and designate ATV and other off-road vehicle opportunities using networks of old roads throughout the management area.
	Objective	1641	Achieve or maintain the following ROS strategy: (see ROS table below) The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.
Cultural Resources	Objective	1642	Maintain the National Register status of eligible properties including Third Fork Guard Station, which is on the Forest's cabin rental program.
	Objective	1643	Conduct inventories to identify historic properties along Shirts Creek and West Mountain Ridge, cabin remains at Miners Flat, and old lookouts at Gabes Peak, Dry Buck, and Greenfield Flats.
	Objective	1644	Monitor the conditions of historic properties in the management area, specifically prehistoric sites in the vicinity of Sage Hen Reservoir and Dry Buck, and cabins on Greenfield Flats and Wilson Meadows.
	Objective	1645	Develop a management plan for Third Fork Guard Station to help maintain this historic property.
Timberland Resources	Objective	1646	Manage suited timberlands for a sustained yield, even flow of forest products, while reducing sediment delivery and moving toward desired vegetation conditions.
	Objective	1647	Reduce the hazard from uncharacteristic wildfire and insect epidemics, with primary emphasis on forestland supporting ponderosa pine.
	Objective	1648	Protect and manage the Third Fork Progeny testing area in accordance with its management plan to produce genetically improved seeds for future reforestation on southwest Idaho forests. Use thinning, fertilization, and pollen management as needed to produce seed cones for ponderosa pine.

ROS Class	Percent of Mgt. Area	
	Summer	Winter
Semi-Primitive Non-Motorized	15%	0%
Semi-Primitive Motorized	3%	81%
Roaded Natural	11%	1%
Roaded Modified	71%	18%

MPC/Resource Area	Direction	Number	Management Direction Description
Timberland Resources	Objective	1649	Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Kennedy Creek, Cottonwood-Pine, and High Valley subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.
	Guideline	1650	Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before timber harvest activities begin in the Kennedy Creek, Cottonwood-Pine, and High Valley subwatersheds.
Rangeland Resources	Objective	1651	Reduce or eliminate livestock/developed recreation conflicts, particularly around Sage Hen Reservoir.
	Objective	1652	Evaluate and incorporate methods to help prevent weed establishment and spread from livestock grazing activities in the Kennedy Creek Cottonwood-Pine, High Valley, and Shirts Creek subwatersheds. Consider changes in the timing, intensity, duration, or frequency of livestock use; the location of salting; and restoration of watering sites.
Mineral Resources	Objective	1653	Evaluate mine at Miners Flat for restoration needs.
	Objective	1654	Locate and evaluate existing and abandoned mines for reclamation needs.
Fire Management	Objective	1655	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1656	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazard and risk. Work with landowners to increase defensible space.
	Objective	1657	Coordinate with adjacent land managers (BLM, State of Idaho, Payette NF) to develop compatible wildland fire suppression strategies.
Lands and Special Uses	Objective	1658	Identify and evaluate opportunities for land exchange in the Sage Hen Recreation Area to acquire lands having high recreation value to increase recreational access, expand existing facilities, and improve management efficiency.
	Objective	1659	Evaluate and maintain as appropriate special use permits, such as Boise State University's seismic sensor, utility corridors, and fiber optic buried cables.
Facilities and Roads	Objective	1660	Develop site plans that include maintenance and improvement needs for all administration sites, including Tripod Lookout.
	Objective	1661	Coordinate with Federal Aviation Administration to improve road maintenance, with emphasis on Forest Road 446 to reduce sediment.
	Objective	1662	Continue use and maintenance of gravel pit sites, and evaluate and locate new sources of gravel.
	Objective	1663	Pursue Forest Highway designations for Forest Roads 614 and 626.

MPC/Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	1664	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Kennedy Creek, Cottonwood-Pine, Sage Hen, Third Fork Squaw Creek, and High Valley subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	1665	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Sage Hen Reservoir and recreation sites	1	PR	PR	PR	PR	PR	PR	PR	PR	M
State Highway 55	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 446	1	R	R	PR	R	PR	PR	R	PR	M
Forest Trail 153, 133	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 618, 626, 614, 645	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 643, 644	2	M	M	M	M	M	M	M	M	MM
Forest Trails 131, 134, 135, 136, 137	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 138, 140, 141, 223	2	PR	PR	M	PR	M	M	PR	M	MM



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 17. North Fork Payette River Location Map

Management Area 17
North Fork Payette River

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 17 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	1
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	27
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	72

General Location and Description - Management Area 17 is comprised of lands administered by the Boise National Forest within the North Fork Payette River drainage, from Banks to Cascade (see map, opposite page). The area lies in Valley and Boise Counties, and is part of the Emmett and Cascade Ranger Districts. The management area is an estimated 78,500 acres, of which the Forest Service manages 83 percent, 2 percent are private lands, and 15 percent are State of Idaho lands. The primary uses or activities in this management area have been dispersed and developed recreation, timber management, and livestock grazing.

Access - The main access to the area is by paved State Highway 55 and well maintained, gravel-surfaced Snowbank Mountain Road and Clear Creek Road (Forest Roads 446 and 409). The density of classified roads in the management area is an estimated 3.0 miles per square mile, although part of the area is inventoried as roadless. Total road density for area subwatersheds ranges between 1.9 and 6.0 miles per square mile. Access is primarily by road in this area, with few if any maintained trails.

Special Features – State Highway 55 has been designated as a state and federal scenic byway. Prominent landmarks in this area include Tripod Peak and Snowbank Mountain. The Dry Buck RNA (582 acres) lies along the southern limit of grand fir in Idaho. An estimated 18 percent of the management area is inventoried as roadless, including portions of the Snowbank, Needles, Peace Rock, and Stony Meadows Roadless Areas.

One eligible Wild and Scenic River, the North Fork Payette River, falls within the management area. The Payette River has one segment in this area with a classification of Recreational. It is an estimated 12.5 miles, with a river corridor area of 4,000 acres. The North Fork is considered eligible for Wild and Scenic River status because of its outstandingly remarkable recreational values.

Air Quality - Portions of this management area lie within Montana/Idaho Airsheds ID-14 and ID-15 and in Gem, Boise and Valley Counties. Particulate matter is the primary pollutant of concern related to Forest management. There is an ambient air monitor located within the airshed in Garden Valley to evaluate current background levels, trends, and seasonal patterns of particulate matter. The closest Class I areas are the Sawtooth, Hells Canyon, and Eagle Cap Wildernesses. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the counties were wildfire, prescribed fire, and fugitive dust from unpaved roads. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low within all three counties (1,700 acres total). There were no point sources within Boise and Valley Counties. In Gem County (near Emmett) point sources may have contributed to particulate matter emissions.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 2,800 feet on the North Fork Payette River to 8,322 feet atop Snowbank Mountain. Management Area 17 falls primarily within the Long Valley Foothills and Long Valley Basin Subsections. The main geomorphic landforms are glacial trough lands, frost-churned uplands and mountain slopes, depositional lands, and fluvial mountain slopes. Slope gradients average between 0 to 20 percent on depositional lands, 15 to 40 percent in the frost-churned uplands, and between 30 to 80 percent in the glacial trough lands and fluvial mountain slopes. The surface geology is predominately granite from the Idaho Batholith east of the North Fork. West Mountain is a transition area between the Idaho batholith and Columbia River basalts. Soils generally have low to high surface erosion potential, and low to high productivity. Subwatershed vulnerability ratings range from low to moderate (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below). In some locations, roads, timber harvest, livestock grazing, and recreation uses have resulted in accelerated erosion, stream channel modification, and streambank degradation.

The management area is in portions of the Lower North Fork Payette River, Clear-Olsen, and Beaver-Big Watersheds of the North Fork Payette River Subbasin. The major streams in the area are the North Fork Payette River, Clear Creek, and Big Creek. Several high mountain lakes occur in the West Mountain area, including Blue, Hidden, Lost, Skein, Raft, and Shirts Lakes. The Howell-Phillips and Big Eddy subwatersheds are part of state-regulated public water systems for the community of Horseshoe Bend. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table below). Some locations have impacts from roads, timber harvest, livestock grazing, irrigation, and recreation use that have increased habitat alteration, flow alteration, nutrients, temperature, and sediment. Three of the 13 subwatersheds in this area were listed in 1998 as having impaired water bodies under Section 303(d) of the Clean Water Act. These subwatersheds are Tripod-Murray, Upper Clear Creek, and Lower Clear Creek. The pollutant of concern was sediment in the Clear Creek subwatersheds. The pollutant in the Tripod-Murray subwatershed was unknown. There are currently no TMDL-assigned subwatersheds associated with this area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	5	7	0	6	6	1	10	1	3	0	2

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. Threatened bull trout have not been recently documented in this area. Recreational fish streams include Big, Clear, and Fawn Creeks, and the North Fork Payette River. Aquatic habitat is functioning at risk in some locations due to stream flow alteration, and accelerated sediment from roads, timber management, livestock grazing, and recreation uses. Native fish populations are at risk due to the presence of non-native fish species.

Vegetation—Vegetation at lower elevations is typically grasslands and shrublands and dry ponderosa pine and Douglas-fir on south and west aspects, and Douglas-fir and grand fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of grand fir, Douglas-fir, and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 8 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage, Montane Shrub, Perennial Grass Slopes, and Perennial Grass Montane. The main forested vegetation groups in the area are Dry Grand Fir (9 percent), Warm Dry Douglas-Fir/Moist Ponderosa Pine (11 percent), Cool Dry Douglas-fir (11 percent), Cool Moist Grand Fir (25 percent), and Warm Dry Subalpine Fir (25 percent).

The Mountain Big Sage and Montane Shrub groups are functioning properly, with only minor impacts from past livestock grazing. The Perennial Grass Slopes and Perennial Grass Montane groups are at or near properly functioning condition; however, past grazing impacts and introduced species have altered composition and structure in localized areas. Rush skeletonweed and other noxious weeds are increasing.

The Dry Grand Fir, Warm Dry Douglas-Fir/Moist Ponderosa Pine (11%), and Cool Moist Grand Fir groups are not functioning properly due primarily to timber management and fire exclusion that have altered stand composition and structure. In managed areas, stands are dominantly young and mid-aged, with relatively few large trees, snags, and large woody debris. In unmanaged areas, stands have more late-seral grand fir and less early seral ponderosa pine and western larch than is desirable, and moderate to high levels of insect and disease infestations. Large-tree, single-storied stand structure is mostly absent. Noxious weeds and introduced species are increasing in the understory. The Clear-Olson (5th code HUC 1705012302) and Beaver-Big (5th code HUC 1705012303) watersheds are high priorities for western larch restoration.

Warm Dry Subalpine Fir and Cool Dry Douglas-fir groups are functioning at risk due to localized impacts from timber harvest and fire exclusion. Late seral subalpine fir is increasing, and seral Douglas-fir and aspen are decreasing.

Riparian vegetation is functioning at risk due to localized impacts from past timber harvest, roads, recreation, and livestock grazing. Noxious weeds and introduced plant species are increasing.

Botanical Resources – Giant helleborine orchid and Idaho douglasia, Region 4 Sensitive species, occur in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses, Spalding's silene, and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Spalding's silene, a Threatened species, may occur in fescue grassland habitats from 1,500 to 5,500 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants – An estimated 39 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. Spotted knapweed, rush skeletonweed, and Canada thistle are currently the main weeds of concern in this management area.

Subwatersheds in the table below have an inherently high risk of weed establishment and spread from activities identified with a "yes" in the various activity columns. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from those identified vectors or carriers of weed seed.

Subwatershed	Road-related Activities	Livestock Use	Timber Harvest	Recreation & Trail Use	ATV Off-Road Use
Big Eddy	Yes	No	Yes	No	No
Tripod-Murray	Yes	No	Yes	No	No
Howell-Phillips	No	No	Yes	No	No

Wildlife Resources—Ponderosa pine and Douglas-fir forests at lower elevations provide habitat for white-headed woodpecker and flammulated owl, and winter range for deer and elk. Osprey and bald eagle habitat are found along the North Fork Payette River corridor. Wolves have recently been documented in this part of the Forest. Grand fir forests at lower and mid elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, and wolverine, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. All habitats provide nesting and forage for migratory landbirds. The northern Idaho ground squirrel historically occurred in some of the meadows and open pine stands. These areas may offer potential habitat for current population expansion. High road densities negatively influence use of habitat by wildlife species affected by road-associated factors such as disturbance, spread of noxious weeds, loss of snags, or poaching.

Terrestrial wildlife habitat is functioning at risk due to habitat changes from timber harvest and fire exclusion, fragmentation from roads and harvest, and disturbance from recreation uses. The

Lower North Fork Payette (5th code HUC 1705012301) watershed has been identified as important to the recovery of Forest sensitive species and other native wildlife utilizing late-seral forests with low canopy conditions, and is identified as a short-term high-priority area for restoration.

Recreation Resources - The Snowbank IRA features undeveloped recreation with non-motorized trail opportunities and high visual sensitivity. Dispersed recreation in the rest of the area includes hunting, fishing, ATV use, snowmobiling, horseback riding, hiking, backpacking, camping, cross-country skiing, and snowmobiling. Snowmobile use is increasing, and the Idaho Department of Parks and Recreation grooms many miles of trail in the area. Both trail and cross-country snowmobiling are very popular in the West Mountains area. The North Fork Payette River and Clear Creek corridors have objectives designed to protect visual quality. The North Fork Payette River provides river-oriented recreation, including five developed campgrounds and some of the more challenging whitewater rapids in the west. Much of the use comes from the Treasure Valley or beyond. The area is in Idaho Fish and Game Management Units 24 and 32A. Recreation special uses include commercial campground operations in the North Fork Payette River corridor, the Williams Creek recreation residence tract, and two outfitter and guide operations.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ethnic History, Agriculture, Ranching, Settlement, Transportation, Forest Service History, and Timber. Historic properties in this management area are associated with Indian fishing and gathering, and historic grazing and logging on the North Fork Payette River and Long Valley. Shoshone and Nez Perce Indians fished for salmon and gathered camas in the lower elevations well into the twentieth century. West Mountain Ridge was an important transportation corridor for Shoshone Indians, and later stockmen traveling between the Weiser River and Long Valley. The Forest Service established the Crawford and High Valley Guard Stations in 1906. There were also two Forest administrative sites on Clear Creek. The Oregon Shortline built the Idaho Northern Railroad branch from Horseshoe Bend to McCall between 1912 and 1915. In the 1920s, logging became the dominant industry in this area. Boise-Payette Lumber Company established several mill towns and railroad camps along the North Fork Payette River and Clear Creek.

Timberland Resources—Of the estimated 57,400 tentatively suited acres in this management area, 34,300 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 6 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPCs 2.2 and 4.1c are identified as not suited for timber production. Outside of the North Fork Payette River corridor, intensive timber activities have occurred in Management Area 17. Forest products such as fuelwood, posts, and poles are also collected in designated areas.

Rangeland Resources - This area has portions of two cattle allotments and one active sheep allotment. Management Area 17 provides an estimated 5,600 acres of capable rangeland. These acres represent about 1 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open for mineral activities and prospecting. The potential for locatable minerals is low to unknown. The potential for geothermal resources is moderate to unknown. The potential for other leasable minerals is low. The potential for common variety mineral materials is moderate or unknown in most of the area, but high in the West Mountain area.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years, there have been about 130 fire starts in the management area, 80 percent of which have been from lightning. Only two percent of the acres have been affected by wildfire in the last 20 years.

Banks, Smiths Ferry and Cascade are nearby National Fire Plan communities and the areas surrounding these communities, as well as the Williams Creek Summer Home area and an area along the Warm Lake Highway are considered wildland-urban interface areas due to private development adjacent to the Forest. Some of the subwatersheds that occur within the wildland-urban interface are also considered to pose risks to life and property from potential post-fire floods and debris flows.

Historical fire regimes for the area are estimated to be: 9 percent lethal, 69 percent mixed1 or 2, and 22 percent non-lethal. An estimated 20 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 40 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special uses include designated electronic communication sites on Snowbank Mountain, utility corridors along Forest Road 422, and a designated utility corridor containing the Emmett-Stibnite power transmission line.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	1701	Manage the North Fork Payette River eligible corridor to its assigned Recreational classification standards, and preserve its ORVs and free-flowing status, until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.

MPC/Resource Area	Direction	Number	Management Direction Description
	Vegetation Standard	1768	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1702	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1703	Prescribed fire may be used in any river corridor as long as ORVs are maintained within the corridor.
	Fire Guideline	1704	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Objective	1705	Coordinate activities in the Dry Buck RNA with Rocky Mountain Research Station. Emphasize introduction of prescribed fire.
	General Standard	1706	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	1707	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	1708	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1709	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1769	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Road Standard	1710	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	1711	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1770	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[2]
	Vegetation Guideline	1712	The full range of treatment activities, except wildland fire use, may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	1771	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1713	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	1714	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	1772	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Fire Guideline	1715	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1716	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1717	Restore or maintain water quality and bank stability on tributary streams to the North Fork Payette River. Manage sediment delivery to achieve an improving trend toward long-term goals.
	Objective	1718	Coordinate with State of Idaho to reduce sediment from State Highway 55.

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[2] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

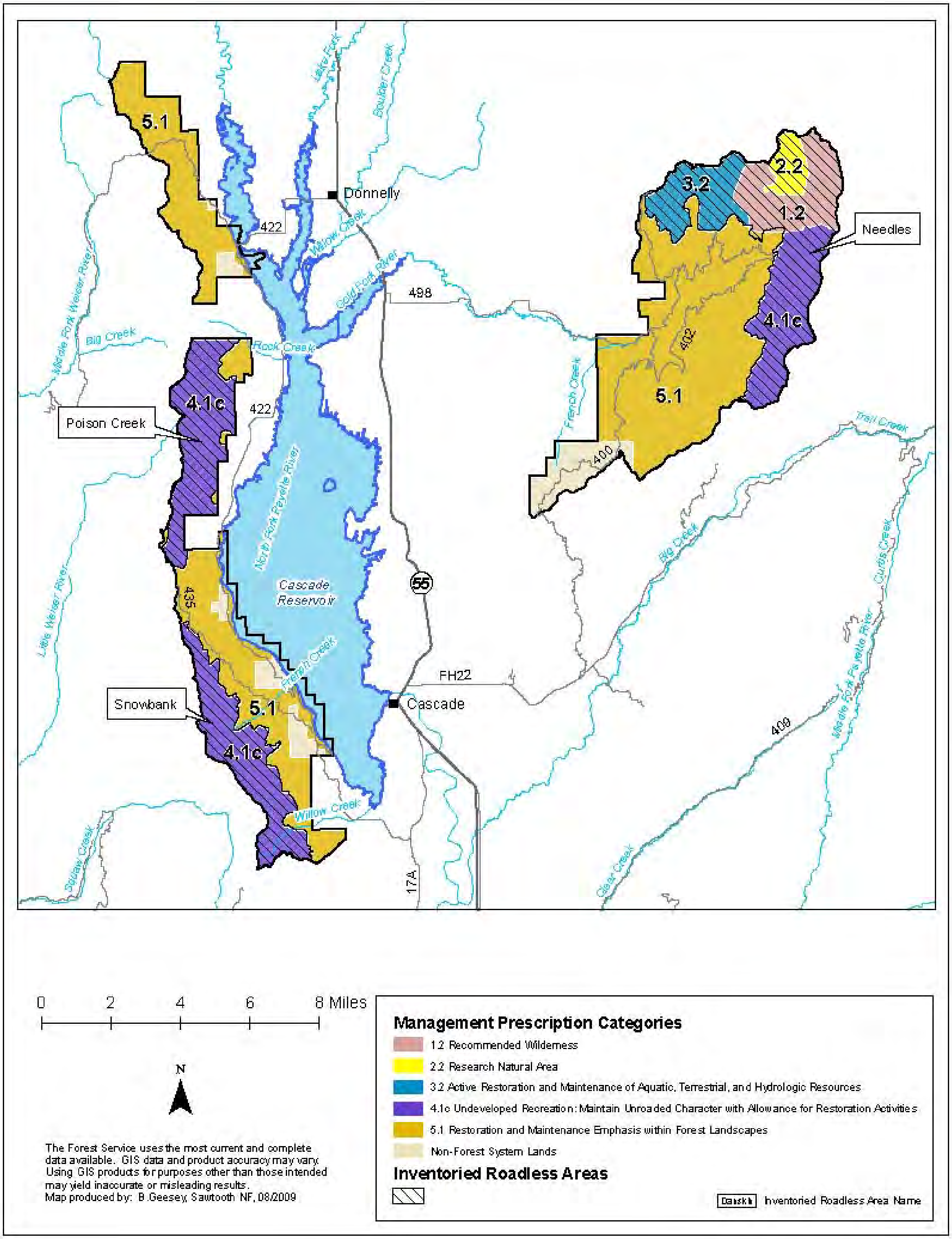
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1719	Work with private landowners in Round Valley and Chair Creek to evaluate riparian and aquatic habitat and make improvement where possible.
	Objective	1720	Restore soil and watershed conditions in the Snowbank Mountain area, emphasizing Forest Road 446 and higher-elevation areas.
Vegetation	Objective	1721	Restore and maintain western larch as an early seral species component in PVG6 (Cool Moist Grand Fir) vegetation group, as described in Appendix A in the Clear-Olson (5th code HUC 1705012302) and Beaver-Big (5th code HUC 1705012303) watersheds.
	Objective	1722	Evaluate the meadow complex at Tripod Meadows to determine whether to reduce the extent of lodgepole pine.
Botanical Resources	Objective	1723	Maintain or restore known populations and occupied habitats of TEPCS plant species, including giant helleborine orchid and Idaho douglasia, to contribute to the long-term viability of these species.
	Standard	1724	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	1725	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.
	Objective	1726	Prevent the establishment of invasive plants and eradicate or control existing noxious weeds along State Highway 55 in order to contain the spread of noxious weeds and exotic plant species. Emphasize treatment of spotted knapweed, rush skeletonweed, and Canada thistle, particularly along Warm Lake Highway and the Road 446.
Wildlife Resources	Objective	1727	Maintain or restore bald eagle wintering habitat along the North Fork Payette River corridor.
	Objective	1773	Maintain or restore bald eagle nesting habitat along the North Fork Payette River corridor, with emphasis on retaining or increasing large tree and snag components.
	Objective	1774	Focus source habitat restoration activities within the Lower North Fork Payette (5th code HUC 1705012301) watershed in areas field-verified to have good-to-excellent conditions for restoration of old forest pine stands. A primary objective of treatment should be to expand the overall patch size of old forest habitat. (*Refer to Conservation Principles 2 and 3 in Appendix E.*)
	Objective	1775	Reduce open road densities within the Lower North Fork Payette (5th code HUC 1705012301) watershed where it is determined that they limit use of source habitats by wildlife species identified as TEPC or R4 Regionally Sensitive. (*Refer to Conservation Principles 5 and 6 in Appendix E.*)
	Objective	1728	Maintain or restore shrubland and grassland communities to provide for big-game winter range habitat in low-elevation Mountain Big Sage, Montane Shrub, and Perennial Grass Slopes vegetation groups.

MPC/Resource Area	Direction	Number	Management Direction Description
	Guideline	1776	Occupied white-headed woodpecker source habitat identified during project planning for vegetative management projects within the Lower North Fork Payette (5th code HUC 1705012301) watershed should be maintained and adjacent patches should be developed to facilitate movement and dispersal of individuals. (*Refer to Conservation Principles 1, 4, and 5 in Appendix E.*)
Recreation Resources	Objective	1729	Continue to provide high-quality snowmobiling opportunities, both trail and cross-country, in the Snowbank portion of the management area.
	Objective	1730	Provide over-snow recreation access and emphasize user education to minimize the potential social or environmental impacts.
	Objective	1731	Work cooperatively with other public agencies to develop cross-country skiing opportunities and a yurt system near Cascade to enhance winter recreation opportunities.
	Objective	1732	Develop vegetation management plans for campgrounds along the North Fork of the Payette River.
	Objective	1733	Continue to coordinate with Boise County, Valley County, and Idaho Department of Parks and Recreation on the grooming of snowmobile trails to enhance recreation opportunities.
	Objective	1734	Designate and improve river access points for river users where needed for resource protection and recreationist safety. Emphasize kayak access points to improve recreation opportunities for users.
	Objective	1735	Develop trail management plans to guide trail maintenance activities.
	Objective	1736	Identify and evaluate opportunities along the Highway 55 corridor to increase recreation opportunities and improve experiences through development of additional recreation facilities as well as improvements to and expansion of existing recreation facilities.
	Objective	1737	Facilitate and participate in the development of a Scenic Byway Corridor Management Plan for the Payette River Scenic Byway with local government agencies and other partners.
	Objective	1738	Evaluate dispersed recreation activities, including OHV use as well as recreation impacts to other resources and recreation experiences in the Tripod Meadows area. If needed, develop a plan to reduce recreation impacts, expand dispersed recreation opportunities, develop OHV trail systems in appropriate locations, and to manage OHV use to reduce impacts to acceptable levels.
	Objective	1739	Develop parking and information facilities at the trailhead for the Blue Lakes Trail to enhance recreational access and experiences.
	Objective	1740	Monitor non-system trail use and enforce existing travel management regulations in-the high mountain lakes area along West Mountain to reduce impacts from motorized use.
	Objective	1741	Continue use by recreation residences within established recreation residence tracts.
	Objective	1742	Develop vegetation management and fuels management plans for lands adjacent to Williams Creek Recreation residence tract.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1743</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>10%</td><td>0%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>5%</td><td>31%</td></tr>
<tr><td>Roaded Natural</td><td>20%</td><td>19%</td></tr>
<tr><td>Roaded Modified</td><td>65%</td><td>50%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="3">Cultural Resources</td><td>Goal</td><td>1744</td><td>Identify, protect, and maintain the National Register status of historic properties in the management area.</td></tr>
<tr><td>Objective</td><td>1745</td><td>Inventory historic properties associated with early Forest Service administrative facilities and the logging railroad era on Clear Creek and its tributaries.</td></tr>
<tr><td>Objective</td><td>1746</td><td>Inventory historic properties associated with early Forest Service administrative facilities, such as East Mountain Lookout, and the railroad-logging era.</td></tr>
<tr><td rowspan="6">Timberland Resources</td><td>Objective</td><td>1747</td><td>Reduce risk from insect damage, particularly from western spruce budworm, by managing stands in a manner that will begin approaching desired conditions for vegetative components.</td></tr>
<tr><td>Objective</td><td>1748</td><td>Reduce hazard from uncharacteristic wildfire and insect epidemics, with primary emphasis on forestlands supporting ponderosa pine.</td></tr>
<tr><td>Objective</td><td>1749</td><td>Manage suited timberlands for a sustained yield, even flow of forest products, while reducing sediment delivery and moving toward desired conditions.</td></tr>
<tr><td>Objective</td><td>1750</td><td>Emphasize stocking control and fuels reduction in plantations.</td></tr>
<tr><td>Objective</td><td>1751</td><td>Reduce the opportunity for noxious weed establishment and spread by keeping suitable weed sites to a minimum during timber harvest activities in the Howell-Phillips, Big Eddy, and Tripod-Murray subwatersheds. Consider such methods as designated skid trails, winter skidding, minimal fire line construction, broadcast burning rather than pile burning, or keeping slash piles small to reduce heat transfer to the soil.</td></tr>
<tr><td>Guideline</td><td>1752</td><td>Existing noxious weed infestations should be treated on landings, skid trails, and helibases in the project area before harvest activities begin in the Howell-Phillips, Big Eddy, and Tripod-Murray subwatersheds.</td></tr>
<tr><td rowspan="2">Rangeland Resources</td><td>Objective</td><td>1753</td><td>Reduce conflicts between livestock grazing and dispersed recreation area use in Blue Lake Basin.</td></tr>
<tr><td>Objective</td><td>1754</td><td>Evaluate and adjust grazing practices on the east side of the Snowbank Mountain/ West Mountain ridgeline to reduce impacts to watershed resources and conflicts with recreation.</td></tr>
<tr><td>Fire Management</td><td>Objective</td><td>1755</td><td>Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1756	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazard and risk. Work with landowners to increase defensible space.
Lands and Special Uses	Objective	1757	Pursue a cooperative agreement with Boise Cascade on maintenance and management of Forest Road 645 to provide efficient transportation system management and improve public service.
	Objective	1758	Initiate process to remove Chapin Cabin and decommission the road to the cabin in Phillips Creek to reduce public safety hazards.
	Objective	1759	Coordinate with Boise County and local landowners to improve maintenance on access to Phillips Creek Subdivision. Continue to work towards shifting jurisdiction to the Boise County for the Phillips Creek Road.
	Objective	1760	Evaluate the need for the footbridge across the North Fork Payette River south of Big Eddy campground to provide access to the railroad. If the bridge is no longer needed, remove it. If the bridge is needed, place it under a special use permit.
	Objective	1761	Continue the special use permits for the Snowbank Mountain communication site. Update the site plan, and coordinate the management of Forest Road 446 and other development at the site with the Federal Aviation Administration.
	Objective	1762	Develop opportunities for interpretation of the Federal Aviation Administration electronic site on Snowbank Mountain.
Facilities and Roads	Objective	1763	Improve Forest Road 626 to Sage Hen Reservoir recreation areas to facilitate recreational access.
	Objective	1764	Pursue Forest Highway designations for Forest Roads 614 and 626.
	Objective	1765	Update the site plan and improve the Crawford Administrative Site, including the water system, to provide safe and acceptable housing for employees. Maintain the historic character of this historic site.
	Objective	1766	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Big Eddy and Tripod-Murray subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	1767	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
North Fork Payette River	1	R	R	PR	R	PR	PR	R	PR	M
Highway 55	1	R	R	PR	R	PR	M	R	PR	M
Forest Highway 22	1	R	R	PR	R	M	M	R	M	M
Forest Road 446 (portion above Road 404 intersection)	1	R	R	PR	R	M	M	R	M	M
Forest Trail 119	1	R	R	PR	R	M	M	R	M	M
Forest Roads 417, 446 (lower portion)	2	M	M	M	M	M	M	M	M	MM
Forest Roads 409, 497, 626, 644, 645	2	M	M	M	M	M	M	M	M	MM
Forest Trails 099, 106, 111, 150	2	PR	PR	M	PR	M	M	PR	M	MM
East Mountain Lookout	2	PR	PR	M	PR	M	M	PR	M	MM
Williams Creek Summer Homes	2	PR	PR	M	PR	M	M	PR	M	MM
Snowbank Communication Site	2	M	M	M	M	M	M	M	M	MM



Management Area 18. Cascade Reservoir Location Map

Management Area 18
Cascade Reservoir

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 18 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	7
2.2 – Research Natural Areas	2
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	5
4.1c – Maintain Unroaded Character with Allowance for Restoration Activities	27
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	59

General Location and Description - Management Area 18 is comprised of lands administered by the Boise National Forest within the North Fork Payette River drainage, from Cascade north to the Payette NF boundary (see map, opposite page). The area lies primarily in Valley County, and is part of the Cascade Ranger District. The management area is an estimated 54,400 acres, which includes several small parcels of private inholdings (2 percent), and a large block of State lands in the West/Deep Creeks area (4 percent). The western portion of the area is bordered by the Payette National Forest to the west and north, the Boise National Forest to the south, and Cascade Reservoir (now known as “Lake Cascade”) and a mix of private and State lands to the east. The eastern portion of the area is bordered by Boise National Forest to the east, Payette National Forest to the north, and mostly private lands to the west and south. The primary uses or activities in this management area have been dispersed and developed recreation, timber management, and livestock grazing.

Access - The main access to the area is by paved State Highway 55. Additional access is provided by Forest Roads on the west side of Cascade Reservoir (422), and up Gold Fork River (498). The density of classified roads in the management area is an estimated 2.4 miles per square mile. Total road density for area subwatersheds ranges between 1.9 and 4.2 miles per square mile. Several trails enter the Needles and Snowbank Roadless Areas.

Special Features - Special features of this area include Cascade Reservoir shoreline and vistas from West Mountain. The Needles RNA (1,187 acres), located near the boundary of the Boise and Payette Forests, contains a lake, wet meadows, alder glades, and certain subalpine fir habitat types. An estimated 39 percent of the management area is inventoried as roadless, including portions of the Needles, Snowbank, and Poison Creek Roadless Areas. The Forest has recommended this portion of the Needles IRA for Wilderness designation.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and Valley County. Particulate matter is the primary pollutant of concern related to Forest management.

There are ambient air monitors located within the airshed in McCall and Garden Valley to evaluate current background levels, trends, and seasonal patterns of particulate matter. The closest Class I areas are the Sawtooth, Hells Canyon, and Eagle Cap Wildernesses. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were fugitive dust from unpaved roads, wildfire, and prescribed fire. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 4,800 feet on Cascade Reservoir to 8,681 feet atop Square Top Mountain. Management Area 18 falls within the Long Valley Foothills and Long Valley Basin Subsections. The main geomorphic landforms are glaciated lands, frost-churned uplands and mountain slopes, depositional lands, and fluvial lands. Slope gradients average between 0 to 20 percent on depositional lands, 15 to 40 percent in the frost-churned uplands, and between 30 to 80 percent in the glaciated and fluvial lands. The surface geology is primarily Idaho batholith granite, although West Mountain is a transition area between the batholith and Columbia River basalts. Soils generally have low to high surface erosion potential, and low to high productivity. Subwatershed vulnerability ratings range from low to moderate, with the majority being low (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being low. In some locations, there are impacts from roads, livestock grazing, timber harvest, and recreational use. Impacts include localized accelerated sedimentation, streambank degradation, and stream bank channel modification.

The management area is in portions of the Cascade Reservoir, Gold Fork River, and Middle North Fork Payette River Watersheds of the North Fork Payette River Subbasin. The major streams in the area are the Gold Fork River, and Poison, French, Campbell, and Van Wyck Creeks. Although Cascade Reservoir does not actually lie fully within the management area boundary, all streams within the area drain into it. Water Quality Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately) (see table below), with the majority being moderate. In some locations, roads, timber harvest, livestock grazing, recreational use have contributed to accelerated erosion, high sediment yields, and higher phosphorus levels (some areas have a high natural incidence of phosphorus). Only one of five subwatersheds in this area was listed in 1998 as impaired under Section 303(d) of the Clean Water Act—the Cascade Reservoir subwatershed. This management area has a TMDL assigned to all of its subwatersheds.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	1	4	0	1	4	0	4	1	1	5	0

Anadromous fish species no longer exist within area streams due to downstream dams that block their migration routes to and from the ocean. This area does support limited populations of bull trout, with the North Fork Gold Fork subwatershed containing an isolated local population of marginal quality. Habitat is currently fragmented. Cascade Reservoir provides habitat for a variety of introduced fish species. Aquatic habitat is not functioning properly in some locations in this management area due to habitat fragmentation from roads and timber harvest, high sediment levels, and impacts to riparian areas. Native fish populations are at risk due to the presence of non-native species. The North Fork Gold Fork subwatershed has been identified as important to bull trout recovery, and as a high-priority area for restoration.

Vegetation—An estimated 27 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage and Alpine Meadows. The main vegetation groups in the area are Dry Grand Fir (8 percent), Cool Moist Grand Fir (22 percent), High Elevation Subalpine Fir (6 percent), Persistent Lodgepole Pine (16 percent), Cool Dry Douglas-fir (11 percent), and Warm Dry DF/Moist PP (8 percent). Aspen in the grand fir and Warm Dry Subalpine fir groups is becoming decadent due to fire exclusion and the encroachment of conifers.

The Alpine Meadows and Mountain Big Sage groups are functioning at risk due to localized impacts from cattle and sheep, lodgepole pine encroachment, lack of fire, and noxious weed invasion around Cascade Reservoir.

The Dry Grand Fir and Warm Dry Douglas-fir/Moist Ponderosa Pine groups are functioning at risk due to fire exclusion and earlier logging practices that removed large-diameter seral species. In the Dry Grand Fir group, this has led to an overstory and understory that is heavy to grand fir. Potential for spruce budworm is high in the grand fir. Cool Moist Grand Fir is not functioning properly due primarily to fire exclusion that has created high stand densities, high fuel loads, and a preponderance of late seral species. Western larch, which is an early seral species in Cool Moist Grand Fir, is high priority for restoration in all watersheds in the management area. Warm Dry Subalpine Fir is close to properly functioning condition. Exceptions are in large burned-over areas where patches of bare ground exist and large woody debris is currently deficit. High Elevation Subalpine Fir is functioning at risk due to localized losses of whitebark pine caused primarily by blister rust.

Riparian vegetation is functioning at risk in some areas due to impacts from grazing that have reduced the willow component, and increased the presence of introduced plant species. Localized areas also lack down woody debris and snags due to fires, past harvest treatments, and firewood gathering.

Botanical Resources – Idaho douglasia, a Region 4 Sensitive species, and Kellogg’s bitterroot, a proposed Sensitive species, are known from this management area. Tall swamp onion and bank monkeyflower, Region 4 Watch species, are also known in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies’-tresses, Spalding’s silene, and slender moonwort may exist. Ute ladies’-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas up to 7,000 feet. Spalding’s silene, a Threatened species, may occur in fescue grassland habitats from

1,500 to 5,500 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - An estimated 24 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species of concern. The main weeds of concern are spotted knapweed, Canada thistle, yellow toadflax, rush skeletonweed, and leafy spurge. All are highly invasive species that currently exist in scattered populations throughout the area. Cascade Reservoir is susceptible to invasion from Eurasian water milfoil, and the shoreline is susceptible to invasion from purple loosestrife.

All of the subwatersheds in this management area have an inherently high risk of weed establishment and spread from road-related. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from road-related vectors or carriers of weed seed.

Wildlife Resources—Douglas-fir and ponderosa pine forests at lower elevations provide some winter range for deer and elk, and limited habitat for white-headed woodpecker and flammulated owl. Osprey and bald eagle habitat are found along Cascade Reservoir. Grand fir forests at mid elevations provide habitat for Region 4 Sensitive species, goshawk, fisher, and great gray owl. High-elevation forests provide habitat for boreal owls and three-toed woodpeckers, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. Some wolverine denning habitat exists in high-elevation cirque basins. The area provides many habitats for migratory landbirds. The northern Idaho ground squirrel, a Threatened species, historically occurred in some of the meadows and open pine stands. These areas may offer potential habitat for current population expansion.

One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays a small portion of this Management Area: Secesh River. Terrestrial habitat is functioning at risk in some locations due to past management practices and project areas that are generally deficient in snags and large woody debris, altered migration routes and corridors, introduction of noxious weeds and exotic species, and the shift in fire regimes in low-elevation areas that have been unmanaged.

Recreation Resources - The Needles IRA features undeveloped recreation with non-motorized trail opportunities and a Preservation VQO. Dispersed recreation in the rest of the area includes hunting, fishing, motorized trail use, snowmobiling, horseback riding, and hiking. The area around Cascade Reservoir has objectives designed to protect visual quality. Cascade Reservoir provides water-oriented recreation, including developed campgrounds, fishing, boating, and water-skiing. Much of the use comes from Valley County and the Treasure Valley area. The area is in Idaho Fish and Game Management Unit 24. A year-round destination resort (Tamarack) is going to be developed on adjacent State of Idaho and private lands. Recreation special uses include commercial campground operations and the Cascade Christian Camp along Cascade Reservoir.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ranching, Mining, Forest Service History, Reclamation, Recreation, and the CCC. Stone tools recovered near the reservoir indicate Indian use of the area as long as ten thousand years ago. The Cascade

Reservoir area was an important fishery for Shoshone and Nez Perce Indians. Long Valley was settled in the 1880s and contains some of the oldest agricultural sites on the Forest. These homesteads supplied the Salmon River and Boise Basin mining camps with meat, fresh produce, and livestock feed. Settlements such as Van Wyck, Thunder City, and Crawford equipped miners headed to the Thunder Mountain gold rush in 1900. Stockmen from eastern Oregon and the Weiser River Valley drove livestock into Long Valley on the Van Wyck Trail. Cascade, established in 1912, was the headquarters of the old Payette National Forest. In 1916, the Forest Service established Gold Fork Guard Station in conjunction with a lookout on Gold Fork Rock. The Civilian Conservation Corps built a new lookout on a nearby peak in the 1930s. The Cascade Ranger District became one of the Forest's most popular recreation destinations after the dam and reservoir were completed in 1948.

Timberland Resources—Of the estimated 36,900 tentatively suited acres in this management area, 19,000 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 4 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. Lands within MPC 1.2, 2.2, 3.2, and 4.1c are identified as not suited for timber production. The level of timber management has been fairly high in roaded areas and low elsewhere. Forest products such as fuelwood, posts, poles, and Christmas trees are collected in designated areas.

Rangeland Resources - This area has portions of five cattle allotments, one active sheep allotment, and a stock driveway. Management Area 18 provides an estimated 1,300 acres of capable rangeland. These acres represent less than 1 percent of the capable rangeland on the Forest. Grazing is prohibited in the headwaters of the Cascade Municipal Watershed.

Mineral Resources - This area is open for mineral activities and prospecting. Recreational suction dredge mining is popular on the Gold Fork River. The potential for locatable minerals is unknown. The potential for geothermal resources is moderate to unknown. The potential for other leasable minerals is low. The potential for common variety mineral materials is moderate or unknown in most of the area, but high in the West Mountain area.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. This management area is not in the Forest's wildland fire use planning area, so no wildland fire use is anticipated. Over the past 20 years, there have been approximately 130 fire starts, 75 percent of which were lightning-caused. This management area ranks second in fire starts per acre, likely due to its proximity to storms up from the south and west, and the complex topography of the area relative to weather flows. Though only 13 percent of the management area has burned since 1988, the 1989 Needles Fire burned 80 percent of the Needles RNA. Another large wildfire in the area was the 2007 North Fork Fire.

Cascade is a nearby National Fire Plan community and most of the western portion of the management area adjacent to Cascade Reservoir as well as surrounding Gold Fork Hot Springs is considered wildland-urban interface area due to private development adjacent to the Forest. Subwatersheds including the wildland-urban interface are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 14 percent lethal, 71 percent mixed1 or 2, and 15 percent non-lethal. An estimated 13 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 44 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - The Midway Point, No Business East, and No Business West designated communications sites are all within the management area. Two proposed utility corridors are located within the management area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	1801	Management actions, including prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	1802	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	1803	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	1804	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	1805	Road construction and reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1806	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
MPC 2.2 Research Natural Areas	General Standard	1807	Mechanical vegetation treatments, salvage harvest, and prescribed fire may only be used to maintain values for which the area was established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	1808	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	1809	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.

MPC Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1810	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1811	Vegetation restoration or maintenance treatments—including mechanical and prescribed fire—may only occur where they: a) Maintains or restores water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintains or restores habitat for native and desired non-native wildlife and plant species; or c) Reduces risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1870	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Road Standard	1812	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1813	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities	General Standard	1814	Management actions—including mechanical vegetation treatments, salvage harvest, prescribed fire, special use authorizations, and road maintenance—must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standard, below.
	Vegetation Standard	1871	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Road Standard	1815	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1816	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape in the area.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	1872	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1820	There shall be no net increase in road densities in the MPC 5.1 portion of the North Fork Gold Fork subwatershed unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the increase in road densities shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the increase in road densities shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitat are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitat. An exception to this standard is where additional roads are required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Road Standard	1821	MPC 5.1 portion of the North Fork Gold Fork subwatershed unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1822	In the MPC 5.1 portion of the North Fork Gold Fork subwatershed, do not reopen classified roads in Level 1 maintenance status or Level 2 roads that have become impassable unless it can be demonstrated through a project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, reopening these roads for use shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, reopening these roads shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. Where reopening these roads cannot meet these constraints, consider decommissioning. An exception to this standard is where reopening Level 1 or 2 classified roads is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	1817	The full range of treatment activities, except wildland fire use, may be used to restore and maintain desired vegetation and fuel conditions. Salvage harvest may also occur.
	Vegetation Guideline	1873	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1818	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	1819	Road construction or reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	1874	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.2 Commodity Production Emphasis within Forested Landscapes	Road Standard	1820	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Road Standard	1821	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Road Standard	1822	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1823	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Fire Guideline	1824	Deleted, as part of 2010 Forest Plan amendment for WCS.
Soil, Water, Riparian, and Aquatic Resources	Objective	1825	Reduce effects of roads and cattle grazing on the upper portion of West Mountain that are contributing sediment and phosphorus to tributaries of Cascade Reservoir.
	Objective	1826	Assist in de-listing Cascade Reservoir from the State of Idaho’s impaired water bodies list by applying appropriate and active watershed restoration to the Cascade Reservoir subwatershed.
	Objective	1827	Continue improvement of streambank stability and increase shrub component by reducing impacts from livestock grazing in the low elevations of drainages.
	Objective	1828	Restore bull trout habitat in the Gold Fork drainage by reducing management-induced sediment and management-created migration barriers.
	Objective	1829	Initiate restoration of watershed conditions and fish habitat in the North Fork Gold Fork subwatershed to help strengthen local bull trout populations.
	Objective	1830	Manage for and emphasize instream flows of cold water on the west side of Cascade Reservoir and the North Fork Payette River.
	Guideline	1831	Coordinate with adjacent landowners, federal, state, local agencies, and private individuals or businesses to improve soil-hydrologic function, water quality, and fish passage within the management area.
Vegetation	Objective	1832	Deleted, as part of 2010 Forest Plan amendment for WCS.
	Objective	1833	Restore and maintain western larch in PVG6 (Cool Moist Grand Fir) as described in Appendix A in all watersheds in the management area.
	Objective	1834	Restore meadow conditions by reducing conifer density that has occurred due to the lack of fire and natural disturbance processes.
Botanical Resources	Objective	1835	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia and Kellogg’s bitterroot, to contribute to the long-term viability of these species.
	Objective	1836	Reduce spotted knapweed, Canada thistle, and rush skeletonweed within rare plant occupied and potential habitat.
	Standard	1837	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.
Non-native Plants	Objective	1838	Manage designated non-native, invasive weeds in an integrated approach, as specified in the Strategic and Annual Operating Plans established by the Upper Payette River Cooperative Weed Management Area Participants.

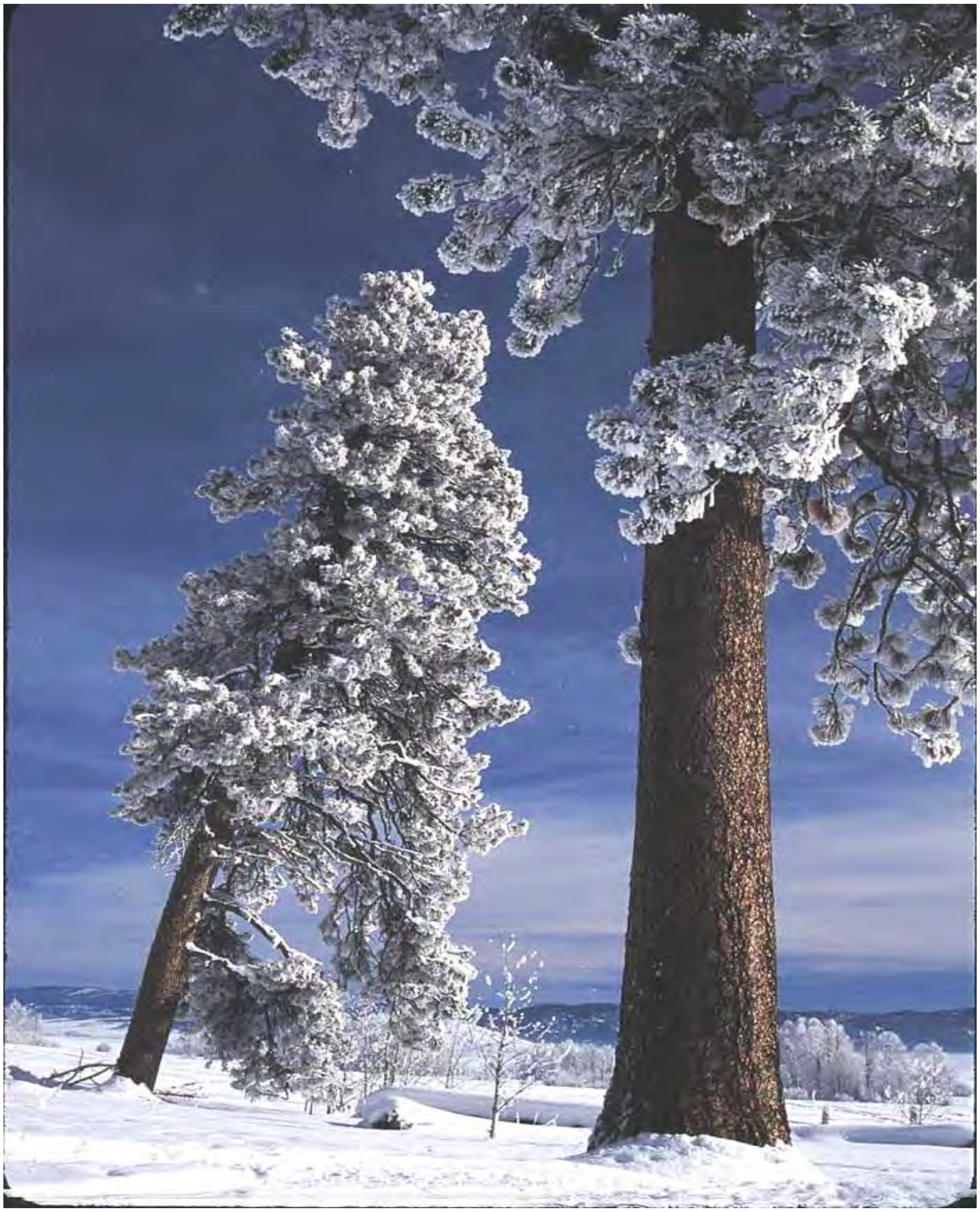
<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1839</td><td>Develop preventive measures to reduce the likelihood of purple loosestrife and Eurasian water milfoil establishment in Cascade Reservoir and other water bodies.</td></tr>
<tr><td rowspan="2">Wildlife Resources</td><td>Objective</td><td>1840</td><td>Manage to provide for nesting habitat for the bald eagle around Cascade Reservoir.</td></tr>
<tr><td>Objective</td><td>1841</td><td>To improve big-game winter range, restore the Mountain Big Sage vegetation group at lower elevations. Emphasize reducing noxious weeds and increasing native plant forage.</td></tr>
<tr><td rowspan="12">Recreation Resources</td><td>Objective</td><td>1842</td><td>Monitor off-road and off-trail ORV use west of Cascade Reservoir, and enforce existing travel restrictions to reduce recreation impacts to wildlife, soil, and water resources.</td></tr>
<tr><td>Objective</td><td>1843</td><td>Develop vegetation management plans for campgrounds along the reservoir to guide vegetation management within the developed sites.</td></tr>
<tr><td>Objective</td><td>1844</td><td>Monitor the non-system trail network surrounding developed and dispersed camping sites to determine and help reduce impacts to soil, water, and vegetation resources.</td></tr>
<tr><td>Objective</td><td>1845</td><td>Explore opportunities to develop additional motorized routes for ORV use.</td></tr>
<tr><td>Objective</td><td>1846</td><td>Evaluate dispersed recreation sites along Cascade Reservoir to determine whether sediment and phosphorous impacts from these sites can be reduced to help implement the associated TMDL.</td></tr>
<tr><td>Objective</td><td>1847</td><td>Evaluate the need for additional developed recreation capacity in existing developed sites to address increased recreational use and demand.</td></tr>
<tr><td>Objective</td><td>1848</td><td>Continue to coordinate with Valley County and Idaho Department of Parks and Recreation on the grooming of snowmobile trails to maintain that winter recreation opportunity.</td></tr>
<tr><td>Objective</td><td>1849</td><td>Identify additional potential developed recreation sites to increase day use and camping opportunities in appropriate locations along the west side of Lake Cascade. Pursue partnership of these sites once their development is approved.</td></tr>
<tr><td>Objective</td><td>1850</td><td>Consider partnership opportunities with the Idaho Department of Parks and Recreation to manage developed recreation facilities at Lake Cascade.</td></tr>
<tr><td>Objective</td><td>1851</td><td>Work cooperatively with other public agencies to develop cross-country skiing opportunities and a yurt system near Cascade.</td></tr>
<tr><td>Objective</td><td>1852</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>12%</td><td>0%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>10%</td><td>51%</td></tr>
<tr><td>Roaded Natural</td><td>16%</td><td>8%</td></tr>
<tr><td>Roaded Modified</td><td>62%</td><td>41%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Objective</td><td>1853</td><td>Maintain the National Register status of the Gold Fork Lookout cabin and other eligible properties.</td></tr>
</table>

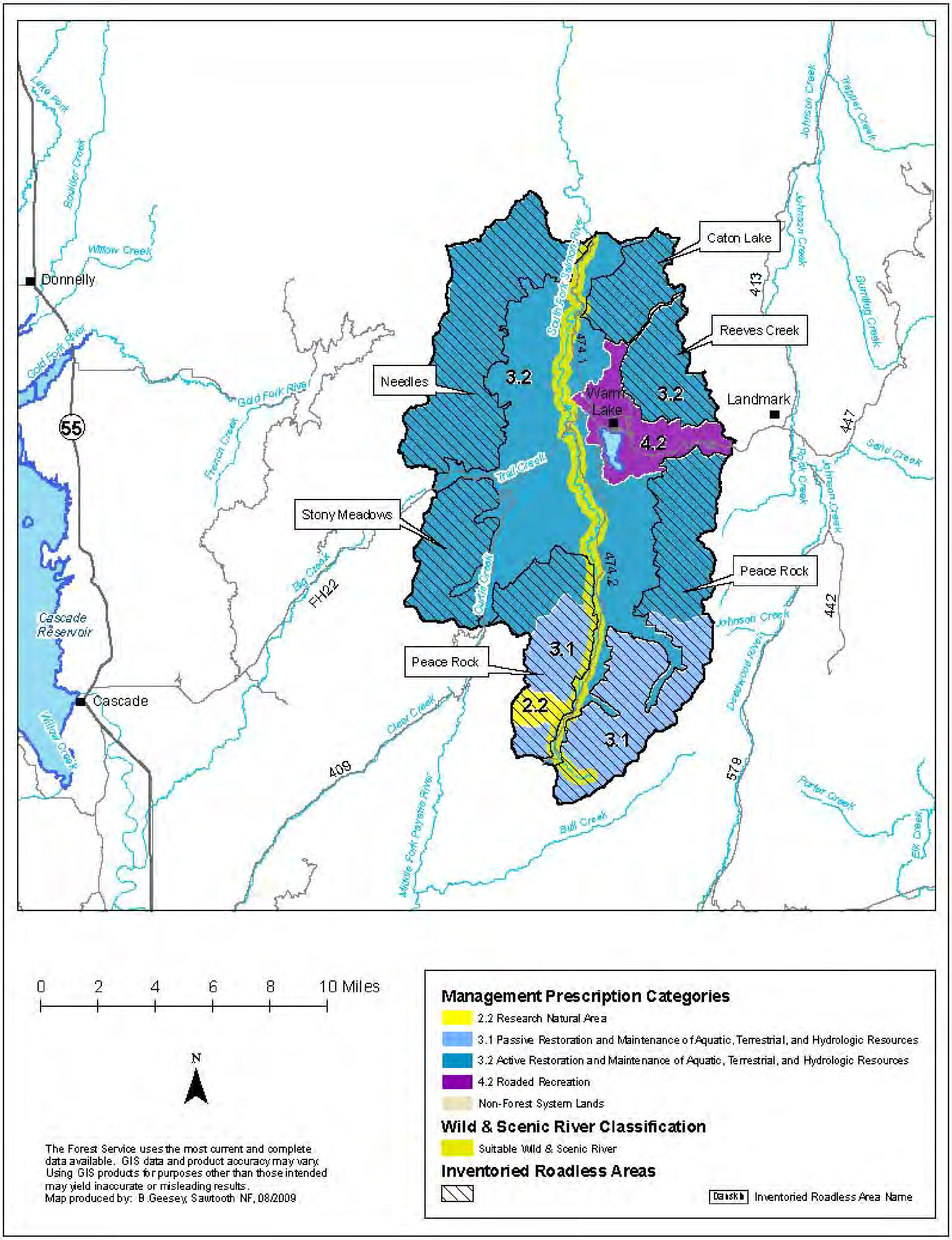
MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	1854	Conduct an inventory to identify historic trails and properties. Provide interpretive materials for the public using these trails.
	Objective	1855	Monitor the conditions of National Register eligible properties in the management area, specifically prehistoric sites located along the Cascade Reservoir.
Timberland Resources	Objective	1856	Reduce risk from undesirable levels of insect damage, particularly from western spruce budworm, by managing stands in a manner that will begin approaching desired future conditions for vegetative components.
Rangeland Resources	Objective	1857	Manage Van Wyck stock driveway and holding pasture use to minimize sediment and phosphorus contributions to Cascade Reservoir.
	Objective	1858	Evaluate grazing within the meadows in the South Fork of Gold Fork River to determine whether soil and water conditions need to be improved.
Fire Management	Objective	1859	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1860	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.
Lands and Special Uses	Objective	1861	Update site plans for the three communication sites on No Business Mountain to meet agency policy and eliminate potential use conflicts.
	Objective	1862	Continue the special use permits for power line and telephone easements.
	Objective	1863	Continue the special use permit for the church organization camp on the west side of Cascade Reservoir.
Facilities and Roads	Objective	1864	Evaluate the Crawford administrative site to determine the need for new facilities for seasonal employees.
	Objective	1865	Meet or exceed maintenance levels on all roads in the Gold Fork drainage, and monitor roads to determine if objective is met. Invite other landowners in the area to participate.
	Objective	1866	Develop proposals to eliminate and stabilize unneeded roads to reduce impacts on other Forest resources and to improve management efficiency of district transportation system.
	Objective	1867	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in all area subwatersheds. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.

MPC/Resource Area	Direction	Number	Management Direction Description
Scenic Environment	Objective	1868	Manage to provide for scenic values of the West Mountain area as seen from the town of Cascade and the Highway 55 corridor.
	Standard	1869	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Cascade Reservoir	1	R	PR	PR	R	PR	PR	R	PR	M
Needles Recommended Wilderness	1	P	P	P	P	P	P	P	P	P
Highway 55	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 422	1	R	R	PR	R	PR	M	R	PR	M
Forest Road 435	1	PR	PR	PR	PR	PR	M	PR	PR	M
No Business Lookout	1	PR	PR	PR	PR	PR	M	PR	PR	M
Forest Trail 133	1	PR	PR	M	PR	PR	M	PR	M	M
Amanita, Rainbow Point, and French Creek Campgrounds	2	PR	PR	M	PR	PR	M	PR	M	M
Forest Roads 186, 497	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 402 (to trailhead)	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 001, 111, 113, 114, 115	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 116, 117, 118, 120, 121	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 150, 162, 196	2	PR	PR	M	PR	M	M	PR	M	MM

Near Cascade Reservoir





The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 19. Warm Lake Location Map

Management Area 19
Warm Lake

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 19 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
1.2 – Recommended Wilderness	Trace
2.2 – Research Natural Areas	1
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	16
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	76
4.2 – Roaded Recreation Emphasis	7

General Location and Description - Management Area 19 is comprised of lands administered by the Boise National Forest near Warm Lake in the upper South Fork Salmon River drainage (see map, opposite page). The area lies in Valley County, and is part of the Cascade Ranger District. The management area is an estimated 103,600 acres, almost all of which are administered by the Forest Service. The area is bordered by Boise National Forest to the east, south, and west, and by Payette National Forest to the north. The primary uses or activities in this management area have been dispersed and developed recreation, fish habitat restoration, timber management, and livestock grazing.

Access - The main access to the area is by the paved Warm Lake Road (Forest Highway 22) from Cascade. Other access routes through the area include the South Fork Salmon River Road (Forest Road 474), Forest Road 579 from Warm Lake to Landmark, Forest Road 478 up Rice Creek, and Forest Road 409 up Curtis Creek. The density of classified roads in the management area is an estimated 1.5 miles per square mile, as over half the area is roadless. Total road density for area subwatersheds ranges between 0.6 and 1.9 miles per square mile. Trails provide access to portions of the roadless areas, and other portions are relatively inaccessible.

Special Features – Prominent landmarks in this area include Warm Lake, the South Fork Salmon River, Vulcan Hot Springs, Rice Peak, and Thunderbolt Mountain. The Back Creek Research Natural Area (1,368 acres) preserves a representation of subalpine fir habitat types. The South Fork Salmon River system has significant spawning and rearing habitat for threatened chinook salmon, steelhead trout, and bull trout. An estimated 52 percent of the management area is inventoried as roadless, including portions of the Caton Lake, Reeves Creek, Peace Rock, Stony Meadows, and Needles Roadless Areas.

A portion of one suitable Wild and Scenic River, the South Fork Salmon River, falls within the management area. The South Fork Salmon River has one segment in this management area with a classification or Recreational. This segment is an estimated 27.5 miles, with an estimated river corridor area of 8,100 acres. The South Fork is considered suitable for Wild and Scenic River status because of its outstandingly remarkable scenic, recreational, geologic, fisheries, cultural resources, and ecological/botanical values.

The Payette and Boise National Forest Wild and Scenic Rivers Suitability Study Report (FEIS Appendix J), completed to address the suitability of South Fork Salmon River for nationally recognized Wild and Scenic River status, concluded that South Fork Salmon River is suitable for designation. Recommended classifications are Recreational for Segment 1 and Wild for Segment 2.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Valley County. Particulate matter is the primary pollutant of concern related to Forest management activities. There are ambient air monitors located within the airshed in McCall and Garden Valley to evaluate current background levels, trends, and seasonal patterns of particulate matter. The Sawtooth and Hells Canyon Wildernesses are the closest Class I areas. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter within the county were fugitive dust from unpaved roads, wildfire, and prescribed fire. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 5,000 feet on the South Fork Salmon River to 8,696 feet atop Rice Peak. Management Area 19 falls primarily within the Upper South Fork Salmon River Subsection, and includes minor portions of the Salmon River Canyonlands and Fitsum Peak Glaciated Lands Subsections. The main geomorphic landforms are glaciated ridges and headlands, depositional lands, and fluvial mountain slopes. Slope gradients average between 5 to 20 percent in the depositional lands, between 40 to 75 percent in the ridges and headlands, and between 40 to 60 percent in the fluvial mountain slopes. The surface geology is Idaho batholith granitics. Soils generally have low to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings are all low (see table below). Geomorphic Integrity ratings for the subwatersheds vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being low (see table below). In some locations, roads, timber harvest, livestock grazing, and recreation in roaded areas have resulted in accelerated erosion, stream channel modification, and streambank degradation.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	0	7	0	2	5	0	5	2	6	7	0

The management area is in the Warm Lake and Upper South Fork Salmon River Watersheds of the South Fork Salmon River Subbasin, which drains north into the Salmon River Basin. The major streams in the area are the South Fork Salmon River and its tributaries, Sixbit, Trail, Curtis, and Rice Creeks. Warm Lake is the largest lake in the management area. The Forest Service currently has a water right from the State of Idaho for regulating the water level of Warm Lake. A small dam structure exists at the lake outlet. Several high mountain lakes occur in the watershed, including Curtis, Rice, Bear Creek, and Roaring Lakes. Subwatershed Water Quality Integrity ratings vary from moderate (functioning at risk) to low (not functioning appropriately), with the majority being moderate (see table above). Some locations have localized impacts from wildfire, roads, and timber harvest that have resulted in minor increases in sediment and nutrient levels. All of the subwatersheds within this area except Warm Lake Creek were listed in 1998 as impaired under Section 303(d) of the Clean Water Act. The pollutant of concern was sediment. In addition, the management area is within a TMDL-assigned subbasin.

The management area has designated critical habitat for chinook salmon. Warm Lake has been stocked with westslope cutthroat trout, rainbow trout, lake trout, and kokanee salmon. Bull trout also occur. Important spawning, rearing, and migratory habitats for chinook salmon, steelhead, and bull trout (all Threatened species) occur in the South Fork Salmon River and many of its tributaries. Native westslope cutthroat trout, redband trout, and introduced brook trout are also present. Chinook spawn and rear in the Warm Lake Creek, Dollar Creek, Tyndall-Stolle, Upper SF Salmon River, and Curtis Creek subwatersheds. Redband trout occur in the Two-bit-Roaring and Warm Lake Creek subwatersheds. Numerous improvements have been made to enhance water quality and fish habitat conditions over the past ten years. Aquatic habitat is functioning at risk due to limiting fish habitat factors in this area, including elevated fine sediment and poor pool habitat. Native fish populations are at risk due to the presence of non-native species. The Curtis Creek and Sixbit Creek subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for restoration.

Vegetation—Vegetation at lower elevations is typically ponderosa pine and Douglas-fir on south and west aspects, and Douglas-fir and grand fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of grand fir, Douglas-fir, and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 8 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups. The main vegetation groups in the area are Cool Moist Douglas-fir (1 percent), Cool Dry Douglas-fir (10 percent), Dry Grand Fir (4 percent), Warm Dry Douglas-fir/Moist Ponderosa Pine (6 percent), Cool Moist Grand Fir (12 percent), Warm Dry Subalpine Fir (34 percent), and Persistent Lodgepole Pine (22 percent).

Cool Moist Douglas-fir is functioning at risk due to the exclusion of fire and the downward trend of aspen that is associated with the vegetative type. Cool Dry Douglas-fir is functioning at risk due to exclusion of fire and outbreaks of Douglas-fir beetles. This group lacks an aspen component, and fires are producing uncharacteristic effects.

The Dry Grand Fir and Warm Dry Douglas-fir/Moist Ponderosa Pine groups are functioning at risk due to fire exclusion and earlier logging practices that removed seral species. This has led to an overstory and understory that is heavy to grand fir. Potential for spruce budworm is high in the grand fir. Down woody debris and snags are lacking in previously harvested areas. Cool Moist Grand Fir is functioning at risk due to fire exclusion and impacts from past timber harvest. This has created areas deficient of snags and large woody debris, shortages of the large tree component, loss of larch and seral species, and a dense understory of grand fir.

Warm Dry Subalpine Fir is functioning properly. Persistent Lodgepole Pine is functioning at risk due to the exclusion of fire and the associated lack of seedling/sapling stages, and the high risk of mountain pine beetle attacking the large even-aged stands that are older and lack vigor.

Though High Elevation Subalpine Fir occupies only a small portion of the management area, whitebark pine is a high priority for restoration due to the amount of disturbance that has taken place in recent years, particularly from wildland fire.

Riparian vegetation is functioning at risk in some locations due to impacts from grazing that have reduced the willow component, and the presence of exotic plant species. Localized areas lack down woody debris and snags due to fires, past harvest treatments, and firewood gathering.

Botanical Resources – Idaho douglasia and giant helleborine orchid, current Region 4 Sensitive species, occur in this management area. Also, proposed Sensitive species in the area include Kellogg's bitteroot, podgrass, white beakbrush, and bulb-bearing water hemlock. Buxbaum's sedge is a Region 4 Watch species also known from this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Spotted knapweed and rush skeletonweed occur in the area, particularly along the main road corridors. An estimated 21 percent of the management area is highly susceptible to invasion by noxious weeds and exotic plant species. The main weed of concern is spotted knapweed, which is currently found in scattered populations throughout the area. Warm Lake is susceptible to invasion from Eurasian water milfoil.

The Two Bit-Roaring subwatershed has an inherently high risk of weed establishment and spread. This risk is due to the amount of drainage area that is highly susceptible to noxious weed invasion and the relatively high level of exposure from road-related activities in this area.

Wildlife Resources—Ponderosa pine and Douglas-fir forests along the South Fork Salmon River provide habitat for white-headed woodpecker and flammulated owl, and winter range deer and elk. The area around Warm Lake is moose winter range. Douglas-fir and grand fir forests at lower and mid elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, lynx, as well as summer range for mammals such as deer, elk, black bear, and mountain lion.

Wolves are present in the area. Bald eagles use the Warm Lake area and portions of the South Fork Salmon River. The area provides habitat for migratory landbirds. One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays a portion of this Management Area: Salmon River.

Terrestrial wildlife habitat is functioning at risk. In managed areas, roads and harvest units have altered some wildlife corridors, routes, and patterns, and timber harvest and fuelwood gathering have reduced snags and large woody debris. In unmanaged areas, fire exclusion has created dense stands that are at increasing risk to uncharacteristic fire. The Warm Lake (5^{th} code HUC 1706020810) and Upper South Fork Salmon (5^{th} code HU 1706020811) watersheds have been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. These two watersheds are identified as short-term high priority areas for subsequent site-specific investigations at a finer scale.

Recreation Resources - The Warm Lake is a popular year-round destination for water-oriented recreation. Forest Service developed sites include three campgrounds, a boat ramp, a picnic area, and a swimming area. Privately owned or operated sites include lodges, summer homes, and organization camps. Dispersed recreation and includes hunting, fishing, boating, hiking, ATV use, snowmobiling, motorbiking, and horseback riding. Several hot springs occur along the SFSR corridor. Users in this area come from Cascade and Long Valley to the west, and Boise and Treasure Valley to the south. The area is primarily in Idaho Fish and Game Management Unit 25. Most trails in the area are open to motorbikes. One rental cabin exists at Stolle Meadows, and Rice Peak Lookout is being developed for rental use. Current recreation special uses include outfitter and guide operations, recreation residence tracts (Paradise Valley and Warm Lake), the Warm Lake and North Shore lodges, the Marantha and Ore-Ida organizational camps, and recreation events.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ethnic Heritage, Agriculture, Mining, Public Land Management, and Recreation. Documented Nez Perce camps existed along the South Fork of the Salmon River and at Warm Lake. These camps were used well into the historic period and the area remains important to the Nez Perce people. Knox Ranch supplied miners on their way to the Thunder Mountain mining district in the 1890s. Knox Ranch is one of the oldest agricultural sites on the Forest. Historic properties associated with the Knox operations include several historic burials and the Billy Cline Cabin. In 1916, the Forest Service converted Cline's cabin to a ranger station. Stolle Guard Station, established in 1907, was originally known as the South Fork Ranger Station. The CCC maintained a summer camp at Warm Lake and a spike camp at Stolle Meadows. CCC crews replaced the structures at Stolle Guard Station with new ones, and built new campgrounds and roads in the area. They also built a new lookout on Rice Peak, originally known as Blue Point.

Timberland Resources - Of the estimated 90,100 tentatively suited acres in this management area, 4,800 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 1 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 4.2, as shown on the map displaying the MPCs for this management area. Past timber management activity has occurred in scattered areas. One large salvage sale (Thunderbolt) occurred in this management area in 1996. This action did not construct any new permanent roads but it did fund multiple watershed restoration projects. Forest products such as fuelwood, posts, and poles are also collected in designated areas.

Rangeland Resources - Grazing is limited to recreational and administrative stock. Management Area 19 provides an estimated 53 acres of capable rangeland. These acres represent less than 1 percent of the capable rangeland on the Forest.

Mineral Resources - This area is open for mining activities and prospecting. The potential for locatable minerals is low to unknown. The potential for geothermal resources is high in the SFSR corridor and moderate elsewhere. The potential for other leasable minerals is low to unknown. The potential for common variety mineral materials is unknown.

Fire Management—Prescribed fire has been used to reduce fuels in the Warm Lake summer homes area. Large wildfires in the last 15 years include the Thunderbolt Fire in 1994 and the Warm Lake Complex in 1989. Over the past 20 years, there have been approximately 300 fire starts, 83 percent of which were lightning-caused. This management area ranks first in fire starts per acre, likely due to its proximity to storms from the south and west, and the complex topography of the area relative to weather flows. Since 1988, an estimated 81 percent of the management area has been burned by wildfires, the majority of which occurred from the 2007 Cascade Complex. Portions of the management area are in the Forest's wildland fire use planning area.

Warm Lake is a National Fire Plan community and the area surrounding Warm Lake is considered wildland-urban interface area due to private development adjacent to and within the Forest. This area is also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 24 percent lethal, 65 percent mixed1 or 2, and 11 percent non-lethal. An estimated 10 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 43 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special-use authorizations include utility corridors to private inholdings, water systems, and a designated utility corridor containing the Emmett-Stibnite power transmission line. The Cabin Creek designated communications site is located within the management area.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 1.2 Recommended Wilderness	General Standard	1901	Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
	Vegetation Standard	1902	Mechanical vegetation treatments, including salvage harvest, are prohibited.
	Recreation Standard	1903	No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute or treaty.
	Recreation Standard	1904	Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
	Road Standard	1905	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty.
	Fire Guideline	1906	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression tactics should minimize impacts to wilderness values.
Suitable Wild and Scenic Rivers	General Standard	1907	Manage the South Fork Salmon River to its Recreational classification standards, and preserve its free-flowing status and ORVs until the river is formally designated by Congress or released from further consideration as a Wild and Scenic River candidate.
	Vegetation Standard	1984	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	1908	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	1909	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	1910	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	1911	Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the area was established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	1912	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably addresses other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	1913	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.
MPC 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1914	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years.
	Vegetation Standard	1915	Mechanical vegetative treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
	Vegetation Standard	1985	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Fire Standard	1916	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
	Road Standard	1917	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1918	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, te rrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably addresses other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	1919	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	1920	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	1986	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	1921	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	1922	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
MPC 4.2 Roaded Recreation Emphasis	Recreation Objective	1923	Within the area identified as 4.2 MPC, manage and design actions to promote, maintain, or enhance the scenic, wildlife viewing, and solitude values in a developed recreation setting.
	Vegetation Standard	1987	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably addresses other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

[4] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	1924	New roads and landings shall be located outside of RCAs in the MPC 4.2 portion of the Warm Lake Management Area downstream of Warm Lake unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Road Standard	1925	New roads shall not be built in the MPC 4.2 portion of the management area downstream of Warm Lake except to replace existing roads in RCAs or directly repair human-caused damage to TEPC fish habitat in streams, unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats.
	Road Standard	1926	In areas within MPC 4.2, downstream of Warm Lake, do not reopen classified roads in Level 1 maintenance status or Level 2 roads that have become impassable unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that**:** a) For resources that are within their range of desired conditions, reopening these roads for use shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, reopening these roads shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. Where reopening these roads cannot meet these constraints, consider decommissioning. An exception to this standard is where reopening Level 1 or 2 classified roads is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	1927	Vegetation management actions—including wildland fire use, prescribed fire, and mechanical treatments—may be used to maintain or restore desired vegetation and fuel conditions provided they do not prevent achievement of recreation resource objectives.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 4.2	Vegetation Guideline	1988	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	1928	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to recreation developments and investments.
Soil, Water, Riparian, and Aquatic Resources	Objective	1929	Improve water quality by reducing road- and trail-related accelerated sediment delivery to the South Fork Salmon River and its tributaries.
	Objective	1930	Assist in de-listing the South Fork of Salmon River drainage from the State of Idaho's impaired water-bodies list by applying appropriate and active watershed restoration to reduce sediment, the identified pollutant source.
	Objective	1931	Improve streambank stability in the Stolle Meadows area by restoring and maintaining cutbank and fillslope stability structures on Stolle Road, and by revegetating banks with native species as needed.
	Objective	1932	Restore aquatic and riparian habitats in the South Fork Salmon River and its tributaries by reducing streambank instability or accelerated sediment resulting from existing roads and other disturbances.
	Objective	1933	Restore habitat for salmon, steelhead, bull trout, and native salmonids in Sixbit and Curtis Creek subwatersheds by reducing the road-related sediment delivery to streams and potential fish migration barriers.
	Objective	1934	Reduce impacts to Warm Lake by reducing sediment delivery and nutrient sources around the lake and by monitoring the water quality.
Vegetation	Objective	1935	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group as described in Appendix A in all watersheds in the management area.
	Objective	1936	Restore Warm Lake Creek Meadow by rejuvenating the willow age class structure lost due to absence floods and fire.
	Objective	1937	Restore meadow composition and vegetation diversity by reducing conifer density.
Botanical Resources	Objective	1938	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Idaho douglasia, Kellogg’s bitterroot, giant helleborine orchid, podgrass, white beakbrush, and bulb-bearing water hemlock to contribute to their long-term viability of these species.
	Objective	1939	Reduce spotted knapweed and rush skeletonweed within rare plant occupied and potential habitat.
	Objective	1940	Consider establishing areas adjacent to Warm Lake and Tule Lake as Botanical Special Interest Areas due to the presence of unique wetland habitats and plant species of concern.
	Objective	1941	Evaluate the need for a management plan for the special botanical areas adjacent to Warm Lake and Tule Lake, and develop a plan if needed.
	Objective	1942	Evaluate areas adjacent to hot springs to determine needed measures to protect sensitive plant species associated with hot springs.
	Standard	1943	Implement the Forest Service approved portions of the conservation strategy for Idaho douglasia to maintain or restore populations and habitat of this species.

MPC/Resource Area	Direction	Number	Management Direction Description
Non-native Plants	Objective	1944	Develop or incorporate measures to reduce the likelihood of noxious weed establishment, with special emphasis on spotted knapweed and rush skeletonweed.
	Objective	1945	Develop preventive measures to reduce the likelihood of Eurasian water milfoil establishment in Warm Lake.
Wildlife Resources	Objective	1946	Evaluate and reduce, if needed, impacts to wildlife from motorized trails within the roadless areas.
	Objective	1947	Maintain or provide nesting habitat for the bald eagle adjacent to Warm Lake.
	Objective	1948	Restore the large, seral species tree component in the Warm Dry Douglas-fir/Moist Ponderosa Pine potential vegetation group to improve flammulated owl and white-headed woodpecker habitat.
	Objective	1949	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Warm Lake (5th code HUC 1706020810) and Upper South Fork Salmon (5th code HU 1706020811) priority watersheds. (*Refer to Conservation Principle 6 in Appendix E.*)
Recreation Resources	Objective	1950	Manage the late summer elevation of Warm Lake to provide adequate water depths at the majority of boat docks around the lake so long as actions are consistent with State of Idaho water law, the needs of various aquatic, water, and riparian resources, and other transportation and recreation facilities.
	Objective	1951	Provide interpretive sites for watchable wildlife and other resources in the Warm Lake area to enhance visitor education and recreation opportunities.
	Objective	1952	Evaluate the trail system around Rice Peak Lookout for recreational opportunities, trail status, and improvement of stream crossings.
	Objective	1953	Improve dispersed recreation management in the South Fork/Warm Lake Basin, south of Penny Spring, to reduce impacts and potential degradation to vegetation, soil, and water resources from recreation use.
	Objective	1954	Continue to coordinate with Valley County and Idaho Department of Parks and Recreation on the grooming of snowmobile trails.
	Objective	1955	Monitor off-road and off-trail ORV use, and enforce existing travel restrictions to reduce recreation impacts to wildlife, soil, and water resources.
	Objective	1956	Improve Rice Peak Lookout for possible inclusion in the cabin rental system.
	Objective	1957	Relocate or reconstruct the Lodgepole/Boulder Creek Trail (108) where it passes through wet meadows to avoid or reduce impacts on the meadows.
	Objective	1958	Relocate and repair segments of the Rock Creek Trail to established Forest system trail standards.
	Objective	1959	Continue use by recreation residences within established recreation residence tracts.
	Objective	1960	Continue the current use of National Forest System lands by organization camps (Maranatha, Ore-Ida) and lodges (North Shore, Warm Lake) until the term of their current authorizations expire. Continued use will be evaluated prior to expiration.

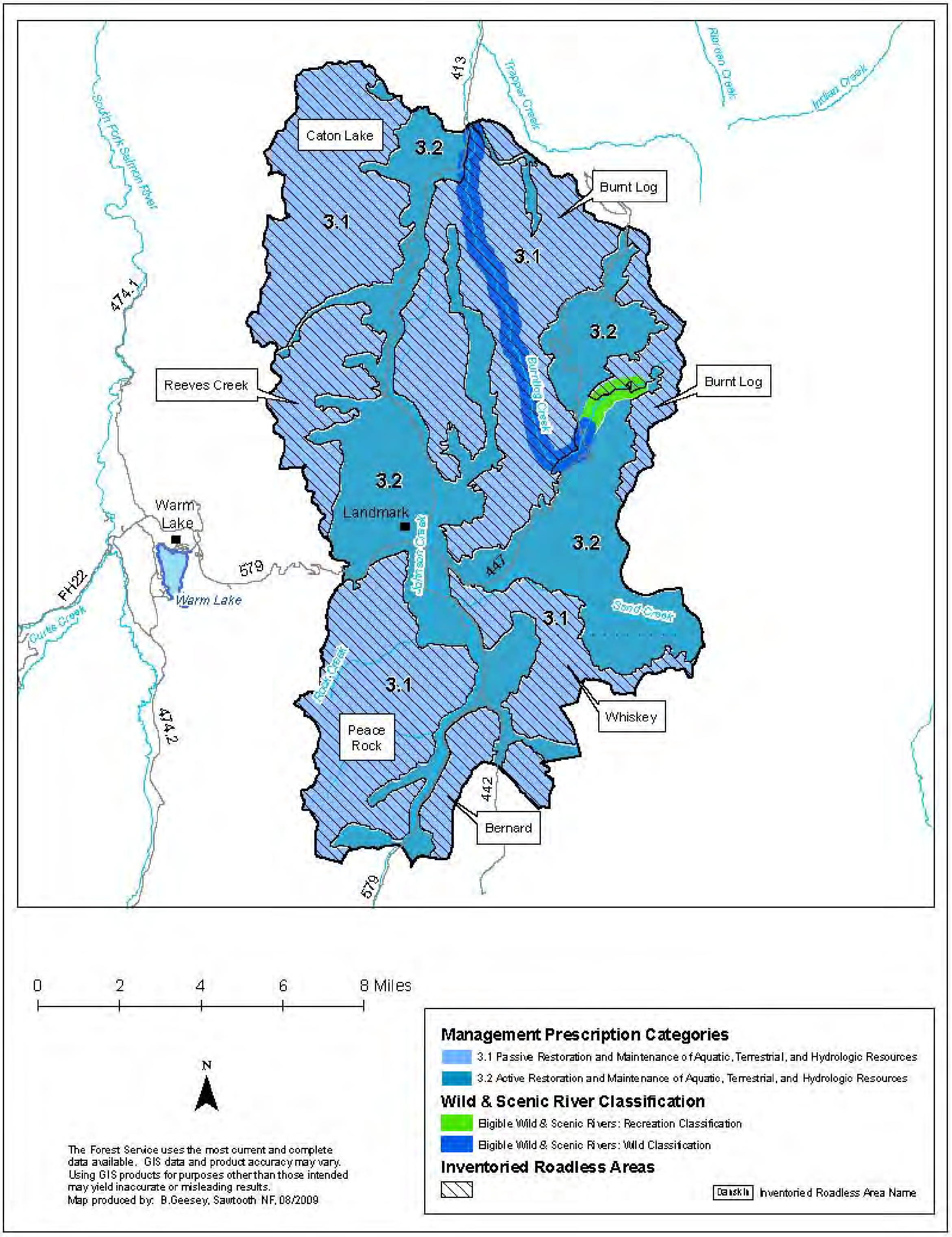
<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>1961</td><td>Continue to use and administer, as needed, the special-use permits for organizational camps and the Warm Lake and North Shore Lodges.</td></tr>
<tr><td rowspan="3">Recreation Resources</td><td>Objective</td><td>1962</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Retention</td><td>3%</td><td>3%</td></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>33%</td><td>2%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>11%</td><td>77%</td></tr>
<tr><td>Roaded Natural</td><td>19%</td><td>9%</td></tr>
<tr><td>Roaded Modified</td><td>34%</td><td>9%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td>Standard</td><td>1963</td><td>Camping by the general public will be limited to developed campsites within the “Fire Discharge Closure Area” surrounding Warm Lake.</td></tr>
<tr><td>Standard</td><td>1964</td><td>The following standards apply to management of the Warm Lake and Paradise Valley Recreation Residence tracts:
a) The total square footage of above ground development or footprint (including all buildings, decks, driveways, walkways, etc.) will not exceed 20 percent of overall lot square footage. Existing development footprints exceeding this standard are authorized.
b) Allowable square footage for all authorized buildings on each lot will not exceed a total of 2,500 square feet. Existing square footages exceeding this standard are authorized.
c) New off lot development (except boat docks and septic systems) will not be authorized. Existing off lot development is authorized and will be included in footprint and square footage calculations.
d) No new two-story buildings or second story additions (except lofts) will be authorized. Existing buildings with a second story are authorized.
e) All buildings, including outbuildings, will be of wood construction and match existing materials.
f) Earth tone colors that blend with the natural surroundings and correspond with the color of other buildings on the lot will be used on building construction, reconstruction, addition, or remodel.
g) Plans for building construction, reconstruction, addition, or remodel will follow the requirements of the programmatic agreement between the Boise National Forest and Idaho State Historic Preservation Office.
h) Additional individual dock locations will not be authorized.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Recreation Resources	Guideline	1965	The following guidelines apply to management of the Warm Lake and Paradise Valley Recreation Residence tracts: a) Manage lots to include no more than one main cabin, storage shed, deck, garage, and outhouse. All above ground development should be within the permitted lot and listed in the permit. b) Plans for new or reconstructed outhouses should include vault style construction. Existing pit toilets should be retrofitted with vaults or removed within 5 years. As cabin septic systems fail, they should be upgraded to meet existing codes. c) Recreation residence permit holders desiring to maintain the historic integrity of their permitted structures should follow the Secretary of Interior's Standards for Rehabilitation and/or Guidelines for Rehabilitating Historic Structures. d) Landscaping of lots (including lawn art, bird and animal feeders, name signs, and etc.) should blend with natural surroundings and consist of native plants. Only native grasses, flowers, shrubs, or trees should be planted. Existing non-native plants should be removed within 1 year. e) A boat dock management plan should be developed to address at a minimum: construction specifications, square footage, lake intrusion, materials, floatation encapsulation, and anchoring. Emphasis should be placed on group or community docks.
Cultural Resources	Objective	1966	Maintain the NHRP status of eligible properties, specifically prehistoric sites on the SFSR, Knox Ranch, Rice Peak Lookout, and Stolle Meadows Guard Station.
	Objective	1967	Determine the historical significance of permitted recreational residence cabins, lodges, and organizational camps. Emphasize the retention of the historic character.
	Objective	1968	Conduct an inventory to identify historic trails and properties. Provide interpretive materials for the public using these trails.
	Objective	1969	Monitor the conditions of National Register eligible properties in the management area.
	Objective	1970	Nominate Knox Ranch, Stolle Meadows Guard Station, and Rice Peak Lookout to the NRHP. Complete the restoration of Knox Ranch and make the site available to the public. Develop a management plan to protect the historic character of these facilities.
Tribal Rights and Interests	Objective	1971	Continue operating under and update as needed the Memorandum of Understanding with the Nez Perce Tribe.
Fire Management	Objective	1972	Identify areas appropriate for Wildland Fire Use, emphasizing the Inventoried Roadless Areas in the southern portion of the management area. Use wildland fire to restore or maintain vegetative desired conditions and to reduce fuel loadings.
	Objective	1973	Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.
	Objective	1974	Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.

MPC/Resource Area	Direction	Number	Management Direction Description
Fire Management	Guideline	1975	Coordinate with the Payette NF to develop compatible wildland fire suppression and wildland fire use strategies.
Lands and Special Uses	Objective	1976	Continue to coordinate with and administer a special-use permit to Idaho Department of Fish and game for operation of rearing and spawning ponds in Stolle Meadows.
	Objective	1977	Continue to coordinate with and provide a special-use permit to the U.S. Fish and Wildlife Service for the fish trap, and rearing and spawning ponds in Stolle Meadows.
	Objective	1978	Continue to administer a special-use permit to Valley County for the trash transfer station near Warm Lake.
Facilities and Roads	Objective	1979	Evaluate passenger vehicle access needs to consider converting roads no longer needed for passenger vehicles to ORV trails.
	Objective	1980	Provide fire crew housing at Warm Lake project camp to help meet National Fire Plan objectives.
	Objective	1981	Maintain Thunderbolt Lookout and trail access.
	Objective	1982	Evaluate and incorporate methods to help prevent weed establishment and spread from road management activities in the Two Bit-Roaring subwatershed. Methods to consider include: ➢ When decommissioning roads, treat weeds before roads are made impassable. ➢ Schedule road maintenance activities when weeds are least likely to be viable or spread. Blade from least to most infested sites. ➢ Consult or coordinate with the district noxious weed coordinator when scheduling road maintenance activities. ➢ Periodically inspect road systems and rights of way. ➢ Avoid accessing water for dust abatement through weed-infested sites, or utilize mitigation to minimize weed seed transport.
Scenic Environment	Standard	1983	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	Sensitivity Level	Visual Quality Objective								
		Fg			Mg			Bg		
		Variety Class			Variety Class			Variety Class		
		A	B	C	A	B	C	A	B	C
Warm Lake, Warm Lake developed recreation sites and summer homes	1	R	R	PR	R	PR	PR	PR	PR	M
Warm Lake Highway	1	R	R	PR	R	PR	PR	R	PR	M
South Fork Salmon River	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 474 to Rice Creek	1	R	PR	PR	R	PR	PR	R	PR	M
Forest Road 409	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Road 467	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 103, 105	1	R	R	PR	R	PR	PR	R	PR	M
Forest Trails 014, 072, 084	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 086, 091, 104, 108	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 109, 112, 150, 161	2	PR	PR	M	PR	M	M	PR	M	MM
Paradise Valley summer homes	1	R	R	PR	R	PR	PR	PR	PR	M

Warm Lake



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

Management Area 20. Upper Johnson Creek Location Map

Management Area 20
Upper Johnson Creek

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 10 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	63
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	37

General Location and Description - Management Area 20 is comprised of lands administered by the Boise National Forest in the upper Johnson Creek drainage east of Cascade, Idaho (see map, opposite page). The area lies in Valley County, and is part of the Cascade Ranger District. The management area is an estimated 90,900 acres, all of which are administered by the Forest Service. The area is surrounded by Boise National Forest, including the Frank Church - River of No Return Wilderness Area to the east. The primary uses or activities in this area have been fish habitat restoration, dispersed recreation, timber management, and livestock grazing.

Access - The main access to the area is by paved Forest Highway 22 from Cascade east to Landmark. It is also possible to access this area by Forest Road 674 from the south. The density of classified roads is an estimated 1.2 miles per square mile, as about half the area is inventoried as roadless. A few trails provide access to the roadless areas.

Special Features - The management area lies just west of the Frank Church - River on No Return Wilderness, and trailheads in the area access trails that lead to Little Pistol Creek, Pistol Creek, and Sulphur Creek. Prominent landmarks in this area include Landmark Forest Camp, Pen Basin, and Halfway Station historical site. An estimated 63 percent of the management area is inventoried as roadless, including all of the Whiskey, and portions of the Caton Lake, Reeves Creek, Burnt Log, Bernard, Meadow Creek, and Peace Rock Roadless Areas.

One eligible Wild and Scenic River, Burntlog Creek, falls within the management area. Burntlog Creek has one segment in this area with a Recreational classification, and one with a Wild classification. The Recreational segment is an estimated 1.9 miles, with a river corridor area of 615 acres. The Wild segment is an estimated 10.9 miles, with a river corridor area of 3,475 acres. Burntlog Creek is considered eligible for Wild and Scenic River status because of its outstandingly remarkable fisheries value.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located within the Airshed in McCall and Garden Valley to obtain current background levels, trend, and seasonal patterns of particulate matter. The Sawtooth and Hells Canyon Wildernesses are the closest Class I areas. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were fugitive dust from unpaved roads, wildfire, and prescribed fire. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from about 6,000 feet on Johnson Creek to 9,195 feet atop Log Mountain. Management Area 20 falls primarily within the Bear Valley-Landmark Basin Uplands Subsection. The main geomorphic landforms are glaciated mountains and rolling uplands and broad valley bottomlands. Slope gradients average between 15 to 40 percent. The surface geology is dominated by granitic rock of the Idaho batholith. Soils generally have low to high surface erosion potential, and moderate productivity. Precipitation ranges from 40 to 60 inches a year and falls mostly as snow from November to April. This area has one of the highest snow packs, and is also one of the coldest places in the state. The mean annual temperature is only 36°F (2°C). Subwatershed vulnerability ratings in this area are all low (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately). Roads, timber harvest, livestock grazing, and recreation are causing localized accelerated sediment, stream channel modification, and stream bank degradation.

The management area is in the Middle and Upper Johnson Creek Watersheds of the South Fork Salmon River Subbasin, which drains north into the Salmon River Basin. The main tributary streams to Johnson Creek in the area are Ditch Creek, Burntlog Creek, and Sand Creek. Several small, high mountain lakes occur in the watershed, most of which are in the headwaters of Ditch Creek. Water Quality Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk), with the majority being moderate (see table below). Past wildfires, roads, and recreation use have increased sedimentation and nutrient levels in some areas. Water bodies in the Park-Sheep, Lunch-Rock, Halfway, and Upper Johnson Creek subwatersheds were listed in 1998 as impaired under Section 303(d) of the Clean Water Act. Sediment was the pollutant of concern. There are no TMDL-assigned watersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
0	0	9	2	5	2	2	7	0	4	0	0

This area has spawning, rearing, and migratory habitat for chinook salmon and steelhead trout, and has designated critical habitat for chinook salmon. The Upper Sulphur Creek, Upper Johnson Creek, and Lower Burntlog subwatersheds provide spawning and rearing opportunities for chinook salmon. Steelhead also spawn and rear in the Lower Burntlog, Lunch-Rock, Upper Johnson Creek, and Sand Creek subwatersheds. Johnson Creek also has populations of native cutthroat trout, bull trout, brook trout, mountain whitefish, and sculpin. Bull trout and native cutthroat trout are found throughout this area. Redband trout have not been documented in this area. Aquatic habitat is functioning at risk due to degraded habitat conditions related to sedimentation, limited pools, low bank stability, and low levels of large woody debris due to past management activities and wildland fires. Native fish populations are at risk due to the presence of non-native species and habitat impacts described above. The Lower Burntlog Creek and Upper Burntlog Creek subwatersheds have been identified as important to the recovery of listed fish species, and as high-priority areas for restoration.

Vegetation—This high-elevation area largely consists of lodgepole and subalpine fir forests, interspersed with meadows. An estimated 9 percent of the management area is comprised of rock, water, or shrubland and grassland vegetation groups, including Mountain Big Sage and Alpine Meadows. The main vegetation groups in the area are Warm Dry Subalpine Fir (35 percent), Cool Dry Douglas-fir (11 percent), and Persistent Lodgepole Pine (42 percent).

Alpine and Dry Meadows are functioning at risk due to localized impacts from historic sheep grazing, lodgepole pine encroachment, and historic lack of fire.

Warm Dry Subalpine Fir and Cool Dry Douglas-fir are functioning properly. Persistent Lodgepole Pine is functioning at risk due to the exclusion of fire and the associated lack of seedling/sapling stages, and the high risk of mountain pine beetle attacking the large even-aged stands that are older and lack vigor.

Though High Elevation Subalpine Fir occupies only a small portion of the management area, whitebark pine is a high priority for restoration due to the amount of disturbance that has taken place in recent years, particularly from wildland fire.

Riparian vegetation is functioning properly.

Botanical Resources - No known populations of Region 4 Sensitive species occur within this management area. However, Mt. Shasta sedge, a proposed Region 4 Sensitive species, and Buxbaum's sedge, a Region 4 Watch species, occur in this management area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate to high potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants: Few noxious weeds and exotic plants have been found within the management area. Only about 3 percent of the management area has high susceptibility to invasion by noxious weeds and exotic plant species.

Wildlife Resources—Because most of this management area lies above 6,000 feet, the terrestrial and avian wildlife to be found are generally high-elevation species. The cool shrublands and forests provide big game summer range but are generally too high for winter range. A limited amount of cool dry forests at lower elevations provide habitat for Region 4 sensitive species, goshawk, great gray owl, and flammulated owl. High-elevation cold forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, lynx, as well as summer range for mammals such as deer, elk, black bear, and mountain lion. Wolverine denning habitat exists in high-elevation cirque basins. Wolves are present in this area. The area provides many habitats for migratory land birds.

One Idaho Comprehensive Wildlife Conservation Strategy focal area overlays a portion of this Management Area: Deadwood. Terrestrial wildlife habitat is functioning at risk. Before the large-scale wildfires of 2007, timber harvest and fuelwood gathering had reduced snags and large woody debris, and in unmanaged areas, fire exclusion had created dense stands that were at increasing risk to uncharacteristic fire. The 2007 fires have created an abundance of large woody debris and burned snags. Corridors, routes, and patterns have been altered by roads and harvest units in managed areas and are influencing use of habitat. The Middle Johnson (5th code HUC 1706020806) and Upper Johnson Creek (5th code HUC 1706020807) watersheds have been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. These two watersheds are identified as short-term high priority areas for subsequent site-specific investigations at a finer scale.

Recreation Resources - There are three small, developed campgrounds within a few miles of Landmark. Dispersed recreation is year-round and includes hunting, fishing, ATV use, snowmobiling, and horseback riding hiking. Much use in this area is local, originating from the Cascade and Warm Lake areas. The area is in Idaho Fish and Game Management Unit 25. Most of the trails in the area are open to motorbikes and snowmobiles. A portion of the Idaho Centennial Trail lies within this area. Recreation special uses include two outfitter and guide operations.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ranching, Transportation, and Forest Service History. Forest archaeologists have documented prehistoric sites on Johnson Creek associated with early indigenous and Shoshonean occupations. Between 1900 and 1904, Pen Basin was the convergence point for several competing routes to the Thunder Mountain gold rush. Weary miners could stop at a way station cabin near the confluence of Johnson and Whiskey Creeks. Stockmen from eastern Oregon and southern Idaho pastured sheep in Pen Basin throughout the summer and early fall. The number of sheep in the basin peaked during World War I, when meatpackers supplying the war effort lent stockmen money to increase the size of their herds. During the 1930s, the CCC constructed campgrounds in Pen Basin and built the present facilities at Landmark Guard Station, established in 1924.

Timberland Resources - Of the estimated 78,900 tentatively suited acres in this management area, there are no identified suited timberlands. Forest vegetation management actions may be undertaken to support the achievement of vegetation desired conditions and other resource objectives in areas allocated to MPCs 3.1 and 3.2. Any timber production that may result from forest vegetation management actions will not count toward the allowable sale quantity but will contribute toward the Forest's Total Sale Program Quantity. Past timber management has occurred in some of the roaded areas. One large salvage sale (Thunderbolt) occurred in the management area in 1996, but this action did not construct any new permanent roads and funded multiple watershed restoration projects. Fuelwood, posts, and poles are also collected in designated areas.

Rangeland Resources - This area has portions one cattle allotment. Management Area 20 provides an estimated 4,000 acres of capable rangeland. These acres represent about 1 percent of the capable rangeland on the Forest.

Mineral Resources - Several hundred mining claims exist in Management Area 20. However, few if any claims are active, and overall potential for mineral development is low to moderate.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. Over the past 20 years there have been approximately 100 fire starts in this management area, almost all of which were from lightning. Since 1988 approximately 82 percent of the management area has burned, the majority of which occurred in 2007. The management area is in the Forest's wildland fire use planning area. There are no National Fire Plan communities or wildland-urban interface areas in this management area. Historical fire regimes for the area are estimated to be: 46 percent lethal, and 54 percent mixed1 or 2. None of the area regimes has vegetation conditions that are highly departed from their historical range. However, 41 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity.

Lands and Special Uses - Special-use authorizations include a telephone utility corridor and a designated utility corridor containing the Emmett-Stibnite power transmission line.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	2001	Manage the Burntlog Creek eligible river corridor to its assigned classification standards, and preserve its outstandingly remarkable values and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	2053	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	2002	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Fire Guideline	2003	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	2004	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	2005	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years).
	Vegetation Standard	2006	Mechanical vegetation treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
	Vegetation Standard	2054	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Fire Standard	2007	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
	Road Standard	2008	Road construction and reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	2009	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	2010	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	2011	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	2055	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	2012	Road construction and reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	2013	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.
Soil, Water, Riparian, and Aquatic Resources	Objective	2014	Improve water quality by reducing road-related accelerated sediment delivery to upper Johnson Creek and its tributaries.
	Objective	2015	Assist in de-listing South Fork of Salmon River drainage, including upper Johnson Creek, from the State of Idaho's impaired water bodies list by applying appropriate and active watershed restoration to reduce sediment, which is the identified pollutant of concern.
	Objective	2016	Improve stream bank stability by reducing sediment delivery to Johnson Creek, and by revegetating banks with native plant species as needed.

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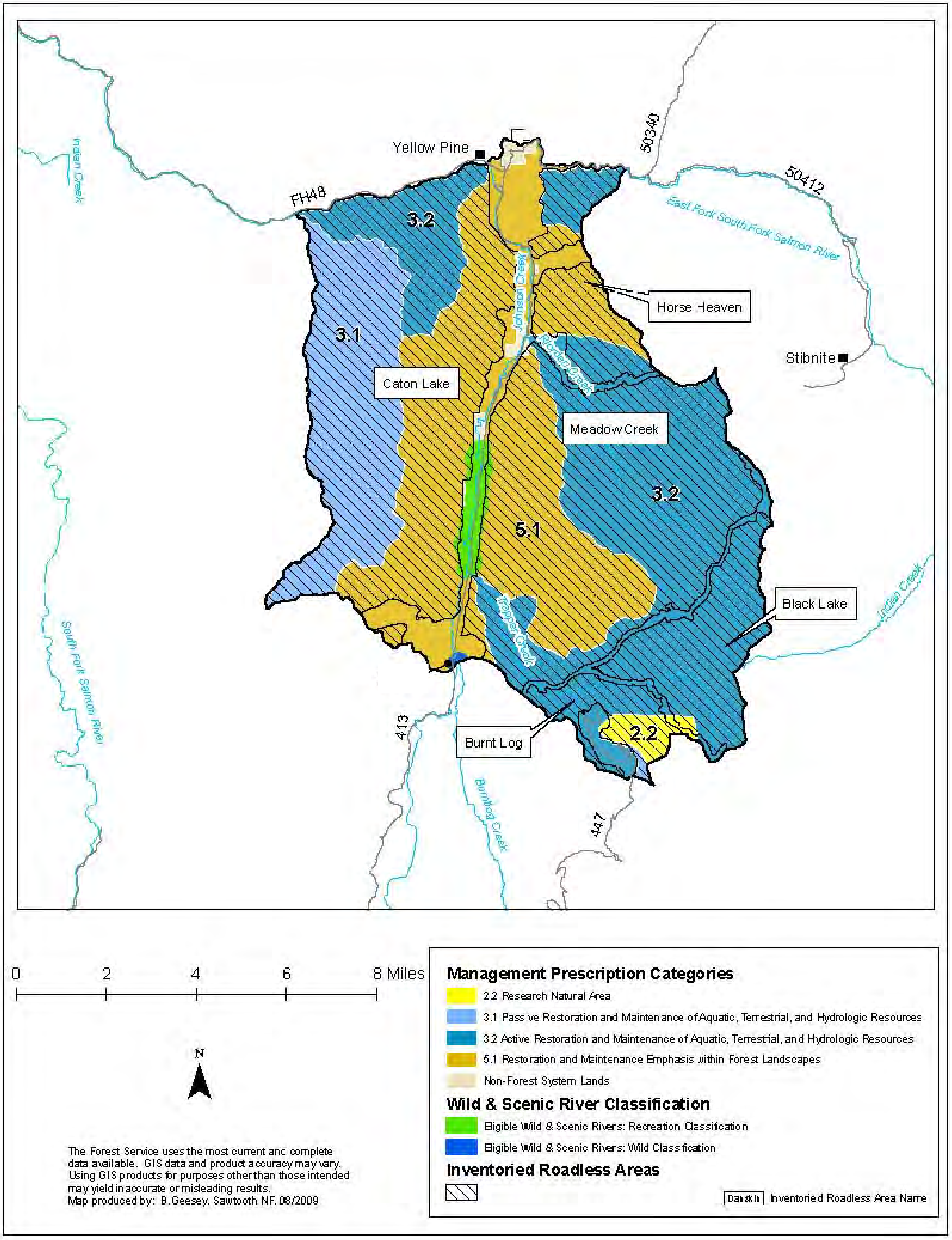
[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Objective	2017	Restore aquatic and riparian habitats in Johnson Creek and its tributaries by reducing bank instability and accelerated sediment from existing roads and other disturbances.
	Objective	2018	Prioritize restoration to improve or maintain chinook salmon, steelhead, and bull trout spawning and rearing habitats. Allow some temporary impacts in order to achieve short-term and long-term benefits to water quality and fish habitat as long as those impacts do not threaten the viability of local fish populations
	Objective	2019	Restore instream fish habitat in the Upper Burntlog and Lower Burntlog subwatersheds so that it is not a limiting factor in listed fish species and native cutthroat population recovery.
	Objective	2020	Identify fish passage barriers and sediment delivery sources in the Burntlog drainage, and design and implement corrective actions to reduce impacts to native fish and their habitat.
Vegetation	Objective	2021	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group as described in Appendix A in all watersheds in the management area.
	Objective	2022	Restore and maintain dry and alpine meadows to retain meadow composition and a diversity of vegetative communities. Reduce lodgepole pine density in dry meadows that has occurred due to the absence of fire within the Boulder, Rock, Whiskey, Bobcat, Mosquito, headwaters of Johnson Creek (Tyndall Meadows) and Sand Creek drainages.
Botanical Resources	Objective	2023	Consider establishing the Mud Lake and Shell Rock Peak areas as Botanical Special Interest Areas due to the presence of unique wetland habitats and plant species of concern.
	Objective	2024	Evaluate and develop, if needed, a management plan for the special botanical areas in the Shell Rock Peak and Mud Lake areas.
	Objective	2025	Maintain or restore known populations and occupied habitats of TEPCS plant species, including Mt. Shasta sedge, to contribute to their long-term viability of these species.
Wildlife Resources	Objective	2026	Identify opportunities and implement vegetation management actions to improve lynx foraging habitat and manage for desired conditions in the Persistent Lodgepole Pine and Warm Dry Subalpine Fir vegetation groups.
	Objective	2056	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Middle Johnson (5th code HUC 1706020806) and Upper Johnson Creek (5th code HUC 1706020807) priority watersheds. (*Refer to Conservation Principle 6 in Appendix E.*)
Recreation Resources	Objective	2027	Continue to coordinate with Valley County and Idaho Department of Parks and Recreation on the grooming of snowmobile trails to maintain winter recreation opportunities.
	Objective	2028	Reduce unauthorized ATV use and enforce existing travel restrictions to reduce recreation impacts to wildlife, soil, and water resources.
	Objective	2029	Evaluate the need for, and establish if needed, a horse/stock use campground at the old Twin Bridges campsites.
	Objective	2030	Relocate the lower end (approximately 1 mile) of the Burntlog Trail, beginning at Twin Bridges and moving toward Fenn Creek, to reduce sediment delivery to streams.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td rowspan="6"></td><td>Objective</td><td>2031</td><td>Provide a bridge crossing over Johnson Creek where the Lodgepole/Boulder Creek Trail (108) comes into Tyndall Meadows to reduce impacts to water quality and fish habitat.</td></tr>
<tr><td>Objective</td><td>2032</td><td>Evaluate and upgrade, as needed, campgrounds and trailheads to reduce impacts to other resources. Include interpretive information on protection of resource values.</td></tr>
<tr><td>Objective</td><td>2033</td><td>Evaluate dispersed recreation sites along Johnson Creek, and improve sites, as needed, to reduce sediment and to reduce impacts to other resources.</td></tr>
<tr><td>Objective</td><td>2034</td><td>Maintain, modify, or improve, as needed, the area trail system to reduce impacts to water quality and to improve user safety.</td></tr>
<tr><td>Objective</td><td>2035</td><td>Enhance interpretive signing and information regarding the wilderness boundaries.</td></tr>
<tr><td>Objective</td><td>2036</td><td>Achieve or maintain the following ROS strategy:
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>26%</td><td>1%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>4%</td><td>99%</td></tr>
<tr><td>Roaded Natural</td><td>19%</td><td>0%</td></tr>
<tr><td>Roaded Modified</td><td>51%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="4">Cultural Resources</td><td>Objective</td><td>2037</td><td>Maintain the National Register status of Landmark Guard Station and other eligible properties.</td></tr>
<tr><td>Objective</td><td>2038</td><td>Conduct an inventory to identify historic trails and properties associated with the Thunder Mountain gold rush. Provide interpretive materials for the public using these trails.</td></tr>
<tr><td>Objective</td><td>2039</td><td>Monitor the conditions of National Register eligible properties, and assess the National Register status of Snowshoe Cabin.</td></tr>
<tr><td>Objective</td><td>2040</td><td>Nominate Landmark Guard Station to the NRHP, develop a management plan to protect its historic character.</td></tr>
<tr><td>Tribal Rights and Interests</td><td>Objective</td><td>2041</td><td>Continue operating under and update as needed the Memorandum of Understanding with the Nez Perce Tribe.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>2042</td><td>Provide specialty products (house logs, posts, poles, etc.) in areas where extraction is compatible with, or does not prevent achievement of, aquatic resources and objectives.</td></tr>
<tr><td>Rangeland Resources</td><td>Standard</td><td>2043</td><td>Riparian area use will be a maximum of 30 percent use of most palatable forage species, or retain a minimum 6-inch stubble height of hydric greenline species, whichever occurs first, when riparian goals and objectives are not being met.</td></tr>
<tr><td rowspan="2">Fire Management</td><td>Objective</td><td>2044</td><td>Identify areas appropriate for Wildland Fire Use, emphasizing the Inventoried Roadless Areas. Use wildland fire to restore or maintain vegetative desired conditions and to reduce fuel loadings.</td></tr>
<tr><td>Objective</td><td>2045</td><td>Use a combination of mechanical and prescribed fire treatments adjacent to Forest Service administrative sites such as Landmark to reduce wildfire hazards.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
	Guideline	2046	Coordinate with the Salmon-Challis NF to develop compatible wildland fire suppression and wildland fire use strategies.
Facilities and Roads	Objective	2047	Evaluate road networks for opportunities to reduce sediment delivery, increase user safety, and provide for fish passage, with emphasis on the Forest Road 467 and part of Forest Road 451.
	Objective	2048	Improve maintenance of the Landmark Guard Station to meet safety standards.
	Objective	2049	Evaluate and improve, as needed, the power and water system at Landmark Guard Station.
	Standard	2050	New roads shall not be built except to replace existing roads in RCAs or directly repair human-caused damage to TEPC fish habitat in streams unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats.
	Standard	2051	Do not reopen classified roads in Level 1 maintenance status or Level 2 roads that have become impassable unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that**:** a) For resources that are within their range of desired conditions, reopening these roads for use shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, reopening these roads shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. Where reopening these roads cannot meet these constraints, consider decommissioning. An exception to this standard is where reopening Level 1 or 2 classified roads is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
Scenic Environment	Standard	2052	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Forest Road 579 (west of Landmark)	1	R	PR	PR	R	PR	PR	R	PR	M
Forest Road 413	1	R	PR	PR	R	PR	PR	R	PR	M
Trout Creek, Summit Lake Campgrounds	1	R	R	PR	R	PR	PR	R	PR	M
Forest Road 579 (south of landmark)	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 410, 440, 442	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Roads 447, 448, 467	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 075, 076, 083	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 089, 090, 091	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 092, 095, 108	2	PR	PR	M	PR	M	M	PR	M	MM
Johnson Creek	2	PR	PR	M	PR	M	M	PR	M	MM
Buck Mountain, Pen Basin Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM



The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009

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Management Area 21
Lower Johnson Creek

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 21 has the following management prescriptions (see map on preceding page for distribution of prescriptions).

Management Prescription Category (MPC)	Percent of Mgt. Area
2.2 – Research Natural Areas	1
3.1 – Passive Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	16
3.2 – Active Restoration and Maintenance of Aquatic, Terrestrial, & Hydrologic Resources	43
5.1 – Restoration and Maintenance Emphasis within Forested Landscapes	40

General Location and Description - Management Area 21 is comprised of lands administered by the Boise National Forest primarily within the Lower Johnson Creek drainage just south of Yellow Pine, Idaho (see map, opposite page). The area lies in Valley County, and is part of the Cascade Ranger District. The management area is an estimated 63,900 acres, which includes several small, private inholdings, such as Wapiti Meadows, Cox Ranch, Bryant Ranch, and the community of Yellow Pine. The area is bordered by the Payette National Forest to the west, north, and northeast, by the Boise National Forest to the south, and by the Frank Church-River of No Return Wilderness Area to the southeast. The primary uses or activities in this management area have been fish habitat restoration, dispersed recreation, timber management, livestock grazing, and mineral development.

Access - The main access to the area is by Boise Forest Road 413 from Landmark to Yellow Pine, and Payette Forest Road 412 from McCall to Yellow Pine. Both of these roads are well maintained and gravel-surfaced. Johnson Creek airstrip is also used for access during summer months. The density of classified roads in the management area is an estimated 0.7 mile per square mile, and over half the area is inventoried as roadless. Total road density for area subwatersheds ranges between 0.4 and 0.9 mile per square mile. Relatively few trails provide access to the roadless portion.

Special Features - The management area lies adjacent to the Frank Church--River on No Return Wilderness. The 1,306-acre Chilcoot Peak Research Natural Area contains an undisturbed small alpine lake and pond, as well as climax lodgepole pine with an understory of Idaho fescue. Prominent landmarks in this area include Yellow Pine and Wapiti Meadows. Chinook salmon spawning areas occur from Deadhorse Rapids to Moose Creek. A portion of the Idaho Centennial Trail lies within this area. An estimated 88 percent of the management area is inventoried as roadless, including all of the Black Lake and portions of the Horse Heaven, Caton Lake, Meadow Creek, and Burnt Log Roadless Areas.

One eligible Wild and Scenic River, Johnson Creek, falls within the management area. Johnson Creek has one segment in this area with a classification of Recreational. This segment is an estimated 2.9 miles, with a river corridor area of 940 acres. It is considered eligible for Wild and Scenic River status because of its outstandingly remarkable cultural resource value.

Air Quality - This management area lies within Montana/Idaho Airshed ID-15 and in Valley County. Particulate matter is the primary pollutant of concern related to Forest management. There are ambient air monitors located within the Airshed in McCall and Garden Valley to obtain current background levels, trends, and seasonal patterns of particulate matter. The closest Class I areas are the Sawtooth, Hells Canyon, and Selway-Bitterroot Wildernesses. Visibility monitoring has been expanded for these areas.

Between 1995 and 1999, emissions trends in both counties improved for PM 10, while PM 2.5 emissions remained constant. The most common sources of particulate matter in the county were fugitive dust from unpaved roads, wildfire, and prescribed fire. In addition to Forest management activities, crop residue and ditch burning may contribute to particulate matter emissions, although the amount of agricultural-related burning was very low in Valley County (less than 600 acres). There were no point sources within the county.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from 4,500 feet on the East Fork South Fork River to 9,195 feet atop Log Mountain. Management Area 21 falls primarily within the Bear Valley-Landmark Basin Uplands and Profile Peak-Monumental Summit Mountains Subsections. The main geomorphic landforms are glaciated mountains and rolling uplands, valley bottomlands, frost-churned uplands, and fluvial mountains. Slope gradients average between 15 to 40 percent in the bottomlands and frost-churned and rolling uplands, and between 30 to 80 percent in the glaciated and fluvial mountains. The surface geology is Idaho batholith granitics. Soils generally have low to high surface erosion potential, and moderate productivity. Subwatershed vulnerability ratings range from low to high (see table below). Geomorphic Integrity ratings for the subwatersheds vary from high (functioning appropriately) to moderate (functioning at risk) to low (not functioning appropriately) (see table below).
In some locations, roads, timber harvest, and recreation are causing accelerated sediment, stream channel modification, and stream bank degradation.

The management area is in portions of the Lower Johnson Creek and East Fork South Fork Watersheds of the South Fork Salmon River Subbasin. The major streams in the area are the East Fork South Fork Salmon River, Johnson Creek, Riordan Creek, and Trapper Creek. Several high mountain lakes occur in the watershed, including Caton, Riordan, Rainbow, and Black Lakes. No Mans-Boulder is part of a state-regulated public water system for the community of Yellow Pine. Water Quality Integrity ratings for the subwatersheds vary from high moderate (functioning at risk) to low (not functioning appropriately) (see table below). In some locations, past wildfires, roads, timber harvest, mining, and recreation use have caused an increase in sedimentation and nutrient levels. Water bodies within the Caton Creek, Loosum-Reegan, No Mans-Boulder, and Wardenhoff-Bear subwatersheds were listed in 1998 as impaired under Section 303(d) of the Clean Water Act. The pollutants of concern were sediment and metals. There are no TMDL-assigned subwatersheds associated with this management area.

Subwatershed Vulnerability			Geomorphic Integrity			Water Quality Integrity			No. 303(d) Subs	No. Subs With TMDLs	No. Public Water System Subs
High	Mod.	Low	High	Mod.	Low	High	Mod.	Low			
1	3	2	3	2	1	0	4	2	4	0	1

This area has spawning, rearing, and migratory habitat for chinook salmon, steelhead trout, and bull trout, and is designated critical habitat for these Threatened species. Johnson Creek also has resident and fluvial populations of bull trout, and populations of redband trout, native cutthroat trout, brook trout, mountain whitefish, and sculpin. Chinook, steelhead, bull trout, and redband trout occur throughout this area, with a strong local population of bull trout in the Riordan subwatershed. Native cutthroat trout are found in the Wardenhoff-Bear and Riordan subwatersheds. Concerns for habitat conditions are related to sedimentation, limited pools, low bank stability, and low levels of large woody debris due to past management activities and wildland fires. For these reasons, aquatic habitat is functioning at risk in some locations. The Wardenhoff-Bear subwatershed has been identified as important to the recovery of listed fish species and as a high-priority area for restoration.

Vegetation—Vegetation at lower elevations is typically ponderosa pine and Douglas-fir on south and west aspects, and Douglas-fir and grand fir forests on north and east aspects. Mid-elevations are dominated by shrubs and forest communities of grand fir, Douglas-fir, and subalpine fir, with pockets of persistent lodgepole pine and aspen. Forest communities of subalpine fir and whitebark pine are found in the upper elevations, interspersed with cliffs and talus slopes.

An estimated 5 percent of the area is comprised of rock, water, or shrubland and grassland vegetation groups, including Alpine Meadows. The main forested vegetation groups in the area are Warm Dry Douglas-fir/Moist Ponderosa Pine (12 percent), Warm Dry Subalpine Fir (38 percent), High Elevation Subalpine Fir (6 percent), Persistent Lodgepole Pine (27 percent) and Cool Dry Douglas-fir (11 percent).

The Alpine Meadows group is functioning at risk due to localized impacts from sheep grazing, lodgepole pine encroachment, and historic lack of fire.

Warm Dry Douglas-fir/Moist Ponderosa Pine is functioning at risk due to exclusion of fire and past high grading, creating a high percentage of Douglas-fir in the overstory and dense stands. The incidence and levels of western pine beetle and Douglas-fir beetle are high. Large-tree, single-storied structure is mostly absent.

Warm Dry Subalpine Fir is functioning properly. High Elevation Subalpine Fir is functioning at risk due to the loss of whitebark pine, which is being infected by blister rust. All the watersheds in the management area are high priority for whitebark pine restoration particularly in the areas affected by recent wildland fires.

Riparian vegetation is functioning properly.

Botanical Resources - No known populations of Region 4 sensitive species occur within this management area. However, Idaho douglasia and Kellogg's bitterroot occur in surrounding areas, and potential habitat and undiscovered populations may exist within the area. No federally listed or proposed plant species are known to occur in this area, but potential habitat for Ute ladies'-tresses and slender moonwort may exist. Ute ladies'-tresses, a Threatened species, may have moderate potential habitat in riparian/wetland areas from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants: Few noxious weeds and exotic plants have been found within the management area. Only about 10 percent of the management area has high susceptibility to invasion by noxious weeds and exotic plant species. The main weed of concern is Canada thistle, which only occurs in a few small populations.

Wildlife Resources—Ponderosa pine and Douglas-fir forests along the East Fork South Fork River provide habitat for flammulated owls, and limited winter range for deer and elk. White-headed woodpeckers may occur here but have yet to be documented. Mixed conifer forests at lower elevations provide habitat for Region 4 sensitive species, goshawk and great gray owl. Peregrine falcon and golden eagles may be found in isolated areas with rocky bluffs. High-elevation forests provide habitat for boreal owls, three-toed woodpeckers, wolverine, lynx, as well as summer range for mammals such as deer, elk, black bear, wolves and mountain lion. Wolverine denning habitat exists in high-elevation cirque basins. The area provides many habitats for migratory landbirds.

Terrestrial wildlife habitat is functioning at risk. Before the large-scale wildfires of 2007, timber harvest and fuelwood gathering had reduced snags and large woody debris, and in unmanaged areas, fire exclusion had created dense stands that were at increasing risk to stand-replacing fire. The 2007 fires have created an abundance of large woody debris and burned snags. In managed areas, corridors, routes, and patterns have been altered by roads and harvest units; and are influencing use of habitat. The Lower Johnson (5th code HUC 1706020805) watershed has been identified as important to the sustainability of Forest sensitive species and other native wildlife affected by human uses on the landscape. This watershed is identified as a short-term high priority area for subsequent site-specific investigations at a finer scale.

Recreation Resources - There are three small, developed campgrounds along the Johnson Creek corridor. Dispersed recreation occurs year-round and includes hunting, fishing, hiking, camping, ATV use, snowmobiling, and horseback riding. Much of the use in this area is local, originating from the Yellow Pine and Warm Lake areas. The area is in Idaho Fish and Game Management Unit 25. Most trails are open to some form of motorized vehicle use. Recreation special uses include two outfitter and guide operations.

Cultural Resources - Cultural themes in this area include Prehistoric Archaeology, Ranching, Forest Service History, and Mining. Lower Johnson Creek contains sites representative of the Western Idaho Archaic Complex, a unique period of Idaho prehistory dating four to six thousand years ago. Nez Perce camps existed along Johnson Creek and at Riordan Lake. These camps were used well into the historic period, and the area remains important to the Nez Perce people.

Yellow Pine and ranches on Johnson Creek were established in the early 1900s in response to mining on Big Creek and the Thunder Mountain gold rush. The Forest Service established Johnson Creek Guard Station in 1922. During World War II, the Stibnite mines were one of the nation's largest producers of mercury and other strategic minerals.

Timberland Resources - Of the estimated 53,000 tentatively suited acres in this management area, 16,000 acres have been identified as being suited timberlands, or appropriate for timber production. This represents about 3 percent of the Forest's suited timberland acres. The suited timberland acres are found in MPC 5.1, as shown on the map displaying the MPCs for this management area. The level of past timber management has been high in roaded areas and low elsewhere. Forest products such as fuelwood, posts and poles are collected in designated areas.

Rangeland Resources - This area has portions of one cattle allotment and one horse allotment. Management Area 21 provides an estimated 2,900 acres of capable rangeland. These acres represent less than 1 percent of the capable rangeland on the Forest.

Mineral Resources - The area is open to mineral activities and prospecting, and development is currently taking place. The locatable mineral potential is moderate to high. The leasable mineral potential for geothermal resources is moderate. The potential for other leasable mineral resources is low. The potential for common variety mineral materials is moderate.

Fire Management—Prescribed fire has been used to reduce activity-generated fuels. Over the past 20 years there have been approximately 70 fires starts in the management area. About 80 percent of the fire starts are from lightning. Since 1988, about 54 percent of the management area has burned, mostly from the 2007 Cascade Complex. Portions of this management area are in the Forest's wildland fire use planning area.

Yellow Pine is a nearby National Fire Plan community and the area surrounding Yellow Pine, as well as areas along the northern boundary of the management area and south along the Johnson Creek Road, is considered wildland-urban interface areas due to private development adjacent to the Forest. Subwatersheds that include these wildland-urban areas as well as Wardenhoff-Bear and No Mans-Boulder are also considered to pose risks to life and property from potential post-fire floods and debris flows. Historical fire regimes for the area are estimated to be: 28 percent lethal, 57 percent mixed1 or 2, and 15 percent non-lethal. An estimated 13 percent of the area regimes have vegetation conditions that are highly departed from their historical range. Most of this change has occurred in the historically non-lethal fire regimes, resulting in conditions where wildfire would likely be much larger and more intense and severe than historically. In addition, 47 percent of the area is in moderately departed conditions. Wildfire in these areas may result in somewhat larger patch sizes of high intensity or severity, but not to the same extent as in the highly departed areas in non-lethal fire regimes.

Lands and Special Uses - Special use authorizations include telephone and electric utility corridors, the Johnson Creek airstrip, water transmission lines, Valley County transfer stations, an Idaho Department of Fish and Game dwelling, fisheries projects, a cemetery, and a designated utility corridor containing the Emmett-Stibnite power transmission line.

MANAGEMENT DIRECTION

In addition to Forest-wide Goals, Objectives, Standards, and Guidelines that provide direction for all management areas, the following direction has been developed specifically for this area.

MPC/Resource Area	Direction	Number	Management Direction Description
Eligible Wild and Scenic Rivers	General Standard	2101	Manage the Johnson Creek eligible river corridor to its assigned Recreational classification standards, and preserve its ORVs and free-flowing status until the river undergoes a suitability study and the study finds it suitable for designation by Congress, or releases it from further consideration as a Wild and Scenic River.
	Vegetation Standard	2156	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[1]
	Vegetation Guideline	2102	In Recreational corridors, mechanical vegetation treatments, including salvage harvest, may be used as long as ORVs are maintained within the river corridor.
	Fire Guideline	2103	Prescribed fire and wildland fire use may be used as long as ORVs are maintained within the corridor.
	Fire Guideline	2104	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize the impacts of suppression activities on river classifications and ORVs.
MPC 2.2 Research Natural Areas	General Standard	2105	Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the area was established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
	Road Standard	2106	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To maintain the values for which the RNA was established.
	Fire Guideline	2107	The full range of fire suppression strategies may be used to suppress wildfires. Fire suppression strategies and tactics should minimize impacts to the values for which the RNA was established.

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[1] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	2108	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years).
	Vegetation Standard	2109	Mechanical vegetation treatments, excluding salvage harvest, may only occur where: a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource affects; and b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
	Vegetation Standard	2157	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[2]
	Fire Standard	2110	Wildland fire use and prescribed fire may only be used where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
	Road Standard	2111	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	2112	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[2] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Watershed Resources	General Standard	2113	Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term (3-15 years) time periods, and must be designed to avoid degradation of existing conditions in the long-term (greater than 15 years).
	Vegetation Standard	2114	Vegetation restoration or maintenance treatments—including wildland fire use, mechanical, and prescribed fire—may only occur where they: a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
	Vegetation Standard	2158	Mechanical vegetation management activities, including salvage harvest, shall retain all snags >20 inches dbh and at least the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet at least the maximum total number snags per acre depicted in Table A-6.[3]
	Road Standard	2115	Road construction or reconstruction may only occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To support aquatic, terrestrial, and watershed restoration activities, or d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
	Fire Guideline	2116	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

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[3] This standard shall not apply to management activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, to manage the personal use fuelwood program, or allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
MPC 5.1 Restoration and Maintenance Emphasis within Forested Landscapes	Vegetation Standard	2117	In the MPC 5.1 portion of the Lower Johnson Creek Management Area, ground- disturbing activities associated with vegetation management actions, and associated road construction and reconstruction, shall be designed in a manner that the project-level NEPA analysis and related Biological Assessment will demonstrate that adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats.
	Vegetation Standard	2159	For commercial salvage sales, retain the maximum number of snags depicted in Table A-6 within each size class where available. Where large snags (>20 inches dbh) are unavailable, retain additional snags ≥10 inches dbh where available to meet the maximum total number snags per acre depicted in Table A-6.[4]
	Road Standard	2118	New roads and landings shall be located outside of RCAs in the MPC 5.1 portion of the Lower Johnson Creek subwatershed, unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that: a) For resources that are within their range of desired conditions, the addition of a new road or landing in an RCA shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, the addition of a new road or landing in an RCA shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. An exception to this standard is where construction of new roads in RCAs is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).

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[2] This standard shall not apply to activities that an authorized officer determines are needed for the protection of life and property during an emergency event, to reasonably address other human health and safety concerns, to meet hazardous fuel reduction objectives within WUIs, or to allow reserved or outstanding rights, tribal rights or statutes to be reasonably exercised or complied with.

MPC/Resource Area	Direction	Number	Management Direction Description
	Road Standard	2119	In the Lower Johnson Creek Management Area, except for the MPC 5.1 portion, do not reopen classified roads in Level 1 maintenance status or Level 2 roads that have become impassable unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that**:** a) For resources that are within their range of desired conditions, reopening these roads for use shall not result in degradation to those resources unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and b) For resources that are in a degraded condition, reopening these roads shall not further degrade nor retard attainment of desired resource conditions unless outweighed by demonstrable short- or long-term benefits to those resource conditions; and c) Adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats. Where reopening these roads cannot meet these constraints, consider decommissioning. An exception to this standard is where reopening Level 1 or 2 classified roads is required to respond to reserved or outstanding rights, statute or treaty, or respond to emergency situations (e.g., wildfires threatening life or property, or search and rescue operations).
	Vegetation Guideline	2120	The full range of vegetation treatment activities may be used to restore or maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
	Vegetation Guideline	2160	The personal use firewood program should be managed to retain large snags (>20 inches dbh) through signing, public education, permit size restrictions or area closures, or other appropriate methods as needed to achieve desired snag densities (Table A-6).
	Fire Guideline	2121	The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.
	Road Guideline	2122	Road construction and reconstruction may occur where needed: a) To provide access related to reserved or outstanding rights, or b) To respond to statute or treaty, or c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat; or d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas; or e) To meet access and travel management objectives.
	Road Guideline	2161	On new permanent or temporary roads built to implement vegetation management activities, public motorized use should be restricted during activity implementation to minimize disturbance to wildlife habitat and associated species of concern. Effective closures should be provided in project design. When activities are completed, temporary roads should be reclaimed or decommissioned and permanent roads should be put into Level 1 maintenance status unless needed to meet transportation management objectives.

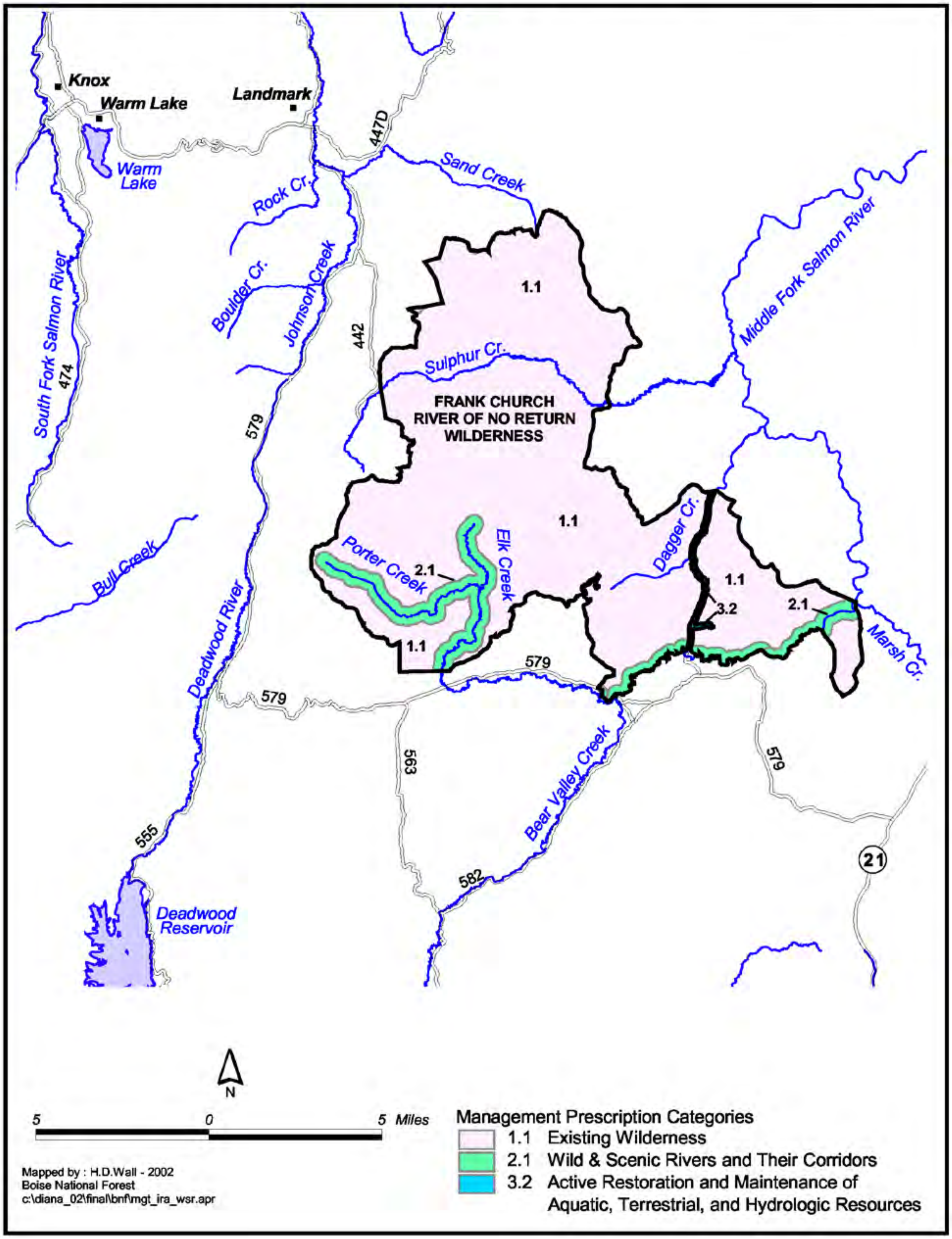
MPC/Resource Area	Direction	Number	Management Direction Description
Soil, Water, Riparian, and Aquatic Resources	Objective	2123	Improve water quality by reducing road-related accelerated sediment delivery to lower Johnson Creek and its tributaries.
	Objective	2124	Assist in de-listing South Fork of Salmon River drainage, including lower Johnson Creek, from the State of Idaho's impaired water bodies list, by applying appropriate and active watershed restoration to reduce sediment, which is the identified pollutant source.
	Objective	2125	Improve streambank stability by reducing sediment delivery to Johnson Creek, and by revegetating banks with native plant species as needed.
	Objective	2126	Restore aquatic and riparian habitats in Johnson Creek and its tributaries by reducing streambank instability and accelerated sediment resulting from existing roads and other disturbances.
	Objective	2127	Evaluate Riordan and Trapper Creek drainages to determine management actions needed to move toward desired conditions, with emphasis on improving riparian areas.
	Objective	2128	Initiate restoration of watershed conditions and fish habitat in the Wardenhoff-Bear subwatershed to help strengthen listed fish species populations.
Vegetation	Objective	2129	Restore whitebark pine in PVG11 (High Elevation Subalpine Fir) vegetation group as described in Appendix A in all watersheds in the management area.
Botanical Resources	Objective	2130	Consider establishing the Shell Rock Peak area as a Botanical Special Interest Area due to the presence of unique wetland habitats and plant species of concern.
	Objective	2131	Evaluate and develop, if needed, a management plan for the special botanical area in the Shell Rock Peak area.
	Objective	2132	Maintain or restore known populations and occupied habitats of TEPCS plant species, to contribute to their long-term viability of these species.
Wildlife Resources	Objective	2162	Determine whether winter recreation activities are impacting wolverine during the critical winter denning period within the Lower Johnson (5th code HUC 1706020805) priority watershed. (*Refer to Conservation Principle 6 in Appendix E.*)
Recreation Resources	Objective	2133	Reduce impacts to riparian areas from recreation use and facilities, especially at Ice Hole, Golden Gate and Yellow Pine Campgrounds.
	Objective	2134	Provide for outfitter and guide opportunities in Caton Lake area to increase recreational access and experiences in this remote area.
	Objective	2135	Continue to coordinate with Valley County and Idaho Department of Parks and Recreation on the grooming of snowmobile trails to maintain this winter recreation opportunity.
	Objective	2136	Reduce unauthorized ATV use and enforce existing travel restrictions to reduce recreation impacts to wildlife, soil, and water resources.
	Objective	2137	Develop vegetation management plans for the Golden Gate, Ice Hole, and Yellow Pine developed recreation sites to guide vegetation management within these sites.
	Objective	2138	Determine if there is a need for an ATV bridge at Riordan Station across Riordan Creek. Install bridge if warranted.

<table>
<tr><th>MPC/Resource Area</th><th>Direction</th><th>Number</th><th>Management Direction Description</th></tr>
<tr><td></td><td>Objective</td><td>2139</td><td>Achieve or maintain the following ROS strategy (± 5%):
<table>
<tr><th rowspan="2">ROS Class</th><th colspan="2">Percent of Mgt. Area (± 5%)</th></tr>
<tr><th>Summer</th><th>Winter</th></tr>
<tr><td>Semi-Primitive Non-Motorized</td><td>27%</td><td>0%</td></tr>
<tr><td>Semi-Primitive Motorized</td><td>36%</td><td>88%</td></tr>
<tr><td>Roaded Natural</td><td>15%</td><td>12%</td></tr>
<tr><td>Roaded Modified</td><td>22%</td><td>0%</td></tr>
</table>
The above numbers reflect current travel regulations. These numbers may change as a result of future travel regulation planning.</td></tr>
<tr><td rowspan="4">Cultural Resources</td><td>Objective</td><td>2140</td><td>Maintain the National Register status of Johnson Creek Guard Station and other eligible properties.</td></tr>
<tr><td>Objective</td><td>2141</td><td>Conduct an inventory to identify historic trails and properties associated with the Thunder Mountain gold rush. Provide interpretive materials for the public using these trails.</td></tr>
<tr><td>Objective</td><td>2142</td><td>Monitor the conditions of historic properties in the management area to identify potential damage or loss.</td></tr>
<tr><td>Objective</td><td>2143</td><td>Nominate Johnson Creek Guard Station to the NRHP, develop a management plan to protect its historic character.</td></tr>
<tr><td>Tribal Rights and Interests</td><td>Objective</td><td>2144</td><td>Continue operating under and update as needed the Memorandum of Understanding with the Nez Perce Tribe.</td></tr>
<tr><td>Timberland Resources</td><td>Objective</td><td>2145</td><td>Design and implement restoration management activities that achieve desired vegetation conditions.</td></tr>
<tr><td>Rangeland Resources</td><td>Standard</td><td>2146</td><td>Riparian area use will be a maximum of 30 percent use of most palatable forage species, or retain a minimum 6-inch stubble height of hydric greenline species, whichever occurs first, where riparian goals and objectives are not being met.</td></tr>
<tr><td>Mineral Resources</td><td>Objective</td><td>2147</td><td>Evaluate abandoned mine areas, specifically Golden Gate and Antimony, for reclamation opportunities.</td></tr>
<tr><td rowspan="4">Fire Management</td><td>Objective</td><td>2148</td><td>Identify areas appropriate for Wildland Fire Use, emphasizing the Inventoried Roadless Areas on the south and east side of the management area. Use wildland fire to restore or maintain vegetative desired conditions and to reduce fuel loadings.</td></tr>
<tr><td>Objective</td><td>2149</td><td>Initiate prescribed fire and mechanical treatments within wildland-urban interface areas to reduce fuels and wildfire hazards. Coordinate with local and tribal governments, agencies, and landowners in the development of County Wildfire Protection Plans that identify and prioritize hazardous fuels treatments within wildland-urban interface to manage fuel loadings to reduce wildfire hazards.</td></tr>
<tr><td>Objective</td><td>2150</td><td>Coordinate and emphasize fire education and prevention programs with private landowners to help reduce wildfire hazards and risks. Work with landowners to increase defensible space around structures.</td></tr>
<tr><td>Guideline</td><td>2151</td><td>Coordinate with the Payette National Forest to develop compatible wildland fire suppression and wildland fire use strategies.</td></tr>
<tr><td>Lands and Special Uses</td><td>Objective</td><td>2152</td><td>Complete the Townsite Act acquisition for Yellow Pine Cemetery.</td></tr>
</table>

MPC/Resource Area	Direction	Number	Management Direction Description
Facilities and Roads	Objective	2153	Evaluate road networks for opportunities to reduce sediment delivery, increase user safety, and provide for fish passage, with emphasis on Forest Roads 440 and 447.
	Standard	2154	New roads shall not be built except to replace existing roads in RCAs or directly repair human-caused damage to TEPC fish habitat in streams unless it can be demonstrated through the project-level NEPA analysis and related Biological Assessment that adverse effects to TEPC species or their habitats are avoided unless outweighed by demonstrable short- or long-term benefits to those TEPC species or their habitats.
Scenic Environment	Standard	2155	Meet the visual quality objectives as represented on the Forest VQO Map, and where indicated in the table below as viewed from the following areas/corridors:

Sensitive Travel Route Or Use Area	**Sensitivity Level**	**Visual Quality Objective**								
		Fg			**Mg**			**Bg**		
		Variety Class			**Variety Class**			**Variety Class**		
		A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
East Fork South Fork Salmon River	1	R	PR	PR	R	PR	PR	R	PR	M
Forest Road 413	1	R	PR	PR	R	PR	PR	R	PR	M
Forest Road 416W to Hennessy Meadow	1	PR	PR	PR	PR	PR	PR	PR	PR	M
Forest Roads 440, 440A	2	PR	PR	M	PR	M	M	PR	M	MM
Yellow Pine, Golden Gate, Ice Hole Campgrounds	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 073, 074, 093	2	PR	PR	M	PR	M	M	PR	M	MM
Forest Trails 096, 097	2	PR	PR	M	PR	M	M	PR	M	MM
Johnson Creek	2	PR	PR	M	PR	M	M	PR	M	MM

Management Area 22 - Frank Church River of no Return Wilderness Location Map



Management Area 22
Frank Church--River of No Return Wilderness

MANAGEMENT AREA DESCRIPTION

Management Prescriptions - Management Area 22 has the following management prescription.

Management Prescription Category (MPC)	Percent of Mgt. Area
1.1 – Designated Wilderness	100

General Location and Description - Management Area 22 is comprised of lands jointly administered by the Boise and Salmon-Challis National Forest within the Frank Church--River of No Return (FC-RONR) Wilderness Area (see Figure III-23). The area lies in Valley County, and is on the Cascade and Lowman Ranger Districts. The management area is an estimated 64,400 acres, and includes a few small, private inholdings along Sulphur and Dagger Creeks. The area is bordered by more Wilderness and the Salmon-Challis National Forest to the north and east, and Boise National Forest to the west and south. The primary use and activity in this management area is wilderness-oriented dispersed recreation. Created by Congress in 1980, the entire FC-RONR Wilderness (2,417,932 acres) spreads across parts of five National Forests. Management direction for this wilderness area is included in the FC-RONR Wilderness Management Plan, approved March 1985. Each National Forest has incorporated that Management Plan into its own respective Forest Plan. Management Area 22, therefore, only covers the portion of the wilderness area where administration is shared between the Boise and Salmon-Challis National Forest. The management area does not cover wilderness lands within the proclaimed boundary of the Boise National Forest that are solely administered by the Salmon-Challis NF (refer to Figure I-1).

In a February 21, 1991, letter, the Intermountain Regional Forester adjusted the Challis and Boise National Forests administrative boundaries and responsibilities for the area that is now Boise National Forest Management Area 22. For mapping purposes, this area is still shown within the administrative boundary of the Salmon-Challis National Forest. The Salmon-Challis administers all management functions in this area except those pertaining to term grazing permits and special-use permits. To maintain administrative efficiencies, the Regional Forested decided to leave existing administration of term grazing permits and special-use permits, such as for outfitter and guides, with the Boise National Forest due, in part, to location of the permittees. Because the Boise National Forest shares some administrative responsibilities of this area, it is included in this revised forest plan as Management Area 22.

Access - The main access to the area is from State Highway 21 near Banner Summit to Bear Valley via Forest Road 579, and via Forest Road 568 from Bear Valley to Dagger Falls. A good network of trails occurs within the area.

Special Features - The FC-RONR is the largest contiguous designated Wilderness Area in the continental United States. This area is considered an important aquatic stronghold and is part of the Central Idaho Wolf Recovery Area. Wilderness recreation and fish and wildlife habitat are the primary resources and uses. Segments of Porter Creek and Elk Creek are eligible for Wild and Scenic River designation. These segments are classified as Wild, and comprise 25.1 miles, with river corridor areas of 8,000 acres.

Air Quality - Air quality is usually excellent; this is a Wilderness Area that is remote from any large population centers. However, smoke from wildland fires is not uncommon in the summer months.

Soil, Water, Riparian, and Aquatic Resources - Elevations range from about 6,000 feet on the Dagger Creek to 8,500 feet near Lookout Mountain. The land is characterized by gentle to steep slopes that are weakly to strongly dissected by streams. The surface geology is dominated by Idaho Batholith granitics. Soils generally have low to high surface erosion potential, and productivity is low to moderate. Geomorphic integrity is functioning at risk in some areas due to impacts from historic livestock grazing that have resulted in localized accelerated erosion, upland compaction, and streambank degradation. However, these conditions are improving.

This management area comprises portions of the Sulphur Creek, Elk Creek, and Upper Bear Valley Creek Watersheds in the Upper Middle Fork Salmon Subbasin, which drains into the Middle Fork Salmon River. The major streams in the area are the Middle Fork Salmon River and its tributaries: Elk, Sulphur, Dagger, and Bear Valley Creeks. Small alpine lakes occur in the headwaters reaches of Collie, Porter, and Honeymoon Creeks. Water quality is functioning at risk in localized areas due to sedimentation impacts from historic livestock grazing, compounded by naturally high sediment rates. However, quality is in an improving trend. There are no water bodies that are listed as impaired under Section 303(d) of the Clean Water Act. This area is not associated with a TMDL-assigned watershed.

Spawning, rearing, and migratory habitat occurs for chinook salmon and steelhead in the Middle Fork Salmon River, and in Sulphur, Elk, Bear Valley Creeks, and their tributaries. Aquatic integrity is considered high, and the incidence of introduced fish species is low. This area is an important aquatic stronghold for threatened salmonids in the Columbia River Basin. Spawning and rearing habitat also occurs for bull trout, which are scattered throughout area streams. However, currently there are no known strong populations. Native cutthroat trout are also present. Aquatic habitat is functioning at risk in localized areas due to historic grazing impacts that have caused accelerated sediment and localized streambank degradation.

Vegetation - This high-elevation area largely consists of lodgepole and subalpine fir forests, interspersed with sagebrush, shrublands, and meadows. An estimated 17 percent of the management area is covered by grasslands, shublands, meadows, rock, or water. Most of this 17 percent is comprised of the Mountain Big Sagebrush, Perennial Grass Montane, and Alpine and Dry Meadows vegetation groups. The dominant forested vegetation groups are Persistent Lodgepole Pine, Warm Dry Subalpine Fir, and Hydric Subalpine Fir.

The Mountain Big Sagebrush group is at properly functioning condition, though fire exclusion and historic grazing impacts have altered structure and species composition somewhat. Older, closed-canopy structure dominates. Alpine and Dry Meadows are functioning at risk because of historic sheep grazing impacts that have removed or set back the sedge component, and fire exclusion that has allowed lodgepole pine encroachment. The Perennial Grass Montane group is functioning at risk because exotic species like cheatgrass are replacing native species in some areas, and this trend is increasing. The Warm Dry Subalpine Fir and Hydric Subalpine Fir groups are at properly functioning condition, although they are at increasing risk to stand-replacing fire due to decades of fire exclusion. However, these groups historically have a lethal fire regime. The Persistent Lodgepole Pine group is functioning at risk due to fire exclusion that has allowed older structural stages to dominate. Stand diversity is low, and the risk of mountain pine beetle infestation and stand-replacing fire is increasing. Riparian vegetation is functioning properly, although livestock grazing impacts have resulted in localized changes in species composition. Exotic plant species are also localized and at low levels.

Botanical Resources - No known populations of Region 4 sensitive species occur within this management area. Blandow's helodium moss, a proposed Region 4 sensitive species, has been found inside the area. Kellogg's bitterroot and Idaho douglasia occur in surrounding areas, and potential habitat and undiscovered populations may exist within the area. No federally listed or proposed plant species are known to occur in the area, but potential habitat for Ute ladies'-tresses, a Threatened species, may occur in riparian/wetland habitats from 1,000 to 7,000 feet. Slender moonwort, a Candidate species, may occur in moderate to higher elevation grasslands, meadows, and small openings in spruce and lodgepole pine.

Non-native Plants - Few noxious weeds and exotic plants have been found within the management area. Less than 10 percent of the area has high susceptibility to invasion by noxious weeds and exotic plant species. The main weed of concern is spotted knapweed.

Wildlife Resources - The area contains an estimated 19,110 acres of key elk summer range, and 360 acres of goat winter range. Lower-elevation Douglas-fir forests provide habitat for a number of Region 4 sensitive species, including fisher and northern goshawk. High-elevation subalpine fir forests provide nesting and foraging habitat for great gray and boreal owls, three-toed woodpeckers, wolverine, lynx, as well as summer range for mammals such as elk, black bear, and mountain lion. Gray wolves were re-introduced near here in 1995 and 1996, and populations likely occur in the area, which is part of the Central Idaho Wolf Recovery Area. The area provides many habitats for migratory land birds. Overall, terrestrial habitat is at or near proper functioning condition. Levels of disturbance and fragmentation are very low.

Recreation Resources - Dispersed recreation such as hunting, fishing, hiking, rafting, and camping occurs throughout Management Area 22. The area is in Idaho Fish and Game Management Unit 34. Although the area is a national attraction, much of the use is limited to the summer and fall seasons due to the remoteness and high elevation. The entire area is considered visually sensitive, and all trails in the area are closed to motorized vehicle use. This area encompasses the only road access to Dagger Falls, which is the main launch site for float trips down the Middle Fork Salmon River. Portions of the Idaho Centennial Trail lie within this management area. Recreation special uses include several outfitter and guide operations.

Currently, most of the Boise portion of the Wilderness provides opportunities for a Primitive recreation (ROS) experience, with the exception of a couple motorized corridors or airstrips that provide Semi-Primitive Non-Motorized, Semi-Primitive Motorized, or Roaded Natural experiences. Adjustments to these corridors are currently being addressed in the revised Wilderness Management Plan. The ROS classes are not likely to change in the future because this is a designated Wilderness, and the Wilderness Act would not permit the type or extent of development that could cause a change in ROS.

Cultural Resources - Cultural themes in this area include Prehistoric Archeology, Ranching, Homesteading, Recreation, and Forest Service History. This portion of the Wilderness contains prehistoric sites associated with early Indian occupations in Idaho. These camps were used well into the historic period and the area remains important to the Shoshone and Bannock Tribes. Blood residue analysis from stone tools recovered from archaeological excavations in the area indicates that Indians were hunting deer and a variety of small game. Shortly before the turn of the century, stockmen began to use Bear Valley for summer pasture. This management area also has a unique history associated with speculative homesteading in the 1920s. Dishonest businessmen enticed prospective homesteaders, many of them unprepared for the winters in the area, to settle illegally in Poker and Ayers Meadows. These homesteaders were forced to abandon their cabins, the remains of which can still be seen today.

Timberland Resources - There are no tentatively suited timberlands in this management area because wilderness designation makes this area inappropriate for timber production.

Rangeland Resources - This area is mostly closed to cattle and sheep grazing. There are two active cattle allotments and two vacant sheep allotments. Some limited pack and saddle stock grazing is allowed. An estimated 6,200 acres are considered capable for livestock grazing. These acres represent about 1 percent of the capable rangeland on the Forest.

Mineral Resources – The FC-RONR Wilderness Act prohibits dredge and placer operations in the area. Lode mining claims are subject to determination of valid existing rights prior to approval of any operating plan. The locatable mineral potential is moderate to high. The leasable mineral potential for geothermal resources is moderate. The potential for other leasable minerals is low. The potential for common variety mineral materials is unknown.

Fire Management - No large wildfires have occurred in this area in the last 15 years, except for the Deadwood Fire.

Lands and Special Uses - Special-use authorizations include two airstrips.

MANAGEMENT DIRECTION

Follow management direction in the FC- RONR Wilderness programmatic and operational plans.

IMPLEMENTATION DIRECTION

General Direction

The Boise National Forest Land and Resource Management Plan provides direction for managing the Forest over the next 10 to 15 years. This chapter explains how management direction from Chapter III of the Plan will be implemented, how implementation activities will be monitored and evaluated, and how the Plan can be kept current in light of changing conditions or other findings.

Implementation of the Plan is guided by existing and future laws, regulations, policies, and guidelines. The Plan is designed to supplement, not replace, direction from these sources, except in specific instances. This Plan replaces all previous management plans except for the Frank Church–River of No Return Wilderness Management Plan, Allotment Management Plans, and approved Fire Management Plans.

All permits, contracts, and instruments for use or occupancy of the Forest must conform to the revised Plan's direction. However, because some existing permits and leases are already committed, they will remain in effect until they can be adjusted to accommodate direction in the revised Forest Plan. The Record of Decision for the revised Forest Plan provides the Responsible Official's direction concerning transition of the permits, contracts, and other uses to reflect direction of the revised Plan.

Budget Proposals

The National Forest System appropriation provides the funds for stewardship and management of 192 million acres of federal lands and the natural ecosystems that exist on those lands. These appropriated funds are key for translating the goals, objectives, and management requirements stated in the Forest Plan to on-the-ground results.

Upon receipt of the final budget every year, the Forest prepares an annual implementation budget. This budget is a result of program development, annual work planning, and monitoring processes. These processes supplement the Forest Plan and make the annual adjustments and changes needed to reflect current priorities within the overall management direction contained in the Plan. Therefore, the funding distribution between program components, and the intensity or level of activities in those programs, is a reflection of the Plan as well as the will of Congress. The final determining factor in carrying out the intent of the Forest Plan is the adequacy of funding, which dictates the rate of implementation of the Plan.

NFMA and NEPA Compliance

Forest Planning is a two-tiered process. The initial planning process established Forest-wide and management area goals, objectives, standards, and guidelines. This level of planning was programmatic in nature, and evaluated possible management activities across the entire Forest. The initial analysis tested the feasibility of activities in arriving at a Forest Plan, but did not evaluate the site-specific effects of individual projects.

The second phase of the planning process is implementing site-specific activities designed to aid in achieving the goals, objectives, management direction, and desired future conditions established in the Plan.

Implementation of the Plan occurs at the project level, using site-specific analysis guided by the National Forest Management Act (NFMA) and the National Environmental Policy Act (NEPA), and other laws and regulations that may be involved in a specific proposal. Project-level compliance with NFMA is primarily concerned with consistency with the Forest Plan and NFMA regulations. NEPA compliance involves an environmental analysis of a specific proposal, and proper documentation and public disclosure of effects in an Environmental Assessment (EA), Environmental Impact Statement (EIS), or a Categorical Exclusion (CE).

Most proposed activities will be consistent with direction in the Plan. When specific proposals are found to be inconsistent with Plan direction, or site-specific analysis shows an error in the Plan, the Plan or the proposal must be adjusted according to the analysis. Most adjustments to the Plan can be accomplished through a non-significant amendment signed by the Forest Supervisor and documented in a CE/Decision Memo, EA/Decision Notice, or EIS/Record of Decision. Significant amendments require documentation through an EIS/Record of Decision and must be signed by the Regional Forester.

Project Implementation in Inventoried Roadless Areas

Inventoried Roadless Areas (IRAs) contain natural landscapes where human activities have not had a significant impact, and the areas meet criteria for potential wilderness designation under the Wilderness Act of 1964. Recent court cases and appeal decisions on such areas require that actions that would irretrievably foreclose the wilderness option, or have a significant adverse environmental impact on the undeveloped character of an IRA, be evaluated through an EIS.

The Forest Plan EIS, Appendix C, contains the location and description of each IRA on the Forest. When an activity is proposed within the boundary of an IRA, it will be evaluated to determine the significance of the activity on irretrievably altering the natural condition and foreclosing on a future wilderness option for the entire area.

Forest Plan management prescriptions allow for development in some IRAs (refer to the Forest Plan EIS, Appendix C or the Management Area descriptions in Chapter III of this Plan). For these areas, the option to develop is discretionary, not a mandate for development, because the site-specific effects of implementation have not been evaluated through the appropriate NEPA procedure. Development has been determined to be tentatively feasible in the Forest planning process, but must be further evaluated on a site-specific level of analysis.

Site-specific analysis of environmental effects for projects in IRAs will include an evaluation of the effects on the wilderness attributes. Appendix C of the Forest Plan EIS contains a description of wilderness attributes for each IRA. The project-level environmental analysis will include a discussion on how the wilderness attributes would be affected by each alternative, along with the cumulative and irretrievable effects. The site-specific analysis will not include a re-evaluation for a wilderness recommendation unless the analysis reveals a significant wilderness attribute not previously identified. The significance of any change in individual wilderness attributes should be disclosed in the evaluation.

Determining significance of the project's effect on an IRA forms the basis for whether a CE, EA, or EIS is the appropriate NEPA process. Some indicators to determine significance are:

- Location and size of proposed projects within the IRA boundary during the planning period. A large development project in the core of a IRA would likely have more significant effects on its wilderness attributes than a small project on the periphery.

- Interconnected actions. The Plan may allow for a series of timber sales during the planning period. Individually, a given sale may not have a significant effect on the IRA. The aggregate or cumulative effects of all sales, however, could be significant.

MONITORING AND EVALUATION DIRECTION

Overview

Evaluation and monitoring provide knowledge and information to keep the Land and Resource Management Plan viable. Appropriate selection of indicators, and monitoring and evaluation of key results helps us determine if we are meeting the desired conditions identified in the Plan. Evaluation and monitoring also help us determine if we should change goals and objectives, or monitoring methods.

Adaptive management is the foundation for planning and management. Forest planning regulation requires that plans be revised every 10-15 years after plan approval [36 CFR 219.10(g)]. One of the lessons learned from experience implementing current Forest Plans is that plans need to be dynamic to account for changed resource conditions such as large scale wildfire or listing of additional species under the Endangered Species Act, new information and science such as taking a systems approach, and changed regulation and policies such as the roads analysis policy.

Evaluation and monitoring are critical to adaptive management. Other component parts include inventory, assessment, planning, and implementation. No single component can be isolated from the whole of adaptive management.

Consider the learning-loop schematic illustrated in Figure 1: No matter where we jump into the loop, all phases are needed to learn. This learning-loop is applicable for site-specific problems, forest plans, or on processes, policy, or any other aspect of an organization. In most of our Forest Plan evaluation and monitoring, however, we will focus our learning on how effective we are at implementing the plan and realizing desired futures from the plan, as well as how to improve plans in the future.

Monitoring and Evaluation and Strategy

Our evaluation and monitoring strategy is straightforward. We will tightly focus implementation, evaluation and monitoring on decisions made in the Record of Decision (ROD). Elements in our monitoring will include requirements from NFMA regulation, as well as other pertinent law and regulation.

We begin monitoring and evaluation processes by thinking about what questions we need to answer about Forest Plan implementation. By understanding the questions, we can begin to identify information needs, data collection designs, and tools needed to turn data into information and knowledge. We used a variety of existing monitoring strategies to help determine which questions to ask, including The Monitoring and Evaluation Strategy - Southwest Idaho Ecogroup Version 1.2 (USDA Forest Service 1997) and others such as Criteria and Indicators from the Local Unit Criteria and Indicator Development (LUCID) process and monitoring strategies from National Marine Fisheries Service and USDI Fish and Wildlife Service Matrices and Pathways.

We must also have a clear understanding of baseline conditions (current resource condition at the time of signing the ROD) versus desired conditions and the evaluation strategies that will help us to determine if movement towards desired conditions is occurring. As previously stated, appropriate selection of resource indicators that help us measure where we want to be versus where we are, and monitoring and evaluation of key results are critical to determining if we are meeting the desired conditions identified in our Plan.

Forest Land and Resource Plan Evaluation and Reports

Evaluation is more than reporting facts and figures. Forest plan evaluation tells how forest plan decisions have been implemented, how effective the implementation has proved to be in accomplishing desired outcomes, what we learned along the way, and how valid our assumptions are that led us to decide what we did in the plan.

The Forest Supervisor will maintain monitoring information for public reviews, including internet-based reports, and will evaluate such on a periodic basis to determine, among other things, need for amendment or revision of the Forest Plan. Formal evaluation and reporting will occur every 5 years, unless the Forest Supervisor deems it necessary that a shorter timeframe is warranted for some evaluations. The 5-year review will provide a comprehensive evaluation of information in response to monitoring questions and regulatory review requirements as depicted in Table IV-1.

Figure 1. An Adaptive Management Learning Loop

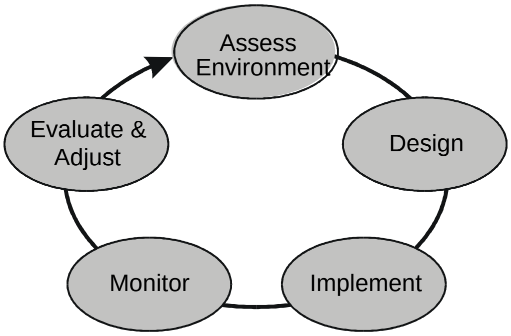


Table IV-1. Forest Plan Evaluation Expectations

Focus of Evaluation	Annual Posting of Results?	Five-Year Evaluation Report?
[A] A program of monitoring and evaluation shall be conducted that includes consideration of the effects of National Forest Management on land, resources, and communities adjacent to or near the National Forest being planned and the effects upon National Forest management from activities on nearby lands managed by other Federal or other government agencies or under the jurisdiction of local governments. [36 CFR 219.7(f)]	No	Yes
[B] The Forest Supervisor shall review the conditions on the land covered by the plan at least every 5 years to determine whether conditions or demands of the public have changed significantly. [36 CFR 219.10(g)]	No	Yes
[C] At intervals established in the plan, implementation shall be evaluated on a sample basis to determine how well objectives have been met and how closely management standards and guidelines have been applied. Based upon this evaluation, the interdisciplinary team shall recommend to the Forest Supervisor such changes in management direction, revision, or amendments to the forest plan as are deemed necessary. [36 CFR 219.12(k)]	No	Yes
[D} Monitoring requirements identified in the forest plan shall provide for—[36 CFR 219.12(k)] 1. A quantitative estimate of performance comparing outputs and services with those projected by the forest plan;	Yes	No
2. Documentation of the measured prescriptions and effects, including significant changes in productivity of the land; and	No	Yes
3. Documentation of costs associated with carrying out the planned management prescriptions as compared with costs estimated in the forest plan.	Yes	No
4. A determination of compliance with the following standards: [i] Lands are adequately restocked as specified in the forest plan;	No	Yes

Focus of Evaluation	Annual Posting of Results?	Five-Year Evaluation Report?
[ii] Lands identified as not suited for timber production are examined at least every 10 years to determine if the have become suited; and that, if determined suited, such lands are returned to timber production; {Note: See also 219.14(d): …Designation in the plan of lands not suited for timber production shall be reviewed at least every 10 years.}	No	Yes
[iii] Maximum size limits for harvest areas are evaluated to determine whether such size limits should be continued; and	No	Yes
[iv] Destructive insects and disease organisms do not increase to potentially damaging levels following management activities.	No	Yes
[E] Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with state fish and wildlife agencies, to the extent practicable (36 CFR 219.19 Fish and wildlife resource).	Yes	Yes
[F] Accomplishment of ACS priority subwatershed restoration objectives.	Yes	Yes
[G] Terms and conditions or reasonable and prudent measures that result from consultation under Section (a) of the Endangered Species Act	Yes	Yes
[H] Effectiveness of mitigation measures and monitoring of risk factors described in the Record of Decision for the Forest Land and Resource Management Plan	No	Yes

Monitoring Elements

Table IV-2 contains monitoring elements organized around monitoring questions. The table addresses requirements from 36 CFR 219.12(k)[4], and includes a description of:

[i] The actions, effects, or resources to be measured, and the frequency of measurements;
[ii] Expected precision and reliability of the monitoring process; and
[iii] The time when evaluation will be reported.

Since data precision and reliability are tied to specific procedures and methods that change as we learn, we expect to update the Forest Monitoring Section to allow for such changes.

Table IV-2. Monitoring Elements

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Perception of management activities on the Forest	(1A) Are interested citizens raising concerns about management activities?	Comment cards, personal contacts, level of National Environmental Policy Act (NEPA)/National Forest Management Act (NFMA) involvement, appeals, litigation	Low	Annually, via leadership team review of substantive comments and NEPA decision appeals	5 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
	(1B) Are consulting agencies part of the process, and are concerns being raised about implementation of the Forest Plan?	Level 1 meeting notes, level of NEPA or NFMA involvement	Moderate	Annually, via Level 1, State 303(d) and permitting reviews and NEPA decisions	5 years
Management actions	(2) Are proposed actions and associated effects being adequately disclosed in NEPA documents?	Review of actions on the Quarterly Schedule of Proposed Actions	Moderate	Annual review of selected projects	3 years
Tribal participation with the Forest	(3) Are current processes meeting the needs for consultation?	Program reviews and personal contacts	Moderate	Annually, using personal contacts, and formal feedback	3 years
Coordination with Tribes	(4) Are traditional cultural resources and special interest areas being considered and maintained?	Projects within known special interest areas or potentially affecting traditional cultural resources	Moderate	Annually review up to 10 percent of projects within known special interest areas or potentially affecting traditional cultural resources	3 years
State and local government participation with the Forest	(5) Are current processes such as commission appearances, field reviews, etc., meeting coordination needs?	Program reviews and personal contacts	Moderate	Annually, using personal contacts, and formal feedback (surveys)	3 years
Accessibility improvement efforts in developed recreation and administrative use facilities	(6) Is disabled access improving in relation to the American Disability Act and other related agency policy and direction?	Condition survey of Forest administrative and developed recreation facilities	Moderate	Annually, conduct condition surveys of up to 20 percent of the Forest's administrative and developed recreation facilities	5 years
Safety of administrative facilities	(7) Are administrative sites safe and accessible for visitors and employees including drinking water sources?	On-site inspection of facilities and drinking water testing	High	As needed, but at least annually using inspection form that keys to INFRA database, drinking water testing program	Annually

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Safety of developed recreation sites	(8a) Are developed recreation sites free of high-risk conditions? (8b) Do water systems meet Federal, State, and local requirements?	On-site inspection of facilities and drinking water testing	High	As directed by State and/or agency requirements	Annually for water systems; 5 years for other
Condition, level of use, and maintenance of roads	(9) Are road conditions improving related to safety or user comfort?	Miles maintained by maintenance class, and condition surveys	Moderate	Annually track miles of roads maintained via INFRA, Conduct condition surveys in accordance with National Condition Survey policy and protocol	5 years
Recreation demand	(10) Are the amount and types of recreation opportunities provided meeting customer needs and expectations?	National recreation use monitoring survey results, Comment forms and user correspondence	Low	Every 4 years for the National Rec. Use Survey; Annually during Forest recreation meetings for other sources	5 years
Recreation use trends, distribution and levels	(11) Are recreation activity levels changing, and are shifts occurring between types of activities, and locations of recreation use?	Field observations by recreation staff, comments, letters, and National Recreation Use Survey results	Low	Every 4 years for the National Rec. Use Survey; Annually during Forest recreation meetings	5 years
Recreation use conflicts	(12) Are conflicts rising between recreational uses?	Comments or complaints from users; number of citations related to closure orders	Moderate	Annually	3 years
Total Recreation Visitor Days (RVDs)	(13) Are recreation activity levels changing or are shifts occurring between types of activities?	Tracking RVDs by various types of recreation activities	Moderate	Forest Service tracking databases, or other sampling techniques	5 years
Dispersed recreation use and distribution	(14) What level of use is occurring in dispersed sites and what impacts are occurring to other resource values?	Site inventory and use survey	Moderate	Annually, survey up to 10 percent of dispersed sites	3 years
Recreation Opportunity Spectrum (ROS) Inventory	(15) Are management activities changing the ROS settings?	Review of project implementation and updating the ROS inventory to reflect any changes in settings	Moderate	Annually via review of selected projects	5 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Track actual daily and seasonal use versus use capacity	(16) What level of use is occurring in special use areas, including recreation sites (e.g., downhill ski areas)?	Ski area attendance reports, annual reports from special uses	High	Annually	3 years
Developed site use and distribution, and resource impacts to sites	(17) What level of use is occurring in developed sites and what impacts are occurring to other resource values?	Use INFRA-Database to track site specific use data	Moderate	Annually via INFRA, survey, public comment cards	3 years
Level of trail maintenance relative to trail use	(18) Are trails being maintained for anticipated levels of use?	Trail counters and MARS for trail construction/ reconstruction or maintenance	Moderate	Annually, up to 10 percent of trail system	3 years
Potential impacts to visual resources	(19) Are Forest management actions being designed and implemented to meet Visual Quality Objectives (VQOs)?	Monitoring project areas from sensitive viewpoints	Moderate	Annually review up to 10 percent of projects on-the-ground from identified viewpoints	3 years
Modification of established VQOs	(20) Are the VQOs appropriate given resource management needs?	Number of Forest Plan amendments that modify established VQOs	High	Annually review management areas where amendments for VQOs were completed	5 years
Protection of historic properties during project implementation	(21) Are historic properties being affected by project activities?	Assess the effects of project implementation on selected projects for at least 5 percent of the projects for which Cultural Resource Management approval had been recommended during the previous year	Low	Annually using field inspection	Annually
Stewardship of historic properties	(22) Are historic properties being managed to standard?	Condition of historic properties	Low	Annually survey up to 5 percent of the historic properties based on heritage assets using condition assessments	3 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Gathering activities on the Forest	(23) Are Forest gathering activities resulting in resource depletion (i.e., mushrooms, bear grass, huckleberries)?	Estimated amount of miscellaneous products collected Reproduction and age class distribution of live plants being collected	Low Moderate	Annually, via review of miscellaneous product permits issued for any given area	3 years
Vegetation treatments	(24) Are planned treatments being implemented?	Acres treated annually	High	Annually via NEPA document decisions	5 years
Effectiveness of vegetation treatments	(25) Is live vegetation at, or moving towards, desired conditions as described in Appendix A of the Forest Plan?	Mix of size classes, canopy closures, species composition and their spatial patterns by forested PVG and non-forested cover types within 5th field hydrologic units	Moderate	5 years or sooner using LANDSAT, FIA inventories, and other local Forest-wide and project-level field inventories	5 years
Riparian condition	(26) Are Forest management activities adequately designed (including delineation of RCAs) to maintain or improve riparian functions and ecological processes important to furthering Forest Plan goals and objectives?	Effects on the riparian functions and ecological processes as identified in Appendix B: Guidance for Delineation and Management of RCAs.	High	3 years via review of selected projects and surveys (e.g., Proper Functioning Condition; IIT Effectiveness Monitoring; remote sensing within 5th field hydrologic units	5 years
Maintenance and restoration of forested conditions	(27a) Has establishment of off-site native tree species affected the maintenance or restoration of desired forested conditions?	Number of regeneration acres dominated by off-site native tree species	Moderate	Survey of regeneration acres	5 years
Habitat for terrestrial Threatened, Endangered, Proposed, Candidate or Sensitive (TEPCS) species, both plant and animal	(28a) Are management actions providing for, or moving toward, the extent of vegetation components necessary to meet the needs of TEPCS species?	Changes in habitat acres	Moderate	Utilize existing databases to track habitat changes in known habitats and restored habitats	5 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Habitat for terrestrial TEPCS species, both plant and animal	(28b) Have restoration and conservation activities been focused in priority watersheds identified in the Vegetation and Wildlife Habitat Restoration Strategy and Map?	Program reviews, total dollars spent, and amount of restoration activity in high priority vs. other 5th field watersheds	High	Annually review selected projects and programs.	5 years
Habitat for terrestrial Threatened, Endangered, Proposed, Candidate or Sensitive (TEPCS) species, both plant and animal	(28c) Have winter recreation monitoring activities been focused in priority watersheds identified in the Source Environment Restoration Strategy Map?	Program reviews, amount of area monitored in high priority versus other 5th field watersheds.	High	Annual completion of monitoring surveys and the distribution of wolverine occurrence records across the species range on the Forest, by watershed.	5 years
Terrestrial Management Indicator Species (MIS)	(29a) Are management actions maintaining or restoring distribution and abundance of management indicator species?	Population trends, demographic population data	High	Annual completion of monitoring surveys and the distribution of occurrence records across the species' range on the Forest by watershed	5 years
Terrestrial MIS	(29b) Are management actions providing for, or moving toward the extent of vegetation components necessary to meet the needs of MIS?	Change in habitat acres; change in large tree structure by PVG; change in acres burned lethally in PVGs applicable to MIS use.	Moderate	Utilize existing databases to track habitat changes in known habitats and restored habitats	5 years
Botanical species of concern, Watch species or Sensitive species	(30) Are Forest management actions affecting known Sensitive species or Watch species habitats at the project level?	Acres of disturbance of known occupied habitat	Moderate	Annually, via review of 5 percent of projects within known occupied habitat	3 years
Soil productivity	(31) Are management actions and forest plan direction effectively maintaining or restoring long-term soil productivity?	Amount of area in non-detrimentally disturbed condition and Total Soil Resource Commitment (TSRC)	Moderate to High	Annually; review of selected activity areas	3 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Snags and coarse wood for wildlife habitat and soil productivity	(32) Are snags and coarse woody debris at, or moving toward, desired conditions as described in Appendix A of the Forest Plan?	Number of snags and coarse wood pieces/logs by size class for each activity area	Moderate to High	Annually review selected assessments, inventories, or projects; aggregate results of annual reviews for reporting	5 years
Distribution of aquatic ecosystems	(33) Are management actions maintaining or restoring the distribution, abundance, and habitat quality of management indicator and TEPC species?	Identification of Watershed Condition Indicators, tracking presence absence data, acres/mile of occupied habitat, number of strongholds, number of isolated populations as identified in the WARS database	Moderate	3 years via review of selected mid- and fine-scale assessments and restoration actions, surveys (e.g., IIT Effectiveness monitoring; Forest Service, Tribal and State Populations and Spawning Surveys)	3 years
Watershed restoration and conservation activities	(34) Have restoration and conservation activities been focused in priority watersheds identified by the WARS process?	Program reviews, total dollars spent and amount of restoration activity in high priority vs. other 6th field watersheds	High	Annually review selected projects and programs. Review results of monitoring with NOAA Fisheries and USFWS annually.	Annually
Project implementation	(35) Have prescriptions, projects, and activities been implemented as designed and in compliance with the Forest Plan?	Project reviews and yearly summaries for Pacfish/Infish IIT team	High	Annual review of IIT Implementation Monitoring, State (DEQ/ DSL) and Forest reviews of selected 6th field hydrologic units	5 years
Landslide prevention	(36) Are management actions and forest plan direction effectively preventing management-induced landslides?	Changes in frequency/size of landslides stratified by hazard risk classes (low, moderate, and high)	Low	As needed via mid-, fine-, and site-scale analyses; remote sensing, and GIS queries	3 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Aquatic ecosystems stream flows	(37) Are forest management actions maintaining or restoring the processes and functions that regulate stream flows and ground water character?	Tracking acres in ECA; road density; # federal water rights obtained; stream discharge in selected 6th field hydrologic units	Moderate	Annually via IIT Effectiveness monitoring; USGS water resources data; R1/R4 Habitat Inventory; mid-, fine-, and site-scale analyses	5 years
Water quality and beneficial use status	(38) Are management actions maintaining or restoring water quality to fully support beneficial uses, and native and desired non-native fish species and their habitats over multiple spatial scales?	Number of 303(d) streams listed versus de-listed; macro-invertebrate tolerance measures; water quality indicators (e.g., temperature, pH, turbidity)	Moderate to High	Annual review of TMDLs, USGS and DEQ databases, Forest water quality stations and selected NEPA projects	2 years
Aquatic ecosystems	(39) Are management actions and forest plan direction effectively maintaining WCIs when currently in the range of desired conditions, and restoring WCIs when outside the range of desired conditions over multiple spatial scales?	Changes in watershed, channel and habitat condition and water quality indicators	Moderate	Annually via review of selected project mid-, fine-, and site-scale analyses; review of IIT effectiveness, R1/R4 Habitat Inventory and DEQ Burp data	2 years
Noxious weed prevention	(40) Are Forest Plan standards and guides effective in preventing establishment of new noxious weed infestations?	Acres of new noxious weed infestations	Moderate	Annual field inspection of projects for 2 years during and after project implementation for selected high-risk projects.	3 years
Noxious weed containment	(41) Are Forest management strategies effective in preventing further expansion of established noxious weed populations?	Acres of known infestation	High	Annually; via inventories and surveys of selected known infestation areas in management areas where strategy is containment	3 to 5 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Noxious weed control and eradication	(42) Are Forest management strategies effective in controlling or eradicating targeted populations of noxious weeds?	Acres of known infestation in management areas identified for eradication or control	High	Annual field inspection of treatment sites that have been identified for eradication or control for 3 years to determine changes in density or total eradication	3 years
Changes in the type of vegetation conditions, volume, growth, or mortality	(43) How have conditions changed and what are the levels of volume, growth, or mortality at the Forest level.	Re-measurements of existing fixed points and new measurements to determine conditions	High	10 year interval or as needed	10 years
Total Sale Program Quantity, which includes Allowable Sale Quantity	(44) Are prescriptions implemented to achieve management objectives meeting the expected outcomes for timber production?	Tracking acres treated (e.g., thinned, harvested, planted) and associated volumes.	High	Annually, via MARS reports, Sale Tracking And Reporting System (STARS), Timber Information Manager (TIM) and Timber Sale Accounts (TSA).	5 years
Head Months Under Permit	(45) Are Forest Plan goals, objectives, standards, and guidelines affecting the number of head months associated with term grazing permits?	Billing and annual operating plans; allotment grazing module from IIT process	High	Annually, via Management Attainment Reporting System (MARS) reports and INFRA	5 years
Range Improvements	(46) Are range improvements being adequately maintained and serving their intended design?	Field inspection and documentation of improvements	High	Annually, on selected high and medium priority allotments via INFRA	5 years
Forage Utilization Levels	(47) Are established utilization levels providing for desired ground cover, soil stability, plant vigor and composition?	Field observation/ utilization studies	High	Annually, review up to 10 percent of active allotments	3 years

Activity, Practice, Or Effect To Be Measured	(tracking #) Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Effectiveness of the Allotment Management System	(48) Are current allotment management strategies effective in meeting or moving toward desired vegetation conditions for non-forested vegetation types?	Grazing Response Index: Frequency (duration of grazing); intensity (use levels); and opportunities (growing periods)	Moderate	Annually, review up to 10 percent of allotments	5 years
Research Natural Areas	(49a) Have management plans been developed for Research Natural Areas that currently lack them?	Number of management plans completed	High	Annually	5 years
	(49b) Have additional RNAs been recommended for establishment?	Number of RNAs recommended for establishment	High	5 years	5 years

Wildlife and Fish Management Indicator Species to Be Monitored

Three terrestrial wildlife species and one fish species have been selected as MIS this planning period (10–15 years) on the Boise National Forest (refer to Table IV-4). Species were selected in habitats where the Forest anticipates implementing the greatest proportion of its projects during this planning period; thus they represent areas where potential risks to wildlife habitat sustainability and species persistence are likely to be highest.

Table IV-4. Boise National Forest Management Indicator Species for this Planning Period

Species	Management Areas	Source Habitat Association
TERRESTRIAL WILDLIFE		
Pileated Woodpecker	All	Selected to address source habitat that includes late seral large trees and old forests across broad elevations that developed under mixed1 and mixed2 fire regimes. Large snags and down logs (>20 inch d.b.h.), in various decay levels, are important special habitat features.
White-headed Woodpecker	1–4; 6–11; and 13–16	Selected to address source habitat that includes large tree and old ponderosa pine forests at low elevations that developed under nonlethal and mixed1 fire regimes. Large ponderosa pine snags, living trees, and down logs (>20 inch d.b.h.), in various decay levels, are important special habitat features.
Black-backed Woodpecker	All	Selected to address source habitat that includes old-forest stages of subalpine, montane, and lower montane forests and riparian woodlands inclusive of fire disturbed patches that developed under mixed2 and lethal fire regimes. Medium-sized snags with heart rot are an important special habitat feature. Fire can be beneficial to this species by stimulating bark beetle outbreaks, an important food source. Black-backed woodpecker populations typically peak in the first 3–5 years after a fire.
FISH		
Bull Trout	All	Selected to address the variety of aquatic habitat needs for other aquatic species that occur across the forest. Bull trout overlap much of the same habitat as other aquatic species and require many of the same watershed and habitat conditions (e.g., clean substrate, cover, low road densities, etc.) for persistence.

Pileated Woodpecker

The pileated woodpecker has been selected as an MIS because it is believed to be functionally linked to a suite of other species that use source habitats tied to large trees, snags, and logs and old forest habitat in mixed conifer forests that occur across broad elevations and developed under mixed fire regimes (Aubry and Raley 2003). Pileated woodpeckers perform key ecological functions as secondary consumers of terrestrial invertebrates and primary cavity excavators of snags and live trees. Habitat components, or key environmental correlates, for this species include large-diameter (>20 inch d.b.h.) snags and living trees, down logs, hollow living trees, and dead portions of live trees (Bull et al. 1992). This species typically uses portions of dying trees and snags in the hard and moderate decay classes (early- to mid- stages of decomposition).

Activities, such as fire suppression, timber harvest, and personal use firewood collection, affect key ecological functions and habitat components (key environmental correlates) associated with these forests, and thus are expected to influence use of the habitat by this MIS. The pileated woodpecker is considered a resident, non-migratory species and is not a game species.

Forest Plan assessments indicate that source habitat for this species has declined from historic levels. Source habitat for this species also falls within areas that address vegetative management objectives, such as fuel reductions in wildland-urban interface (WUI) areas. While long-term beneficial effects to historic source habitat are anticipated (Figure IV-3, **PA-HRV**), temporary and/or short-term negative impacts to habitat quality or distribution may be necessary to progress toward desired long-term wildlife habitat needs for species of conservation concern (such as white-headed woodpecker) and to address the variety of other multiple-use management objectives in the Forest Plan.

In addition, this species is able to take advantage of departed habitat conditions in lower-elevation forests that historically operated under nonlethal fire regimes. While this species' historic habitat is believed to be slightly below historic levels, when combined with habitat this species can use when in a departed condition, the total quantity of source habitat is within historic amounts (Figure IV-3; **PA**). Retaining low-elevation forests in these departed conditions may be at the expense of species of conservation concern, such as white-headed woodpecker, that historically occupied these areas when fire disturbance processes were functioning appropriately. Nonetheless, retention of some low-elevation forest departed landscapes may be necessary in the short term to address habitat distributional needs for species that can take advantage of departed landscapes. Therefore, in addition to selecting pileated woodpecker as an MIS for reasons discussed above, it will also allow the Forest to assess trade-offs between the need to

1. retain departed landscapes to meet short-term habitat needs for species such as pileated woodpeckers, versus
2. restore departed landscapes toward conditions more consistent with those believe to have existed historically to address short- and long-term habitat needs of species such as white-headed woodpeckers.

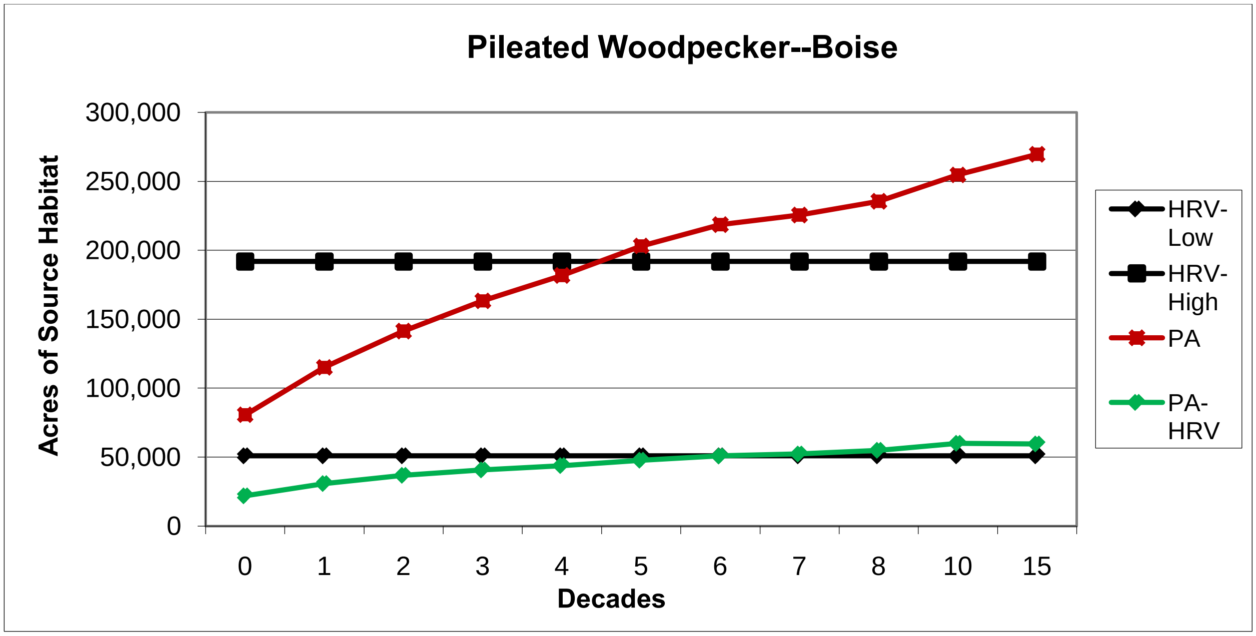


Figure IV-3. Modeled source habitat trends (including habitat in historic and departed forest types) for pileated woodpecker on the Boise National Forest over 15 decades. Year 0 is the amount of source habitat believed to exist following updates to habitat baselines in 2007. PA refers to a "Proposed Action" analyzed and adopted in 2010 as an amendment to the Boise Forest Plan.

White-headed Woodpecker

The white-headed woodpecker has been selected as an MIS because it is believed to be functionally linked to a suite of other species that use source habitats tied to large trees, open canopy conditions, large snags, and old forest habitat in low-elevation forests dominated by ponderosa pine that developed under nonlethal and mixed1 fire regimes. The white-headed woodpecker plays an important ecological role as a primary consumer of seeds and secondary consumer of terrestrial invertebrates (Marcot 1997, O'Neil et al. 2001). They are also a primary excavator, creating cavities for their own use and for other species, and may play a role in seed dispersal by transporting seeds short distances from source trees to anvil sites (Garrett et al. 1996). White-headed woodpeckers are associated with live trees and snags 15–30+ inches d.b.h. (Marcot 1997, O'Neil et al. 2001); particularly in the presence of old forest ponderosa pine (Frederick and Moore 1991; Blair and Servheen 1995; Dixon 1995a, 1995b, 1998) fire disturbance, and existing cavities or dead parts of live trees (O'Neil et al. 2001).

Activities, such as fire suppression, timber harvest, and personal use firewood collection, affect key ecological functions and habitat components (key environmental correlates) associated with these forests, and thus are expected to influence use of the habitat by this MIS. The white-headed woodpecker is considered a resident, non-migratory species and is not a game species.

Forest Plan assessments indicate that source habitat for this species has dramatically declined from historic levels. Source habitat for this species also falls within areas that address vegetative management objective such as fuel reductions in WUI areas in the nonlethal and mixed1 fire regimes. While long-term beneficial effects to source habitat are anticipated (Figure IV-4), temporary and/or short-term negative impacts to habitat quality or distribution may occur when addressing the variety of other multiple-use management objectives in the Forest Plan.

In addition, as discussed under pileated woodpeckers, forests believed to be in a departed condition that historically supported this species are currently believed to support Pileated woodpeckers and their associated species. In some cases, these departed forests may provide important short-term habitat patches for this species. Trade-offs between the need to restore old forest habitat in nonlethal and mixed1 fire regimes may need to be weighed against short-term needs to retain some departed forests to meet the needs of other species. These tradeoffs are expected to be most apparent in active management areas; e.g., areas assigned to MPC 5.1 or 6.1.

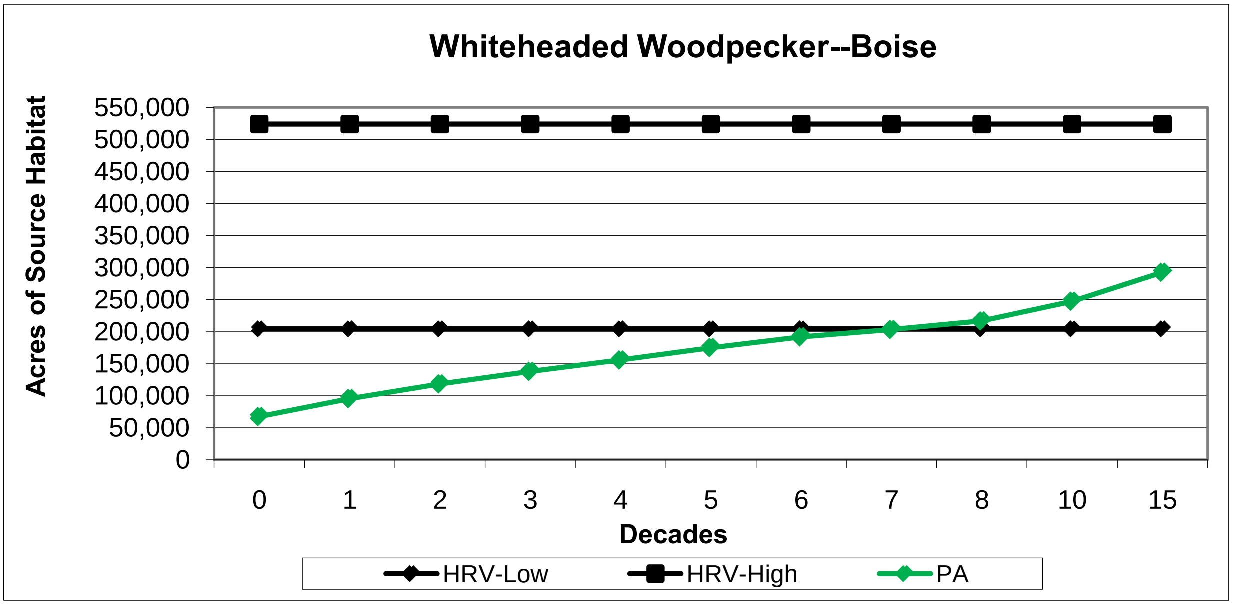


Figure IV-4. Modeled source habitat trends for white-headed woodpecker on the Boise National Forest over 15 decades. Year 0 is the amount of source habitat believed to exist following updates to habitat baselines in 2007. PA refers to a "Proposed Action" analyzed and adopted in 2010 as an amendment to the Boise Forest Plan.

Black-backed Woodpecker

The black-backed woodpecker has been selected as an MIS because it depends on fire landscapes and other large-scale forest disturbances. It is an irruptive species, opportunistically foraging on outbreaks of wood-boring beetles following drastic changes in forest structure and composition, resulting from fires or uncharacteristically high-density forests (Dixon and Saab 2000). Dense, unburned, old forest with high levels of snags and down logs across broad elevations are important habitat for this species, particularly for managing habitat over time in a well-distributed manner because these areas provide places for low levels of breeding birds and an opportunity for future disturbances, such as wildfire or insect and disease outbreaks (Dixon and Saab 2000, Hoyt and Hannon 2002, Tremblay et al. 2009, Hutto and Hanson 2009). Habitat that will support persistence of this species benefits other species dependent on forest systems that develop in the presence of fire and insect and disease disturbance processes.

This species performs key ecological functions on the landscape as secondary consumers of terrestrial invertebrates, primary cavity nesters, and physically fragments standing and down wood (O'Neil et al. 2001, Marcot 1997). Population levels of black-backed woodpeckers are often synchronous with insect outbreaks and targeted feeding can control or depress such outbreaks (O'Neil et al. 2001). Key environmental correlates of this species include an association with medium-sized snags and live trees with heart rot. Fire can benefit this species by stimulating bark beetle outbreaks, an important food source; black-backed woodpecker populations typically peak in the first 3–5 years after a fire.

This species' restricted diet renders it vulnerable to the effects from fire-suppression programs and post-fire salvage logging in its habitat (Dixon and Saab 2000). Management that affects key ecological functions habitat components (key environmental correlates) associated with these disturbed forests are expected to influence use of the habitat by this MIS. The black-backed woodpecker is considered a resident species and is not a game species.

Source habitat for this species can fall within areas that address vegetative management objectives, such as fuel reductions in WUI areas within the mixed2 and lethal fire regimes. In addition, similar to the pileated woodpecker, in some cases, departed forests may provide important habitat patches for black-backed woodpeckers. Trade-offs between the need to restore old-forest habitat that developed in nonlethal and mixed1 fire regimes in some locations will need to be weighed against short-term needs to retain some departed forests to meet the needs of other species.

While long-term benefits to source habitat are anticipated (Figure IV-5), temporary and/or short-term negative impacts to habitat quality or distribution may be needed to progress toward desired long-term wildlife habitat that supports the needs of this species and address the variety of other multiple-use management objectives in the Forest Plan.

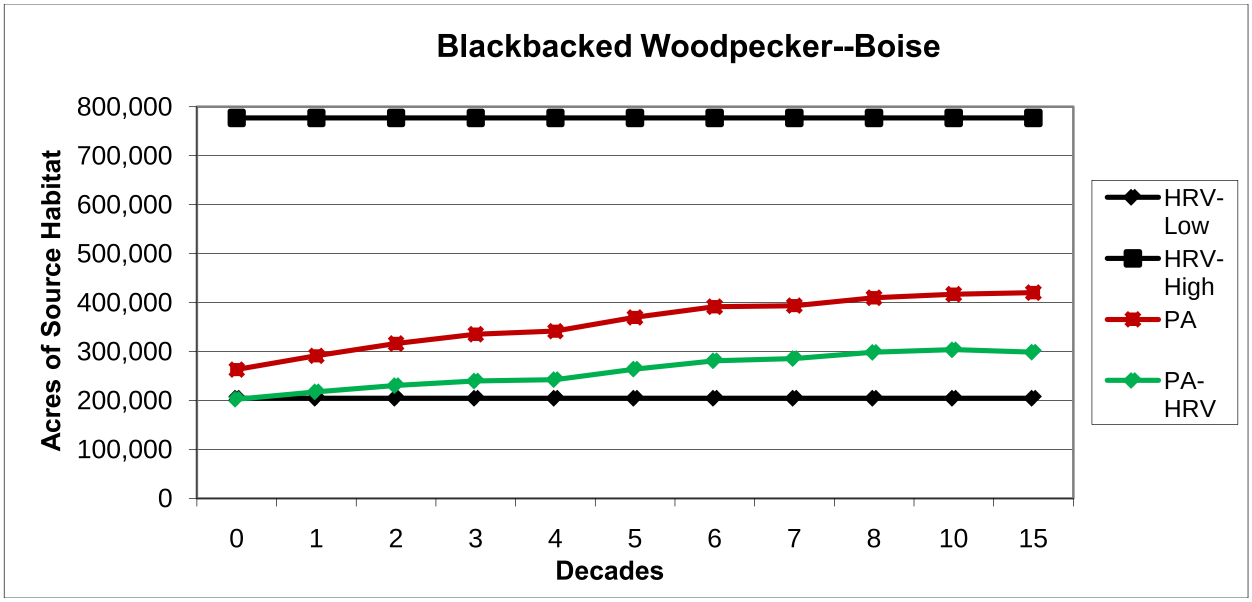


Figure IV-5. Modeled source habitat trends for black-backed woodpecker on the Boise National Forest over 15 decades. Year 0 is the amount of source habitat believed to exist following updates to habitat baselines in 2007. PA refers to a "Proposed Action" analyzed and adopted in 2010 as an amendment to the Boise Forest Plan.

Bull Trout

Bull trout has been proposed as an MIS because they represent a wide range of aquatic habitat needs for other aquatic species. Bull trout overlap much of the same habitat as cutthroat, steelhead, and Chinook and require many of the same watershed and habitat conditions (e.g., clean substrate, cover, low road densities, etc.) as other aquatic species.

Bull trout are present throughout most of the Boise National Forest and local populations generally do not extend beyond the boundaries of the Payette, Sawtooth, or Boise National Forests, collectively known as the Southwest Idaho Ecogroup. Bull trout have not been considered a game species; thus, there has been no stocking to mask population trends.

Their habitat requirements make them highly vulnerable to land management activities that raise water temperatures, increase sedimentation, decrease connectivity, modify streamside/riparian function, and encourage fishing/poaching access. Thus, it is believed that changes to bull trout habitat and population trends would be indicative of changes to other aquatic species.

FOREST PLAN AMENDMENT AND REVISION

The Forest has adopted a Continuous Assessment and Planning (CAP) approach to its Forest Plan revision. Forest plans are normally revised on a 10-year cycle; with anticipated completion of the revision occurring 10-15 years after plan approval. As previously discussed, one of the lessons learned from implementation of the current Forest Plan is that plans need to be dynamic to account for changed resource conditions and changed regulations and policies. To keep plans current with changing conditions and issues, they often require amendment.

CAP recognizes the need to keep plans current and puts into place both procedures and an organization to conduct assessments to aid in determining the need for forest plan amendment and revisions prior to the scheduled 15-year update. Within an adaptive management framework, the need to amend or revise the Forest Plan may result from:

The need to amend the plan may result from:

- Recommendations of an interdisciplinary team based on monitoring and evaluation results.
- Determinations by the Forest Supervisor that existing or proposed projects, permits, contracts, cooperative agreements, or other instruments authorizing occupancy and use are appropriate, but not consistent with elements of the Plan's management direction.
- Administrative appeal decisions.
- Planning errors found during forest plan implementation.
- Changes in physical, biological, social, or economic conditions.

The Forest Supervisor will determine whether the proposed changes in the Forest Plan are significant or non-significant. Significance here is defined by the NFMA regulations, and is different than significance as used under NEPA.

The dichotomous key and flow chart below provide a general idea as to how items monitored will be evaluated in the context of the Forest Plan, and a general gauge as to how to determine the relative significance resulting from monitoring.

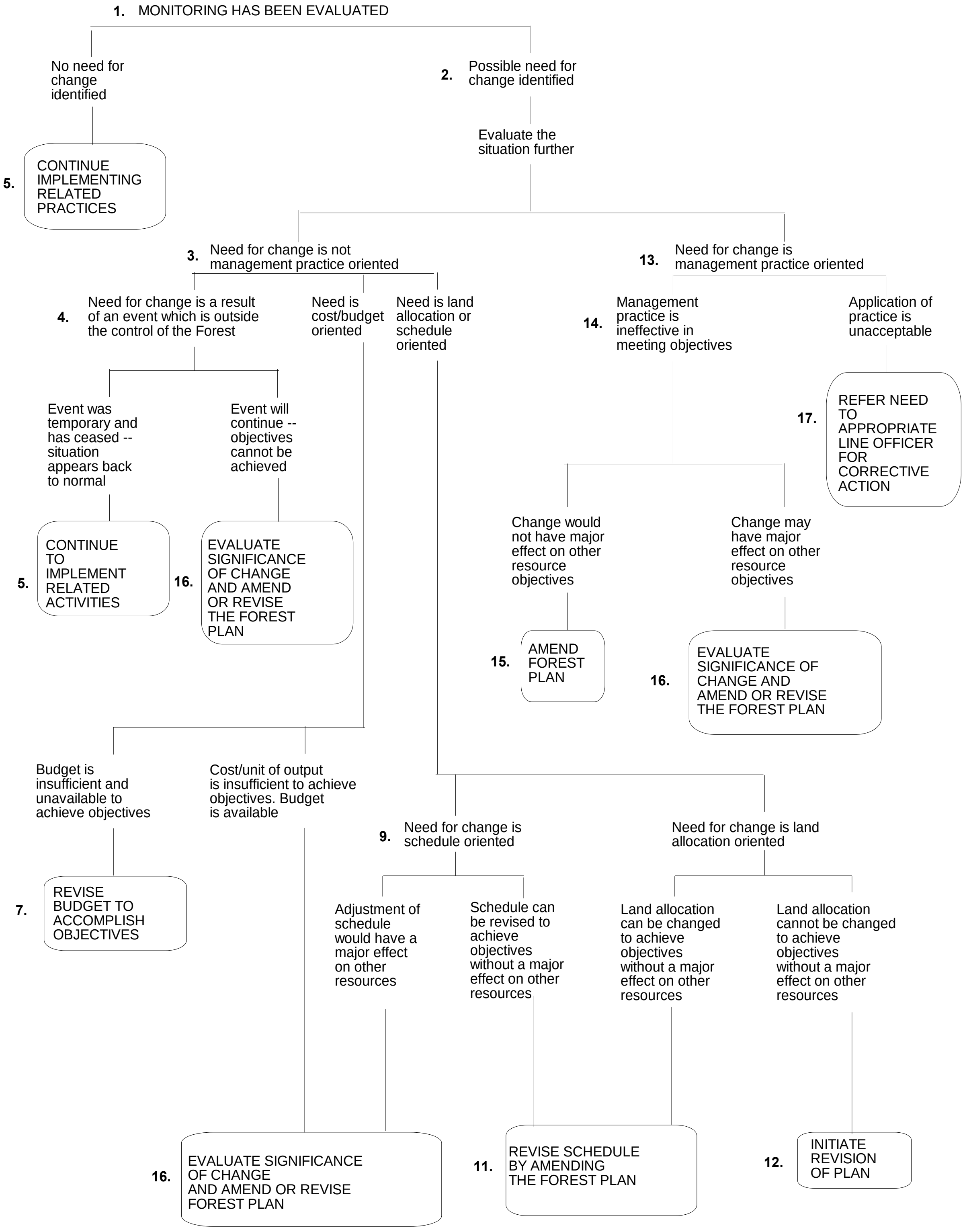
Additional analysis in support of Plan implementation activities conducted at various scales above the project (site) level is also a form of CAP. Completing these analyses can improve our understanding of ecosystems and associated social and economic dimensions, and provide context information for project planning. Ecosystem analysis at the mid and fine scale, for example, is designed to help set the stage for project planning and NEPA analysis, focus ID team discussion on key management issues at multiple scales, and provide a basis for integrating project designs. This type of analysis is not a decision-making process in the context of NEPA.

For more information on CAP, see the final section of Chapter II in this document.

Table IV-3. Key to Sorting Results of Monitoring and Evaluation

PROCEED TO.	**NUMBER**
1. Monitoring has been evaluated, and	
a. No Need for Change Identified	5
b. Possible Need for Change Identified	2
2. Evaluate the situation further:	
a. Need for Change is **not** management practice oriented	3
b. Need for Change **is** management practice oriented	13
3. Need for change is not management practice oriented	
a. Need is result of an event, which is outside the control of Forest	4
b. Need is cost-budget oriented	6
c. Need is land allocation or schedule oriented	8
4. Event is outside the control of Forest	
a. Event was temporary and has ceased - situation appears back to normal	5
b. Event will continue - objectives cannot be achieved	16
5. Continue to implement related activities	
6. Need for change is cost-budget oriented	
a. Cost per unit of output is insufficient to achieve objectives; Budget is available	7
b. Budget is insufficient and unavailable to achieve objectives	16
7. Revise budget to accomplish objectives	
8. Need for change is land allocation or schedule oriented	
a. Need for change is schedule oriented	9
b. Need for change is land allocation oriented	10
9. Need for change is schedule oriented	
a. Adjustment of schedule would have a major effect on other resources	16
b. Schedule can be revised to achieve objectives without a major effect on other resources	11
10. Need for change is land allocation oriented	
a. Land allocation can be changed to achieve objectives without a major effect on other resources	11
b. Land allocation **cannot** be changed without a major effect on other resources	12
11. Revise schedule or land allocation by amending the Forest Plan	
12. Initiate revision of the Forest Plan	
13. Need for change is management practice oriented	
a. Management practices ineffective in meeting goals and objectives	14
b. Application of practice is unacceptable	17
14. Management practice is ineffective	
a. Change would not have major effect on other resource objectives	15
b. Correction may have major effect on other resource objectives	16
15. Amend the Forest Plan	
16. Evaluate significance of change and amend or revise the forest plan	
17. Refer need for change to appropriate line office for corrective action	

Figure IV-2. Monitoring and Evaluation Flow Chart



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Boise National Forest
Land and Resource Management Plan

Appendix A

Appendix A.
Vegetation

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INTRODUCTION

Appendix A contains the mapping criteria, classification descriptions, and desired condition tables for vegetation outside of designated wilderness areas that fall within Management Area 22. Separate tables and/or narratives relate to desired conditions for 3 vegetation types: 1) components of forested vegetation; 2) woodland and shrubland; and 3) riparian vegetation, including vegetation in riparian conservation areas (RCAs). Desired conditions do not represent a static state; they are dynamic because the ecosystems are dynamic. The desired conditions will not be evident on every acre of the Boise National Forest (Forest) at every point in time; spatial and temporal variability will always exist. However, Forest management's long-term goal is to achieve desired conditions distributed across the planning unit. The desired conditions are to be evaluated Forest wide for tree size class, canopy cover, and species composition; at the 5th field hydrologic unit (HU) for spatial pattern; and at the activity area for snags and coarse woody debris. Desired conditions for tree size class, canopy cover, and species composition are evaluated through Forest Plan monitoring. This evaluation process may result in Forest Plan amendments that will guide future project development. Snags and coarse woody debris are evaluated during project planning. Watershed or activity area scales of analysis may be used where a different reference is more appropriate to identify opportunities for a specific treatment.

The historical range of variability (HRV) was used as a basis for developing desired conditions. The HRV has been suggested as a framework for coarse filter conservation strategies (Hunter 1990) and is described as an appropriate goal for ecological conditions (Landres et al. 1999). The assumption is that if it is possible to produce or mimic a variety of historically functioning ecosystems across the landscape, then much of the habitat for native flora and fauna should be present. The desired conditions described below fall within a portion of the HRV and are also balanced with social and economic desired conditions.

In many areas, current conditions deviate strongly from desired conditions; this deviation may create opportunities for managing vegetation. However, even under careful management it may take several decades for these areas to approach desired conditions. During that time, managers will have to choose among several approaches to maintain progress toward desired conditions. There may be many different paths to a common endpoint that meet different management objectives, but each path has its own trade-offs. Navigating these paths and trade-offs will be the challenge of ecosystem management in trying to achieve desired vegetative conditions. As we move forward with vegetation management and learn more from monitoring and scientific research, desired conditions may change, or we may alter the paths we choose to achieve them. For these reasons, it is impossible to describe a completely prescriptive approach to desired conditions. We can only offer guidance on how to achieve desired conditions.

Exceptions to the desired vegetative conditions may exist, possibly as a result of management direction in other resource areas or undesirable site-specific conditions. In some cases, Management Area direction may have different goals and objectives for specific areas (e.g., developed campgrounds) that would override the Forest-wide desired conditions. Each Management Prescription Category (MPC) may also have a different theme regarding how to achieve desired conditions. All of these differences need to be considered when we design our projects.

The desired conditions are general conditions that can be modified at the local or project level based on site-specific biophysical conditions. Some examples of projects where desired conditions could deviate from those in Appendix A include restoring rare plant habitat or considering the needs of a threatened or endangered species where the Forest-wide desired conditions would not provide the site-specific conditions appropriate to the plant community. The rationale for deviating from Appendix A desired conditions would be documented through project-level analysis to help develop an alternate site-specific desired condition.

Appendix A provides the foundation for coarse filter forestland, woodland, shrubland, and grassland ecosystems and associated functions and processes. It also provides desired conditions for fine filter elements such as snags and coarse woody debris and sets a context for riparian areas, wetlands, and alpine communities. Desired conditions are defined as ranges rather than an "average" or "target" in order to provide for a diversity and variety of conditions within and across landscapes. The desired conditions are framed by the HRV and fire regimes and—though presented in terms of tangible attributes of structure, patch, and pattern—embody intangible attributes of function and process. These intangible attributes, particularly disturbance processes that contribute to ecosystem structure and function, are generally captured as Forest-wide goals and in the desired conditions for spatial pattern.

National Standards for Vegetation Classification

Ecosystem assessment and land management planning at national and regional levels require consistent standards for classifying and mapping existing vegetation. An existing standardized vegetation classification system provides a consistent framework for cataloging, describing, and communicating information about existing plant communities. The net value of using standardized existing vegetation classifications and maps is improved efficiency; accuracy; and defensibility of resource planning, implementation, and activity monitoring. Appendix A represents a vegetation classification for existing vegetation that precedes U.S. Department of Agriculture (USDA) Forest Service policy and protocol for consistent standards for classification; the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant 2005) documents and establishes these standards. Our vegetation inventories and maps do not match these standards. However, as new inventories and maps are completed, these will be consistent with USDA Forest Service existing vegetation classification standards for dominant vegetation, size class, and canopy cover. At that time, Appendix A will also be modified with desired conditions that are consistent with established classification standards.

Fire Regimes and Spatial Pattern

Recent advances in theory and empirical studies of vegetation and landscape ecology indicate that, to achieve long-term biological diversity across landscapes, management needs to consider the major disturbance processes, including variability and scale, which determine ecosystem components and their spatial pattern (Baker 1992; Baker and Cai 1992; Hessburg et al. 2007). Because fire was historically a major disturbance process in the west, historical fire regimes have been recommended to help set context for the individual components of the desired conditions (Wallin et al. 1996).

Fire regimes are summarized in Table A-1. Figure A-1 displays vegetative spatial patches and patterns that generally resulted from the historical fire regimes (i.e., fire disturbance that occurred on the landscape for approximately 500 years before European settlement [Hann et al. 2004]). Hann et al. (2004) state that appropriate landscapes for evaluating fire regimes are "relatively large-scale, contiguous areas big enough to exhibit natural variation in fire regimes and associated vegetation." They recommend basing the landscape size on the dominant historical fire regime within an area; appropriate landscapes can range from 500 to 300,000 acres in highly dissected topography. Spatial patterns are evaluated at the watershed (5th HU) landscape unit because, in most cases, this scale is large enough to represent the desired fire regime patch dynamics that created the largest patch sizes on the Forest (i.e., the lethal fire regimes). Much larger patches than would be appropriate to represent using a watershed context could be created from very large stand-replacing fires. However, such fires, even within the historical range of lethal fire regimes, are generally inconsistent with current management given the complexity of management goals and objectives within national forests (Wallin et al. 1996; Cissel et al. 1999). Therefore, depending on the mix of fire regimes, a watershed may be dominated by a few or many patches. For example, a watershed dominated by nonlethal fire regimes may be primarily large tree size class with fine-grained patches of smaller tree size classes. A watershed dominated by mixed fire regimes may have numerous small to large patches of different tree size classes, while a watershed dominated by lethal fire regimes may have primarily smaller tree size classes with fine-grained patches of larger-sized trees.

Table A-1. Fire Regimes

Fire Regime	Fire Interval	Fire Intensity	Vegetation Patterns (Agee 1998)
Nonlethal	5–25 years	≤10% mortality	Relatively homogenous with small patches generally less than 1 acre of different seral stages, densities, and compositions created from mortality.
Mixed1	5–70 years	>10–50% mortality	Relatively homogenous with patches created from mortality ranging in size from less than 1 to 600 acres of different seral stages, densities, and compositions.
Mixed2	70–300 years	>50–90% mortality	Relatively diverse with patches created by mixes of mortality and unburned or underburned areas ranging in size from less than 1 to 25,000 acres of different seral stages, densities, and compositions.
Lethal	100–400 years	>90% mortality	Relatively homogenous with patches sometimes greater than 25,000 acres of similar seral stages, densities, and compositions. Small inclusions of different seral stages, densities, and compositions often result from unburned or underburned areas.

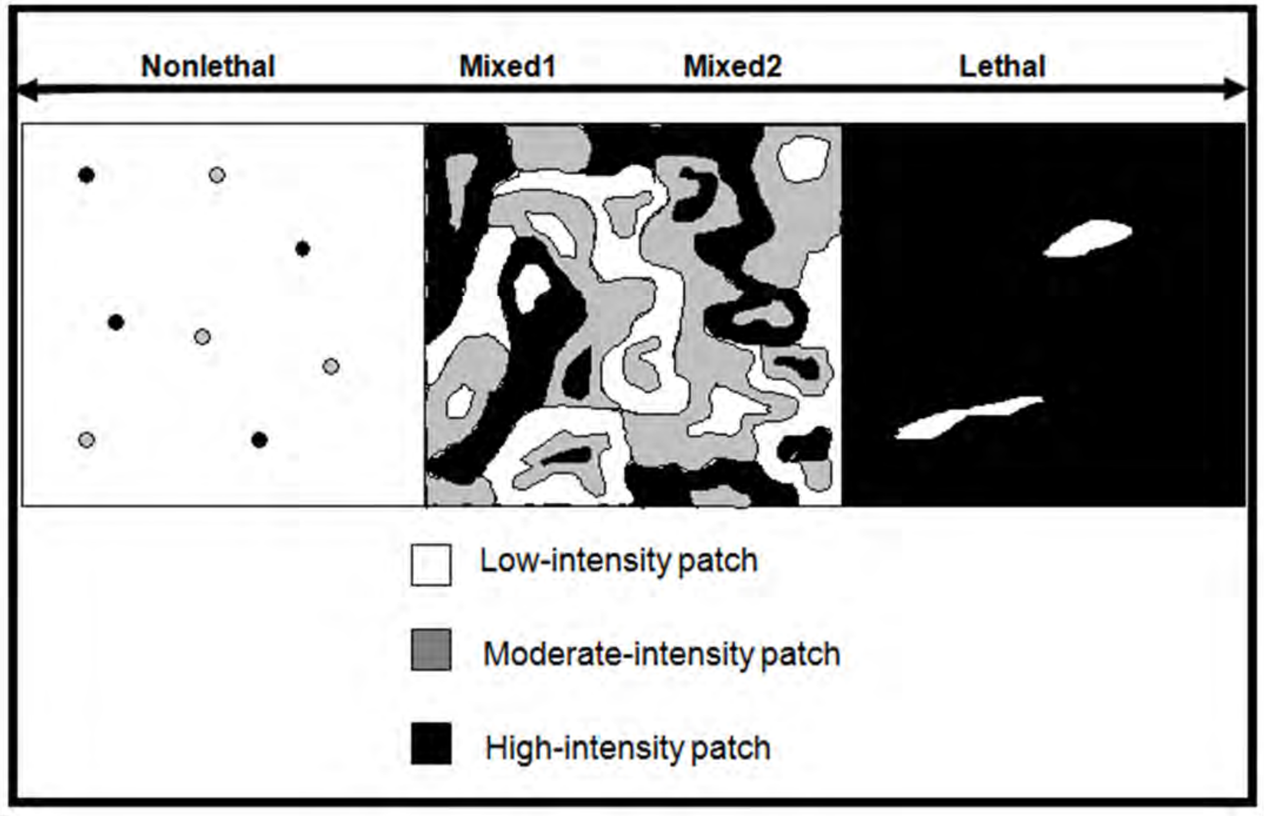

Figure A-1. Patch Dynamics of Fire Regimes (from Agee 1998)

Evaluating spatial pattern is a daunting task that requires both a conceptual framework to organize and simplify ecosystem complexity and knowledge of the details of particular systems (Spies and Turner 1999). Historically, patterns like those in Figure A-1 were the result of disturbance regimes and succession that created spatial elements within and between vegetation types, including amount, proportion, size, interpatch distance, patch size variation, and landscape connectivity.

Landscape spatial patterns affect ecological processes and can be illustrated through differences in plant species composition and structure and through habitat utilization by wildlife. Despite recent interest and progress in spatial patch and pattern research, it remains challenging to determine the conditions under which spatial heterogeneity is and is not important for various processes or organisms (Spies and Turner 1999). Ecosystems often include recognizable patchiness, usually corresponding to physical changes in topography, hydrology, and substrate or due to large disturbances (Whittaker 1956; Bormann and Likens 1979; Taylor and Skinner 2003). Patchiness in the landscape can create changes in microclimate at patch edges, resulting in demographic fluxes of many individual plant species, varied plant species distribution, and edge-oriented patterns (Matlack and Litvaitis 1999). These effects can subsequently alter ecological processes and habitat utilization.

Within a watershed, several forested vegetation types may be interspersed with several shrubland and/or grassland vegetation types. Additionally, several MPC designations may be superimposed upon these vegetation types. It is important to consider the composition of the landscape that contains a project area. At the project level, opportunities exist to consider spatial patterns, how a project can affect spatial patterns, and what those effects (positive or negative) will be to plant and animal species. During project design, spatial pattern considerations are dependent upon current conditions and overriding management concerns for the area. Generally, these conditions and concerns are site-specific, depending on the project scale. Repeating patterns of change emerge at landscape scales, and some order can be found through descriptions of successional pathways, patch mosaics, and seral stages that facilitate understanding and managing vegetation at landscape scales. The challenge and art of management is to simplify without losing important attributes or losing sight of the underlying complexity (Spies and Turner 1999). Another useful way of understanding vegetation dynamics is to characterize the landscape as a shifting mosaic of patches of different ages and developmental stages (Bormann and Likens 1979). The proportion of different age classes or seral stages across a landscape and over time is one of the fundamental characteristics of the vegetation mosaic.

In some cases, the prevailing landscape pattern has been altered so strongly that historical information may be necessary to determine appropriate landscape patterns. For example, fire was historically an important disturbance that maintained the dynamics between native grass and big sagebrush dominance. Frequent small fires opened the shrub canopy and aided the establishment of native perennial grasses at small scales, creating a mosaic of grassland and shrubland communities in different development stages at large scales (Knick 1999). The system dynamics changed when cheatgrass invaded the sagebrush ecosystem and provided continuous fuels, compared to more patchily distributed native bunchgrasses. This invasion facilitated fire spread and shrub loss, resulting in shrubland fragmentation into smaller, spread out patches. Ultimately, many patches did not persist (Knick and Rotenberry 1997). Patch and pattern have changed and may no longer provide for the processes and habitat associated with these systems (Rotenberry and Wiens 1980; Knick and Rotenberry 1995; Paige and Ritter 1999; Connelly et al. 2000; Knick and Rotenberry 2000). Spatial pattern considerations and subsequent management will be particularly difficult in these highly disrupted ecosystems and vegetation types.

DESIRED VEGETATION CONDITIONS

Forested Vegetation

The desired conditions for forested vegetation are described below. Forested vegetation refers to land that contains at least 10 percent canopy cover by forest trees of any size, or land that formerly had tree cover and is presently at an earlier seral stage. Forested vegetation is described by habitat types, which use potential climax vegetation as an indicator of environmental conditions. At the Forest Plan level, forested habitat types have been further grouped into potential vegetation groups (PVGs) that share similar environmental characteristics, site productivity, and disturbance regimes. These groupings simplify the description of vegetative conditions for use at the broad scale. For additional details on the specific habitat types and groupings into PVGs, see Mehl et al. (1998) and Steele et al. (1981).

Table A-2 displays the forested PVGs grouped by fire regimes. Additional information on PVGs is available in the Vegetation Classification and Mapping sections.

Table A-2. Forested potential vegetation groups by fire regimes

Fire Regimes	Potential Vegetation Group
Nonlethal	PVG 1—Dry Ponderosa Pine (*Pinus ponderosa*)/Xeric Douglas-fir (*Pseudotsuga menziesii*)
	PVG 2—Warm Dry Douglas-fir/Moist Ponderosa Pine
Nonlethal-Mixed1	PVG 5—Dry Grand Fir (*Abies grandis*)
Mixed1-Mixed2	PVG 3—Cool Moist Douglas-fir
	PVG 4—Cool Dry Douglas-fir
	PVG 6—Cool Moist Grand Fir
Mixed2	PVG 7—Warm Dry Subalpine Fir (*Abies lasiocarpa*)
	PVG 11—High Elevation Subalpine Fir
Mixed2-Lethal	PVG 10—Persistent Lodgepole Pine (*Pinus contorta*)
Lethal	PVG 8—Warm Moist Subalpine Fir
	PVG 9—Hydric Subalpine Fir

Tree Size Class

Tree size class is based on the largest diameter at breast-height (d.b.h.) of trees according to the following definitions (Table A-3). If none of the definitions apply, the size class is considered grass/forb/shrub/seedling (GFSS). Though a smaller size class may represent a greater canopy cover area than a larger size class, the tree size class is determined by the largest trees that meet the class definition, not the most abundant.

Table A-3. Tree size class definitions

Diameter at Breast-Height (Inches)	Total Nonoverlapping Canopy Cover Of Trees (%)	Tree Size Class
≥20.0	≥10	Large
≥12.0	≥10	Medium
≥5.0	≥10	Small
≥0.1	≥10	Sapling

A few individual trees (such as relic or legacy trees) representing a distinctly different tree size are not recognized as a size class if the total nonoverlapping canopy cover is <10 percent. For example, two or three 18-inch d.b.h. trees in a plantation may be legacies; these legacies would not define the tree size class even though they are the largest trees in the stand since their canopy cover would not meet or exceed 10 percent. In this example, the size class is defined by the plantation trees and not the legacies.

Table A-4 displays Forest-wide desired amounts for tree size classes other than large. For each PVG, this table shows the desired range of the forested vegetation for each tree size class. The range for each size class reflects the dynamic development of trees, considering growth rates, type and extent of disturbances, and varying growth conditions. The individual components are described in more detail below.

Table A-4. Forest-wide range of desired tree size classes for stages other than large tree, arranged by fire regime

Tree Size	Nonlethal		Nonlethal -Mixed1	Mixed1-Mixed2			Mixed2		Mixed2 -Lethal	Lethal	
	PVG 1 (%)[a]	PVG 2 (%)	PVG 5 (%)	PVG 3 (%)	PVG 4 (%)	PVG 6 (%)	PVG 7 (%)	PVG 11 (%)	PVG 10[b] (%)	PVG 8 (%)	PVG 9 (%)
GFSS	1–12	4–5	3–4	9	14–15	7–8	7–16	9–15	16–23	15–17	13–15
Saplings	2–12	3–7	3–7	9	7–9	7–9	11–15	14–15	11–16	11–15	8–15
Small	2–18	5–21	4–22	18–27	19–22	11–27	21–22	19–22	46–48	22–23	17–22
Medium	3–29	7–35	7–30	23–36	24–36	18–36	32–36	22–38	11–20	28–29	25–29

[a] Percentage of forested vegetation within each PVG

[b] See the large tree size class discussion below for the desired conditions for medium size class in PVG 10

Below, Table A-5 displays the Forest-wide desired amounts for the large tree size class, by PVG.

Canopy Cover Class

The tree size class is based on the largest d.b.h. trees that meet the definitions described in the Tree Size Class section. Canopy cover class represents the total nonoverlapping cover of all trees in a stand, excluding the seedling tree size class. Trees in the seedling tree size class are used to estimate canopy cover class only when they represent the only structural layer present.

Canopy cover classes are based on the following:

- Low = 10–39 percent canopy cover
- Moderate = 40–69 percent canopy cover
- High = 70 percent or more canopy cover

Canopy cover class may be determined from visual estimates using aerial photos or from algorithms in programs such as Forest Vegetation Simulator. Canopy cover is used in two different calculations; the first is to determine tree size class as described in the “Tree Size Class” section. In this case, the largest trees that contain >10 percent canopy cover determine the size class and the only canopy cover used is the cover of trees in that specific size class. Once the Tree Size Class is determined, the second calculation involving canopy cover is the one described in this section and uses trees of all sizes (except seedling) to determine nonoverlapping canopy cover. This calculation determines the total canopy cover used when evaluating desired conditions.

Species Composition

Table A-5 displays the Forest-wide desired condition ranges for the large tree size class, including canopy cover class and species composition. For species composition, finer scales are not expected to mirror these values because of the specific mix of habitat types present in individual analysis areas. For example, for PVG 1, the desired range of 96–99 percent ponderosa pine would be attained when evaluated at the Forest-wide scale, while the remainder of PVG 1, up to 4 percent of the area, would be any other combination of tree cover. However, the Douglas-fir/mountain snowberry habitat type, which occurs in PVG 1 only rarely, supports ponderosa pine. Therefore, managing for a species composition that reflects the Forest-wide desired condition would likely not be appropriate since managing for a predominance of Douglas-fir would be more ecologically suitable for this habitat type. Therefore, the proper species “mix” for a project area should be determined by habitat types and other concerns, such as wildlife or wildland/urban interface.

Table A-5. Forest-wide range of desired conditions for the large tree size class for forested vegetation within each potential vegetation group (PVG), arranged by fire regime

Fire Regime	PVG	Large Tree Size Class	Canopy Cover Class	Species Composition[a]
Nonlethal	PVG 1	47–91%	Low: 63–83% Moderate: 17–37% High: 0%	Aspen: Trace Ponderosa pine: 96–99% Douglas-fir: 0–2%
	PVG 2	59–80%	Low: 61–81% Moderate: 19–39% High: 0%	Aspen: Trace Lodgepole pine: Trace Ponderosa pine: 81–87% Douglas-fir: 10–16%
Nonlethal-Mixed1	PVG 5	66–84%	Low: 25–45% Moderate: 55–75% High: 0%	Aspen: Trace Lodgepole pine: Trace Ponderosa pine: 80–88% Western larch : 0–1% Douglas-fir: 7–17% Engelmann spruce : Trace Grand fir: 0–1%
Mixed1-Mixed2[b]	PVG 3	23–41%	Low: 5–25% Moderate: 75–95% High: 0%	Aspen: 1–11% Lodgepole pine: Trace Ponderosa pine: 26–41% Douglas-fir: 47–69%
	PVG 4	20–34%	Low: 8–28% Moderate: 72–92% High: 0%	Aspen: 4–13% Lodgepole pine: 10–20% Ponderosa pine: Trace Douglas-fir: 66–81%
	PVG 6	28–56%	Low: 0–20% Moderate: 80–100% High: 0%	Aspen: Trace Lodgepole pine: 1–5% Ponderosa pine: 23–41% Western larch: 15–29% Douglas-fir: 15–25% Engelmann spruce: 0–2% Grand fir: 9–23% Subalpine fir: 0–3%
Mixed2	PVG 7	10–21%	Low: 0–14% Moderate: 86–100% High: 0%	Aspen: 6–11% Lodgepole: 28–42% Ponderosa pine: Trace Western larch: Trace Douglas-fir: 24–34% Engelmann spruce: 3–5% Grand fir: Trace Subalpine fir: 12–21%
	PVG 11	14–27%	Low: 25–45% Moderate: 55–75% High: 0%	Aspen: Trace Lodgepole pine: 18–25% Whitebark pine : 32–47% Engelmann spruce: 8–13% Subalpine fir: 18–29%
Mixed2-Lethal	PVG 10	Medium Tree Size Class[b] (See Table A-3)	Low: 0–21% Moderate: 71–91% High: 0–18%	Aspen: Trace Lodgepole pine: 82–94% Whitebark pine: Trace Douglas-fir: Trace Engelmann spruce: Trace Subalpine fir: Trace

Fire Regime	PVG	Large Tree Size Class	Canopy Cover Class	Species Composition[a]
Lethal	PVG 8	18–21%	Low: 0%	Aspen: Trace Lodgepole pine: 25–34% Western larch: 9–16% Douglas-fir: 23–37% Engelmann spruce: 10–17% Subalpine fir: 11–17%
			Moderate: 51–71%	
			High: 29–49%	
	PVG 9	31–37%	Low: 0%	Aspen: Trace Lodgepole pine: 29–37% Western larch: Trace Douglas-fir: Trace Engelmann spruce: 28–33% Subalpine fir: 29–33%
			Moderate: 51–71%	
			High: 29–49%	

[a] Use this table as a reference. For project purposes, describe the desired species composition based on species composition of the habitat types present within the analysis area. Refer to the appropriate habitat type guide for the analysis area when determining the correct species mix, including those species that may occur as accidentals.

[b] Large tree size class was not modeled as part of the HRV.

While Table A-5 displays the Forest-wide desired species composition for the large tree size class, this same species composition can be used to help guide projects conducted in intermediate tree size classes. Individual species described as “trace” were not explicitly modeled when developing the HRV because they occur in habitat types that represent a minor part of the PVGs within the southern part of the Idaho Batholith and/or because little is known about their historical occurrence within a PVG. Aspen, which occurs in minor amounts in many PVGs, is an example. Because aspen is a minor component, it has not been extensively studied to fully understand its role. However, these “trace” species should be retained where they are found within the landscape, particularly species in decline, including aspen, whitebark pine, and western larch.

The appropriate species composition for a project area may vary from Table A-5 based on the mix of habitat types present, particularly for PVGs such as PVG 6, which includes several habitat types representing a broad environmental range. For project application in most PVGs, it is necessary to determine the mix of habitat types that comprise the PVGs within the project area. Since most project areas will generally contain fewer habitat types than are represented by the PVGs, the desired species composition should reflect that more limited set. Therefore, the project area desired species composition may deviate from the desired Forest-wide composition but should, where appropriate, result in landscapes dominated by early-seral species. These species are better adapted to site conditions and are usually more resilient to disturbances such as fire. For example, the desired species composition for sites dominated by warmer, drier habitat types in PVG 6, which supports ponderosa pine, would be different from sites dominated by cooler, more frost-prone habitat types that support lodgepole pine.

The ranges in Tables A-4 and A-5 were developed from HRV estimates adopted from Morgan and Parsons (2001). The high end of the range for the large tree size class is equal to the mean HRV value; the low end of the range equals the low end of the HRV. Although current conditions may prevent us from obtaining desired conditions for quite some time, management actions over a longer period (perhaps more than 100 years) should result in forested vegetation approaching Forest-wide desired conditions in Tables A-4 and A-5. For the large tree size class, Table A-5 shows the set of components that together achieve the desired conditions.

Shrub and Herb Communities within the Forested Potential Vegetation Groups

Like with the tree component, the shrub and herb communities historically occurred within some range of variability depending on disturbance processes and succession (Steele and Geier-Hayes 1987). The shrub and herb communities that occur across the landscape reflect environmental conditions such as elevation, aspect, topography, and soils and other factors, including management activities. The desired conditions for these communities are to have healthy, resilient, and resistant native shrub and herb species.

Snags and Coarse Woody Debris

Snags and coarse woody debris are created by disturbances and vary depending on vegetation type and stage of succession (Hutto 2006). In older forests, snags and coarse woody debris are generally products of disease, insects, lightning, low-intensity fire, and senescence (Spies et al. 1988). In postdisturbance forests, most snags and coarse woody debris are products of the disturbance that created the early-seral condition (Drapeau et al. 2002). Therefore, snags and coarse woody debris in older forests often exhibit more advanced stages of decay than postdisturbance forests, though some components of predisturbance snags and coarse woody debris may still be present (Nappi et al. 2003). In all forests, snags and coarse woody debris serve important ecological functions.

Much of the research regarding snags in older forests has focused on using them as nesting habitats, particularly for primary cavity nesters (Hutto 2006). Recent research has shown that while snags in postdisturbance forests provide nesting habitat, they are also an important resource for foraging (Nappi et al. 2003), particularly for species such as the black-backed and three-toed woodpeckers which forage on insects that infest recently burned trees. Although these trees only provide suitable foraging habitat for a short time, they are an invaluable resource for these woodpecker species.

Tables A-6 and A-7 display the snag and coarse woody debris desired conditions for green stands in PVGs. Snags and coarse woody debris are finer-scale elements than the coarse-scale vegetative components of species composition, size class, and canopy cover. Snags and coarse woody debris occur as more discrete components within stands, whereas the species composition, tree size class, and canopy cover class occur across stands. Therefore, snags and coarse woody debris are evaluated during project planning for an activity area (refer to the Glossary), which better reflects the appropriate scale to consider these elements. The activity area for snags and coarse woody debris is the specific site affected, whether the effects are positive or negative. Actions that need to be assessed include timber harvest, reforestation, timber stand improvement, and prescribed fire activities.

Table A-6. Desired range of snags per acre in green stands for potential vegetation groups

Diameter Group	Nonlethal		Nonlethal–Mixed1	Mixed1–Mixed2			Mixed2		Mixed2–Lethal	Lethal	
	PVG 1[a]	PVG 2[b]	PVG 5[b]	PVG 3[b]	PVG 4[b]	PVG 6[b]	PVG 7[b]	PVG 11[a]	PVG 10[a]	PVG 8[b]	PVG 9[b]
10–19.9 inches	0.4–0.5	1.8–2.7	1.8–5.5	1.8–4.1	1.8–2.7	1.8–5.5	1.8–5.5	1.4–2.2	1.8–7.7	1.8–7.5	1.8–7.5
≥20 inches	0.4–2.3	0.4–3.0	0.4–3.5	0.2–2.8	0.2–2.1	0.2–3.5	0.2–3.5	0.0–4.4	NA	0.2–3.0	0.2–3.0
Total	0.8–2.8	2.2–5.7	2.2–9.0	2.0–6.9	2.0–4.8	2.0–9.0	2.0–9.0	1.4–6.6	1.8–7.7	2.0–10.5	2.0–10.5

Note: This table is not meant to provide an even distribution of snags across every acre of the forested landscape, but to provide numbers that serve as a guide to approximate an average condition for an activity area.

[a] Minimum height = 15 feet. Snags at or greater than the minimum height contribute to the desired conditions. However, snags less than the minimum height contribute to ecological functions and should be retained.

[b] Minimum height = 30 feet.

Table A-7. Desired range of coarse woody debris in green stands, in tons per acre, and desired amounts in large classes for potential vegetation groups

Indicator	Nonlethal		Nonlethal–Mixed1	Mixed1-Mixed2			Mixed2		Mixed2–Lethal	Lethal	
	PVG 1	PVG 2	PVG 5	PVG 3	PVG 4	PVG 6	PVG 7	PVG 11	PVG 10	PVG 8	PVG 9
Dry Weight (Tons/acre) in Decay Classes I and II	3–10	4–14	4–14	4–14	4–14	4–14	5–19	4–14	5–19	5–19	5–19
Distribution ≥15 inches	>75%	>75%	>75%	>65%	>65%	>65%	>50%	>25%	>25%	>25%	>25%

Note: The recommended distribution is to try to provide coarse wood in the largest size classes, preferably over 15 inches (12 inches for PVG 10), that provide the most benefit for wildlife and soil productivity. This table is not meant to provide an even distribution of coarse wood across every acre of the forested landscape, but to provide numbers that serve as a guide to approximate an average condition for an activity area.

Because the desired conditions in Tables A-6 and A-7 are for green stands, in many cases they may not be appropriate for postdisturbance forests. While a portion of the snags and coarse woody debris in stands may be a legacy of postdisturbance communities, the kind of material created immediately postdisturbance and the role it plays is different than dead wood dynamics in green stands. Drapeau et al. (2002) found that snags in postdisturbance stands were generally less decayed than those in green stands. Postdisturbance communities are important habitats for primary cavity nesters, while green stands have a greater proportion of secondary cavity nesters.

Using historical fire regimes, Agee (2002) presents several diagrams that depict the spatial and temporal variability found in snag and coarse woody debris numbers. According to Agee, the landscape ecology of historical fire regimes is a function of place. Low-intensity fire regimes had small patches and little edge, while high-intensity regimes had the largest patch sizes and moderate amounts of edge (Figure A-1). Moderate- or mixed-intensity fire regimes had intermediate patch sizes and maximum amounts of edge.

Spatial distribution of snags and coarse woody debris is important. However, the desired conditions described in Tables A-6 and A-7 are not meant to provide an even distribution of snags or coarse woody debris across every acre of the forested landscape. The numbers serve as a guide to approximate an average condition for an activity area. It would be undesirable for all the dead material in an activity area to be clumped into one corner or one type of area, leaving little or no material in the remainder of the area. Though snags are generally found in clumps within patches, snag patches should be distributed across the activity area rather than clustered in a portion of the activity area; the activity area should have snag patches throughout, depending on what is appropriate for the PVG. In addition, snags eventually become coarse woody debris. Because coarse woody debris is also created from green trees it is often more uniformly distributed across the landscape than snags.

Agee (2002) also discusses how woody debris dynamics have historically varied by fire regime (Figure A-2). Frequent, low-intensity fires limited the amount of coarse woody debris. Figure A-2 displays fluctuations in course woody debris found in low-intensity fire regimes; the peaks may be as high as 13–16 tons/acre, the lows could be <0.5 tons/acre, and the average is around 5 tons/acre (Graham, personal communication 2001). Although fires were frequent, they rarely affected every acre. In moderate-intensity fire regimes, fires consumed and created coarse woody debris several times per century (Agee 2002). In high-intensity fire regimes, a "boom-and-bust" dynamic operated: substantial coarse woody debris was created postdisturbance, followed by a century or more without further substantial input. Therefore, it is important to understand the dynamics of the project area's particular PVG to best determine desired levels.

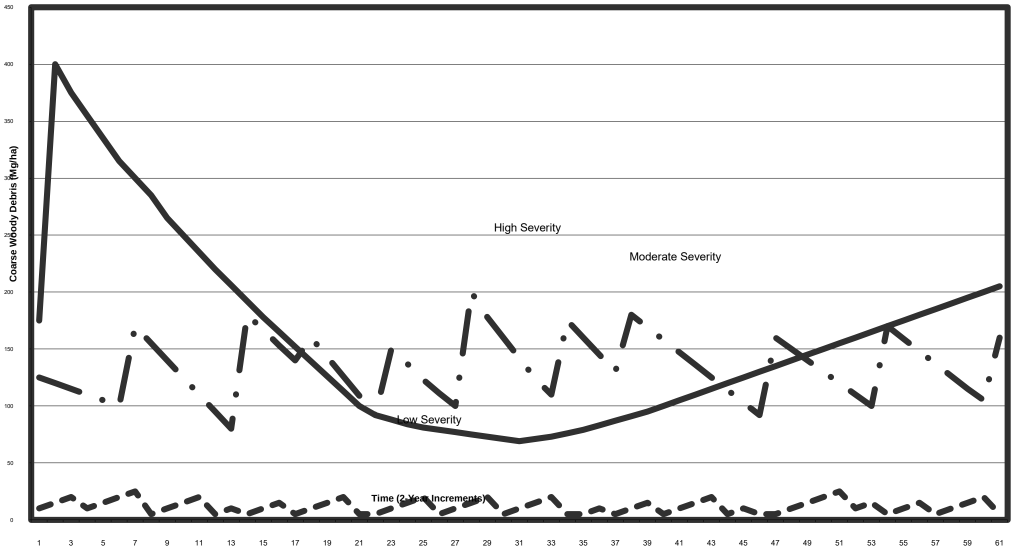

Figure A-2. Temporal cycling of coarse woody debris by fire regime (Agee 2002)

Large-diameter snags and coarse woody debris may not be available in seedling, sapling, and small tree size stands depending on the amount of material present from postdisturbance early-seral stands. In this case, some of the tonnage and snag numbers can be in smaller size classes. It is not expected that the total amounts, particularly for coarse woody debris, will be made up in smaller size classes, but there should be opportunities to progress toward the desired ranges. In particular, the amount of material retained with diameters <6 inches should be balanced against the fire hazard it—and the finer material that often comes with it—may create. Several factors determine the potential fire hazard created by surface fuels, including the kind, depth, continuity, and extent of surface fuels; connectivity to standing trees; and proximity to adjacent fuels. The risk of creating a potentially hazardous condition should also be considered relative to the area's management objectives.

Our primary objective is to provide the majority of coarse woody debris in larger size classes as this material is retained on-site longer. Although some small and intermediate stage stands may not have the larger material available, the expectation is not to compensate with an abundance of material in the small and medium size classes. If only smaller material is available, some should be left to assist with long-term soil productivity. Coarse woody debris with diameters ≥15 inches (≥12 inches for PVG 10) and lengths ≥6 feet are referred to as logs. These large pieces provide important material for meeting wildlife needs.

Single management treatments may not produce all the dead material in the amounts and/or decay classes desired. However, treatments should be designed to provide structural, compositional, and functional elements that contribute to long-term sustainability of snags and coarse woody debris. In many cases, actions will consume coarse wood (e.g., prescribed fire). However, if the action results in mortality that produces snags or coarse woody debris, it will contribute to desired levels of large snags and coarse woody debris over time. Furthermore, a range of dead wood sizes and age classes should be retained. Snag height minimums described in Table A-6 are just that—minimums—and do not preclude functions provided by smaller snags (Figure A-3). Large trees and snags provide nesting or denning sites longer than small snags do (Graham 1981; Morrison and Raphael 1993). However, smaller snags provide foraging sites, which are needed in greater abundance than nesting sites (Bunnell et al. 2002).

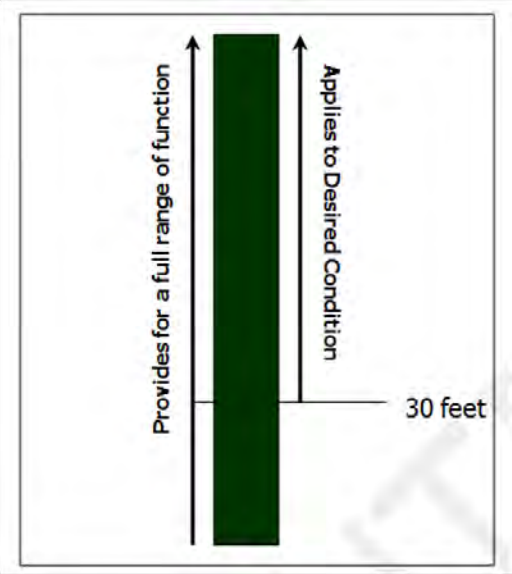

Figure A-3. Range of snag function relative to minimum height described in the desired condition (example for potential vegetation groups with 30-foot minimum height)

Historical fire regimes, particularly the nonlethal and mixed1 regimes, continually recycle material. Larger material may take several fire cycles before it is fully consumed. This constant recycling also helps provide decay class variety, another important component of achieving desired conditions. Therefore, management actions should result in a variety of snag and coarse wood decay classes. Some wildlife species prefer hard snags, while others prefer those with more decay. For soil productivity, inputs from these different decay classes need to occur at various temporal increments to ensure productivity gaps do not result over time. To provide for continual recruitment into decay class III, only decay classes I and II count towards the desired amounts; the goal is to provide snags and coarse woody debris in decay class III. In addition to decay, characteristics that affect the type and extent of wildlife use of coarse woody debris include physical orientation (vertical or horizontal), size (diameter and length), wood species, and overall material abundance (Harmon et al. 1986; Bunnell et al. 2002).

The increasing number of studies on tree mortality and decomposition are providing a global view of how these processes vary by forest type and climate. These data also provide the basis for a dynamic rather than a static approach to the management of woody material (Harmon 2002). However, to be successful, this perspective must be coupled with a detailed understanding of how certain species and ecosystem processes vary with snag and coarse woody debris amount and quality. The application of a static-state approach, as illustrated by the desired conditions, is based on a set of general objectives designed to provide snags and coarse woody debris across the Forest. However, applying a static-state approach does not account for the dynamic nature of ecosystem processes and the specific objective-oriented needs of species and their functions (Harmon 2002). Evidence suggests a variety of snags and coarse woody debris, with a variety of decay and size characteristics, may be needed to provide for all functional wildlife groups and may be necessary for continuous soil productivity. Therefore, project analysis should consider that greater range of function and process that cannot be captured by the desired conditions.

Legacy Trees

Perry and Amaranthus (1997) defined forest legacies as “anything handed down from a pre-disturbance ecosystem.” These legacies can occur at different scales ranging from the landscape to the stand to individual components within a stand (Huckaby et al. 2003; Van Pelt 2008). For example, within a lethal fire area, unburned or underburned patches as well as individual trees are legacies. Legacies are not an artifact of current land-use activities—they also occurred in the historical landscape (Huckaby et al. 2003). Old live and dead ponderosa pine and western larch trees are an important legacy of the historical condition in many areas (see the Snags and Coarse Woody Debris section for a discussion on dead trees). They are generally resistant to nonlethal/mixed1 fire, provide food and habitat for wildlife, and genetic material reflective of the local site conditions (Huckaby et al. 2003), particularly when present in plantations. However, legacies may now be less common in number and/or distribution due to changes in disturbance regimes (Van Pelt 2008). Since legacies, in particular certain underrepresented old tree legacies, are deficient within many landscapes, retaining old trees, as well as trees that are transitioning into old, provides the greatest opportunity for creating and/or replacing these important components.

Vegetative Hazard and Wildfire within Forested Potential Vegetation Groups

Vegetative desired conditions are directly related to fire hazard: both define conditions that can occur on the landscape. Fire hazard describes potential fire behavior based on characteristics such as the horizontal and vertical arrangement of fuels, fuel continuity, and flammability. High fire hazard implies conditions where fires have a high likelihood of being lethal or difficult to suppress even without contributing factors such as drought or wind. In nonlethal and mixed1 fire regimes, near historical conditions are expected to reduce the risk of lethal wildfires due to the emphasis on larger trees, more fire resistant seral species, and discontinuous ladder and surface fuels. Ignitions within these conditions are more likely to stay on the ground, increasing the chances of keeping a wildfire small (Wagle and Eakle 1979; Omi and Martinson 2002). This scenario is not the case, however, in mixed2 and lethal fire regimes, which have a greater component of more flammable later-seral species and more continuous ladder and surface fuels. By definition, lethal fires are consistent with the way historically mixed2 and lethal fire regimes operate.

Wildfires, whether historically characteristic or uncharacteristic, are undesirable in some cases, particularly in wildland/urban interface areas. Although wildfire risks can partially be addressed by using defensible space, in many situations larger landscapes are a more appropriate scale to deal with concerns about firefighter and public safety and the multitude of infrastructures, resources, and values often associated with interface areas. Therefore, the juxtaposition and arrangement of vegetative conditions relative to wildland/urban interfaces need to be considered at a scale greater than the project area. It is important to consider the vegetative conditions adjacent to the wildland/urban interface because the desired vegetative conditions for some areas may contribute to a risk of stand-replacing wildland fire. In particular, the desired conditions for forested vegetation in mixed2 and lethal fire regimes are generally more hazardous than those found in nonlethal and mixed1 fire regimes. Since desired conditions are intended to create vegetative communities that reflect historical conditions, the resulting disturbances would also reflect historical disturbances. Therefore, by definition, desired conditions for PVGs in mixed2 and lethal fire regimes would produce more stand-replacing wildland fire.

Although desired conditions in certain PVGs increase the hazards associated with stand-replacing wildland fire, the risk of these events may be reduced using a variety of vegetation management techniques. These techniques can include strategically placing fuel breaks, surrounding vulnerable areas with vegetative conditions where fires can be more easily suppressed, or arranging treatments to break up continuous hazardous conditions (Deeming 1990; Graham et al. 1999; Finney 2001; Fulé et al. 2001; Omi and Martinson 2002). In some cases these types of strategic treatments can be effective without being extensive.

Although vegetative management techniques can reduce lethal wildland fire risk, they address only one of several factors (vegetative conditions). Vegetative manipulation alone cannot eliminate all the risks associated with wildland fire (Figure A-4). The efforts made by property owners on their own behalf are essential in protecting homes in the wildland/urban interface.

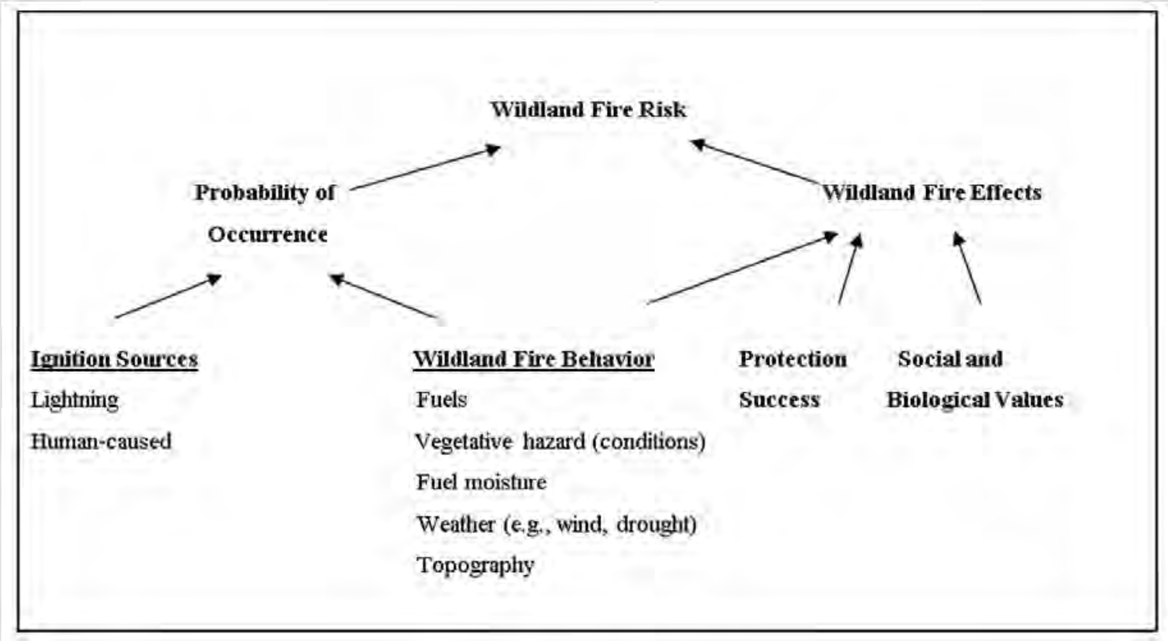

Figure A-4. Factors that contribute to wildland fire risk (adopted from Bachman and Allgöwer 1999)

Vegetation and Wildlife Restoration Strategy

A *Vegetation and Wildlife Restoration Strategy* was developed for forested vegetation to identify Forest-wide priorities for restoring the large tree size class. Watersheds were assigned to active and passive restoration categories and prioritized as high, medium, or low. Active watersheds are those with the most historically nonlethal and mixed1 fire regimes and high priority are those with the greatest number of acres in medium and large tree size class within these fire regimes. These watersheds were selected as high priority because they likely contain larger patches of conditions that can be restored faster toward desired conditions than areas that have fewer medium and large tree size class acres and likely smaller patches. Active restoration is generally where management activities such as thinning, planting, control of nonnative plants, and prescribed fire may be needed to create conditions that are more resilient and resistant to disturbance. In many cases within historically nonlethal and mixed1 fire regime areas, conditions are such that current disturbances often create structures, functions, and processes that are out of sync with historical conditions and therefore can have undesirable ecosystem consequences.

Passive restoration watersheds are those where current disturbances are likely to operate most similar to historical disturbances. In these areas, allowing disturbance processes creates desirable ecosystem results. High-priority watersheds are those that have been undisturbed for a long time and would benefit from disturbances that begin to diversify spatial patch, pattern, and structure. Low-priority watersheds are those that have experienced recent large-scale disturbance, such as wildfire, and need time to allow early-seral conditions to progress into other tree size classes.

Other Forested Vegetation Types

In addition to developing desired conditions for the 11 PVGs, one additional forest type, climax aspen, is found on the southern portion of the Boise National Forest. As is the case for the 11 PVGs, forested vegetation for this forest type refers to land that contains at least 10 percent crown cover by trees of any size or land that formerly had tree cover and is currently at an earlier seral stage. Table A-8 displays the desired condition ranges for climax aspen. Refer to the Vegetation Classification section below for a description of climax versus seral aspen, as these desired conditions do not apply to seral aspen.

Desired condition ranges for climax aspen are presented somewhat differently than ranges for other forest types. Rather than a range of desired values for specific components, the climax aspen desired condition is represented as ranges of acres found in the various aspen size classes. To reach the desired ranges, conditions would have to be within these ranges. Although current conditions may prevent us from obtaining the desired conditions for quite some time, over a longer period (perhaps more than 100 years), management actions should result in vegetation approaching Forest-wide desired conditions.

Table A-8. Desired condition ranges for climax aspen

Aspen Size Classes	Desired Amounts of Size Classes by Percent of Area
GFSS, <10% canopy cover or areas where tree height is <4.5 feet.	40–60% in this class
Saplings (0.1–4.9 inch d.b.h.), all canopy covers	20–35% in these two classes combined
Small (5.0–11.9 inch d.b.h.), all canopy covers	
Medium (≥12 inch d.b.h.), all canopy covers	20–25% in this class

Shrublands

Shrublands occur on areas not classified as forestland and where shrub cover has the potential to be >10 percent. Desired conditions have been developed for some shrubland communities that occur on the Forest. The shrubland groups reflect the LANDFIRE Environmental Site Potentials (ESPs) (refer to the Vegetation Classification section for descriptions of shrubland types). Like the forested vegetation, these groupings reflect similar environmental characteristics, site productivity, and disturbance regimes. Table A-9 displays the fire regimes for the shrubland communities.

Table A-9. Shrubland environmental site potential groups by fire regime

Fire Regime	Shrubland Environmental Site Potential Group
Mixed1	Low Sagebrush
Mixed1-Mixed2	Mountain and Wyoming Big Sagebrush
	Montane Shrub

Similar to forested vegetation, desired conditions for shrublands are expressed as ranges of acres found in the various conditions. To reach the desired ranges, conditions would have to be within these ranges. Although current conditions may prevent us from obtaining desired conditions for quite some time, over a longer period (perhaps more than 50 years), management actions should result in shrubland vegetation approaching Forest-wide desired conditions.

Canopy Cover Class

Shrubland desired conditions are represented by shrub canopy cover based on the following classes:

- Grass/Forb = <10 percent canopy cover
- Low = 10–25 percent canopy cover
- Moderate = 26–35 percent canopy cover
- High = 36 percent or more canopy cover

Canopy cover class may be determined through aerial photo visual estimates or while conducting on-site assessments. As expressed here, canopy cover represents the total nonoverlapping shrub cover.

Table A-10 presents the desired condition ranges for the Low Sagebrush ESP Groups, and Table A-11 represents the desired condition ranges for the Mountain Big Sagebrush ESP Groups. Although LANDFIRE ESPs were grouped together for Mountain and Wyoming Big Sagebrush for coarse-filter analysis, apply the desired conditions displayed in Table A-12 for projects in areas with Wyoming Big Sagebrush. Table A-13 contains the desired condition ranges for the Montane Shrub ESP Groups.

Table A-10. Desired condition ranges for Low Sagebrush Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	0–20
Low	80–100
Moderate	0
High	0

Table A-11. Desired condition ranges for Mountain Big Sagebrush[a] Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	13–33
Low	27–47
Moderate	12–32
High	8–28

[a] Includes Basin Big Sagebrush communities

Table A-12. Desired condition ranges for Wyoming Big Sagebrush[a].

Canopy Cover Class	Area (%)
Grass/Forb	25–30
Low	20–35
Moderate	13–33
High	12–32

[a] Unlike the other vegetation groups, desired conditions for Wyoming Big Sagebrush are not within the HRV. Because these sites are extremely vulnerable to nonnative species invasion following disturbance, the intent is to limit disturbance in areas currently occupied by Wyoming Big Sagebrush. Lack of disturbance will increase the amount of area in higher canopy covers compared to historical conditions but will reduce the risk of increasing occupancy by invasive species.

Table A-13. Desired condition ranges for Montane Shrub Environmental Site Potential Groups

Canopy Cover Class	Area (%)
Grass/Forb	0
Low	5–25
Moderate	5–25
High	60–80

Similar to the forested vegetation types, in some cases it may take many years to develop the desired conditions. If an area has recently experienced a large wildfire, the necessary structural complexity can take many years to develop at a landscape level. Conversely, an area with little disturbance over many years may have dense canopy cover. Management actions that reduce the canopy covers would be an example of "trending toward" desired conditions, even if only applied on a small scale. When at desired conditions, maintenance activities would keep the balance of canopy cover classes within the range of desired conditions; as some acres become denser through succession, other acres may be treated to limit overall canopy cover density. For example, if the Mountain Big Sagebrush ESP Groups are currently at desired conditions but with acres of high canopy cover approaching the high end of the range, it may be necessary to move some of these acres into another canopy cover class to prevent conditions from exceeding desired ranges and creating insufficient amounts of other canopy cover classes. Natural disturbances will also play a role in the movement of acres in and out of canopy cover classes.

Herb Communities within the Shrubland Environmental Site Potentials Groups

Like with the tree and shrub component, the grass and forb communities that developed within shrubland ecosystems occurred within some HRV depending on disturbance processes and succession. These herb communities also reflect environmental conditions such as elevation, aspect, topography, and soils and other factors, including management activities that affect sites. Due to the high variability of these communities across the Forest, desired conditions should be determined at the site-specific scale. The desired conditions should focus on producing healthy, resilient, and resistant grass and forb communities dominated by native species.

Riparian Vegetation

For riparian vegetation made up of coniferous PVGs, refer to Tables A-3 and A-4 for the desired conditions. The desired conditions in Tables A-3 and A-4 include the upland portions of coniferous vegetation found in the RCAs. Additional information for RCAs is found in Appendix B, Table B–1.

Riparian vegetation is dominated by a variety of species, age classes, and structures—including deciduous trees, willows, alders, sedges, and hydric grasses—depending on stream substrate, gradient, elevation, soil hydrology, and disturbance processes. Riparian areas have their own disturbance processes that influence vegetative dynamics causing an almost continual readjustment in successional stages in many areas. Riparian vegetation is also influenced by upland and upstream processes. Site conditions are highly variable due to these factors, which will influence riparian vegetation desired conditions in any site-specific location. Therefore, site-specific desired condition determinations are needed, when and where appropriate.

Grasslands

Grasslands occur in areas where forest or shrubland canopy cover does not have the potential to exceed 10 percent. Grassland communities on the Forest are comprised of perennial grass species. The grassland groups reflect the LANDFIRE ESPs (refer to Vegetation Classification section at the end of this appendix for descriptions of grassland types). Like the forested and shrubland vegetation, these groupings reflect similar environmental characteristics, site productivity, and disturbance regimes. Two grassland communities are described for the Forest: Perennial Grass Slopes and Perennial Grass Montane. The fire regimes for these communities are mixed1 to mixed2 for the Perennial Grass Slopes and nonlethal to mixed1 for the Perennial Grass Montane. Desired conditions in these grasslands support native species and aim to reduce threats from nonnative species, particularly invasive annual grasses.

Wetlands/Marshes, Alpine, and Other Vegetation Types

Other vegetation types not described above exist on the Forest. Desired conditions need to be determined, as appropriate, on a project basis, using available local information. Other Forest-wide and Management Area direction may apply to these types, such as limiting potential establishment and spread of noxious weeds. Some of these communities may also be important habitats for rare plants.

VEGETATION MAPPING

Forested Vegetation Mapping

Forested vegetation is evaluated using habitat types, which use potential climax vegetation as an indicator of environmental conditions. Habitat types provide a way to describe the mix of vegetative communities that may occur within landscapes based on site potential. For example, subalpine fir habitat types—which generally occur on cooler sites—would support a different mix of vegetative communities than ponderosa pine habitat types, which are found on warmer sites. Existing vegetation is described using cover types, which represent the vegetation on the landscape. Cover types are often an earlier seral stage relative to the climax plant community. Cover types, and associated attributes of tree size class and canopy cover class, were mapped using a Landsat remote sensing classification developed at the University of Montana by Redmond et al. (1998). This information was updated in 2008 to reflect changes from wildland fires and other disturbances.

Forested PVGs were mapped using a modeling process. The Forest was divided into 5th field HU groupings that shared similar larger-scale environmental characteristics, such as climate and geology. Each of these groupings was modeled separately. Models were based primarily on slope, aspect, elevation, and land type associations but could also include forest inventory information, forest timber strata information, cover type information, existing habitat type mapping, and cold air drainage models. Where necessary, some field verification did occur. Modeling rules were developed and processed in ArcGrid. Draft maps were sent to ranger district personnel knowledgeable of the area for review, and refinements were made as necessary.

Non-forested Vegetation Mapping

Shrubland and grassland areas were identified using LANDFIRE ESPs, which are based on NatureServe's Ecological Systems Classification (Comer et al. 2003). ESPs represent the natural plant communities that would become established at late or climax stages of successional development in the absence of disturbance. They reflect the current climate and physical environment as well as the competitive potential of native plant species. The LANDFIRE ESP concept is similar to that used in potential vegetation classifications, including habitat types (Daubenmire 1968; Pfister et al. 1977). Therefore, the ESP groups described for the shrubland and grassland communities are conceptually similar to the PVGs used to describe the forested vegetation. The LANDFIRE ESP layer was generated using a predictive modeling approach that relates spatially explicit layers representing biophysical gradients and topography to field training sites assigned to ESP map units. Existing vegetation was described in LANDFIRE using Existing Vegetation Types (EVTs).

VEGETATION CLASSIFICATION

Forest Vegetation—Potential Vegetation Groups

PVG 1—Dry Ponderosa Pine/Xeric Douglas-fir

This group represents the warm, dry extreme of the forested zone and typically occurs at lower timberline down to 3,000 feet and up to 6,500 feet on steep, dry, south-facing slopes. Ponderosa pine is a dominant cover type that historically persisted due to frequent nonlethal fire. Under such conditions, open, park-like stands of large, old ponderosa pine dominated the area, with occasional Douglas-fir, particularly at higher elevations. Understories are sparse and consist of low- to moderate-density perennial grasses, such as bluebunch wheatgrass and Idaho fescue. Shrubs—such as mountain snowberry and bitterbrush--dominate in some areas. This group is scattered throughout the Forest.

PVG 2—Warm, Dry Douglas-fir/Moist Ponderosa Pine

This group represents warm, mild environments at low to middle elevations but may extend upward to 6,500 feet on dry, south-facing slopes. Ponderosa pine, particularly at lower elevations, or large ponderosa pine mixed with smaller size classes of Douglas-fir are the dominant cover types in this group. Historically, frequent nonlethal fire maintained stands of large, park-like ponderosa pine. Douglas-fir occurred on moister aspects, particularly at higher elevations. Understories are mostly graminoids—such as pinegrass and elk sedge—with a cover of shrubs, such as common snowberry, white spirea, and mallow ninebark . This group is found in many places on the Forest.

PVG 3—Cool, Moist Douglas-fir

This group represents the cooler extremes in the Douglas-fir zone and can extend from 6,800 to 4,800 feet following cold air. This group has a relatively minor representation on the Boise National Forest. Ponderosa pine occurs as a major seral species in the warmest extremes of the group. In cold air areas, particularly where cold air accumulates to form frost pockets, lodgepole pine may dominate. In some areas, Douglas-fir is the only species capable of occupying the site.

Other areas may support grand fir, and adjacent sites are often subalpine fir. The conifer cover types that historically dominated resulted from several factors, including fire frequency and intensity, elevation, and topography. Understories in this group are primarily shrub species, including mountain maple, mountain ash, and blue huckleberry . Several other species—including Scouler's willow, thimbleberry, and chokecherry—may occur from disturbance, depending on its intensity. Historical fire regimes were mixed (generally mixed1 where ponderosa pine occurs and mixed2 where other species dominate), creating a diversity of vegetative combinations. Two habitat type phases occur within this PVG: 1) Douglas-fir/mountain maple on the Forest and west side of the Sawtooth National Forest and 2) Douglas-fir/mountain maple–mountain snowberry adjacent to the Forest and on the east side of the Sawtooth National Forest.

PVG 4—Cool, Dry Douglas-fir

Douglas-fir is the only species that occurs throughout this group's entire range. Lodgepole pine may be found in areas with cold air, and quaking aspen is also a common early-seral species. Understories are sparse due to the cool, dry environment and often support pinegrass and elk sedge. Understories of low shrubs—such as white spirea, common snowberry, Oregon grape, and mallow ninebark—occur in some areas that represent slightly different environments across the group. The historical fire regime ranged from mixed1 to mixed2 depending on the fuels present at the time of ignition. Organic matter accumulates slowly in this group, so fire effects depend on the interval between fires, stand density and mortality, and other factors. Fire regimes tend to be mixed1 in drier habitat types with discontinuous fuels and mixed2 in habitat types that support lodgepole pine as a major seral species. This group is most common on eastern portions of the Forest, though it may be found in minor amounts at higher elevations in the Douglas-fir zone in other parts of the Forest. In these cases, it is usually found above 6,000 feet on sites too cool to support ponderosa pine. Where it is common, this group occurs at lower elevations in areas beyond the extent of ponderosa pine.

PVG 5—Dry Grand Fir

This group is found throughout the distribution of grand fir; only on the Boise and Payette National Forests; and at elevations ranging from 4,300 to 6,400 feet, often on drier, upper slopes and ridges. Ponderosa pine and Douglas-fir are common cover types that appear to have been maintained by fire regimes that were historically nonlethal to mixed1 in micro-sites. In many areas, this group may have resembled PVG 1 and PVG 2, with open, park-like stands of large ponderosa pine. Mixed species stands were likely restricted to small micro-sites that burned less frequently. Understories are similar to PVG 2; pinegrass, elk sedge, and white spirea are common.

PVG 6—Moist Grand Fir

This group is found at elevations ranging from 3,400 to 6,500 feet and represents moister environments in the grand fir zone. It is found on the northern portion of the Forest and often occurs adjacent to dry grand fir. The two species may intermix depending on topography. Ponderosa pine is common at the drier extremes of the group, and lodgepole pine occurs in colder areas. Western larch may also be present as an early seral species. Douglas-fir and Engelmann spruce cover types also occur in this group. Understories are shrubby and include blue huckleberry, mountain maple, mountain ash, mallow ninebark, and occasionally pachistima. A conspicuous herb layer is also common in understories, particularly following disturbance. Historical fire regimes were mixed, ranging from mixed1 to mixed2, in part due to the wide environment represented by this group. Where ponderosa pine was maintained as a common seral species, it appears fires were more often mixed1 because ponderosa pine produces a heavy seed that generally disperses only short distances. Ponderosa pine is found in both phases of the grand fir/mountain maple habitat type and the grand fir/twinflower habitat type, twinflower phase. In other areas where western larch, Douglas-fir, or lodgepole pine were maintained as common seral species, mixed2 fire may have been more common. Mixed2 areas include the grand fir/blue huckleberry habitat type; grand fir/twinflower habitat type, beargrass phase; grand fir/queencup beadlily habitat type; grand fir/beargrass habitat type; grand fir/dwarf huckleberry habitat type; and grand fir/western goldthread habitat type. This difference within the PVG reflects a split described by Crane and Fischer (1986) of the grand fir habitat types in the Grand Fir Habitat Types Fire Group into warm, dry, cool, and moist subgroups.

PVG 7—Warm, Dry Subalpine Fir

This group is common and found in warmer, drier environments in the subalpine fir zone at elevations from 4,800 to 7,500 feet. At lower elevations on the Forest, this group is found on steep, north-to-east aspects but shifts to south-to-west aspects as elevation increases. On the eastern part of the Forest, the group is found on more rolling topography. Adjacent sites at lower elevations are Douglas-fir or grand fir, and these commonly intermix with subalpine fir where topography controls cold air flow. Douglas-fir is the most common cover type throughout the group. Ponderosa pine may be found at the warmest extremes, particularly where this group grades into the Douglas-fir or grand fir zone. Lodgepole pine or Engelmann spruce may occur at cool, moist extremes, but these cover types rarely dominate. Understories are commonly shrubby and include mountain maple, mountain ash, serviceberry, and Scouler's willow. On the eastern portion of the Forest, graminoids comprise the majority of the cover under the tree layer. Historical fire regimes were generally mixed2, though mixed1 fires may have occurred where ponderosa pine was maintained.

PVG 8—Warm, Moist Subalpine Fir

This group occurs mainly north of Cascade, Idaho, and is as a relatively minor PVG on the Forest. It becomes better represented on the Nez Perce National Forest. Elevations generally range from 5,000 to 7,200 feet but may follow cooler air down to 4,500 feet. This group occurs on moist, protected areas such as stream terraces; toe slopes; and steep, northerly aspects. Cover types include lodgepole pine, western larch, Douglas-fir, and Engelmann spruce but the presence and combination of these species depend on site conditions and past disturbances. Dense shrubs are common under the tree cover and include Sitka alder, menziesia, blue huckleberry, Utah honeysuckle, mountain maple, mountain ash, and serviceberry. Historical fire in this group was more commonly lethal, though underburns may have occurred on rare occasions. Ignitions likely occurred in adjacent areas due to the location of this group. Whether these areas burned or not may have depended on the weather prior to and at the time of ignition.

PVG 9—Hydric Subalpine Fir

Seasonally high water tables control this group, which is a minor component on the Forest, and the extent may be small in some areas depending on the presence of these conditions. This group is found at elevations ranging from 9,000 to as low as 4,500 feet in frost pockets and along cold air drainages. This group most commonly occurs on wet toe slopes, stream terraces, seep areas, and old bogs. The cover type is mostly lodgepole pine, followed by Engelmann spruce and subalpine fir. Early-seral conditions usually support lodgepole pine because this species tolerates intermittent high water tables and cold air that often accumulate in these areas. In severe frost-prone areas, lodgepole pine can persist for long periods. In other areas with better cold air drainage, Engelmann spruce and subalpine fir rapidly establish under lodgepole pine. Understories are primarily dominated by herbs and grasses that require the seasonal influence of a high water table. Shrubs are sparse, though Labrador tea can dominate some sites. Historically, fire was lethal in this group. Like PVG 8, ignitions more likely occurred on adjacent, drier slopes, and burning in this group likely depended on weather conditions before and at the time of ignition.

PVG 10—Persistent Lodgepole Pine

This group is common throughout the subalpine fir zone. It represents cold, dry subalpine fir sites that range in elevation from over 9,200 feet down to 5,200 feet in frost pockets. Lodgepole pine is the dominant cover type, though small amounts of other species may occasionally occur. Vegetation under the tree cover can be sparse. Generally, grasses and scattered forbs are the most common components. Shrubs are sparse and consist mainly of low-growing huckleberries, including dwarf huckleberry and grouse whortleberry. Historically, this group experienced lethal fire, though nonlethal fires may have occurred during stand development. Lodgepole pine is more often nonserotinous in western portions of Idaho and appears to become more serotinous moving easterly in the state. Within the Forest, lodgepole pine may reproduce in areas that experience nonlethal fires, resulting in more vertical stand diversity in some areas than is often found where lodgepole pine is mostly serotinous. Over time, the combination of these low-intensity events, subsequent reproduction, and mountain pine beetle mortality would have created fuel conditions that allowed lethal fires to occur under the right weather conditions.

PVG 11—High Elevation Subalpine Fir (with Whitebark Pine)

This group occurs at the highest elevations of the subalpine fir zone and generally represents the upper timberline conditions. It often grades into krummholz or alpine communities. Whitebark pine is a major seral species in this group and Engelmann spruce and subalpine fir are climax co-dominants. In some areas, whitebark pine serves as a cover for Engelmann spruce–subalpine fir establishment. Understories are primarily forbs and grasses tolerant of freezing temperatures, which can occur any time during the growing season. Shrubs are sparse due to the cold, harsh conditions. Historically, the fire regime in this group is characterized as mixed2, though the fire effects were highly variable. Ignitions are common in this group due to high elevation; however, fire effects were patchy because fuel conditions were historically sparse due to cold growing conditions and shallow soils. Fire regimes are mixed2.

Stand Structure

Stands can be classified as single- or multistoried. Historically, this structure reflected succession and disturbance, while current stand structure can also be attributed to management activities. Stands generally become multistoried in the absence of disturbance, with seral, shade intolerant species forming upper layers with later seral/climax, shade-tolerant species underneath. Single-storied stands historically resulted from disturbance processes such as nonlethal fire that killed regeneration. In some cases, single-storied stands can be even-aged, such as a lodgepole pine stand that results from a lethal fire and is unaffected by disturbance until the next lethal fire. In other cases, single-storied stands can be multi-aged, such as a ponderosa pine stand where small groups or individuals regenerated following disturbances that occurred at different times and survived, eventually becoming large enough to be defined as the largest tree size class.

Other Forested/Woodland Vegetation Types

Aspen

Aspen covers a broad environmental range across the Intermountain Region (Mueggler and Campbell 1982). It grows at elevations as low as 5,000 feet and as high as 11,000 feet. Aspen occurs both as a seral and climax tree species within its range (Mueggler 1985). Most aspen on the Forest is seral, although small areas of climax aspen do occur on the Mountain Home Ranger District. Where it is seral, aspen is an early-seral stage of forested PVGs. Throughout areas where it is seral, individual stands are relatively small, seldom exceeding 5 acres (Mueggler 1985), and are maintained on the landscape by disturbance. Historically, fire is considered a primary disturbance agent (Jones and DeByle 1985). Fires result in single-aged stands that develop from root suckering, and fire frequencies and severities vary greatly from low to high. Though aspen does not burn readily, all but the lowest intensity fires kill aspen because of its thin, uninsulated bark. Decline in aspen, particularly seral aspen, has been attributed to a lack of disturbances that allowed this shade-intolerant species to persist across the landscape where conifers could eventually shade it out (Jones and DeByle 1985).

Shrubland and Grassland Vegetation

Shrubland Environmental Site Potentials Groups

Low Sagebrush—The following LANDFIRE ESPs were assigned to this group:

- Columbia Plateau Low Sagebrush Steppe
- Great Basin Xeric Mixed Sagebrush Shrubland
- Columbia Plateau Scabland Shrubland

This ESP group is dispersed in patches overlapping Wyoming and Mountain Big Sagebrush sites. Patchiness is highly related to sites with strongly developed soil (clay hardpan) and sites where soils are generally derived from basalt or rhyolitic parent material. Typically, this group occurs in the precipitation zone from 8 to 16 inches and on slopes <40 percent. Canopies are generally open, with few areas of closed or dense canopies. Fires are seldom (every 40 to 60 years), with a mixed1 fire regime. Historical vegetation disturbances were related to frost heaving of fine soil, ungulate grazing of highly palatable sagebrush, and fast spring snowmelt conditions. Common species in this group are bluebunch wheatgrass, Sandberg bluegrass, wild onion , milk vetches , eriogonums, and fleabanes. Rabbitbrush may occur. Low sagebrush on the Forest is primarily little sagebrush; however, black sagebrush also occurs and was included in the low sagebrush cover type.

Mountain and Wyoming Big Sagebrush—The following LANDFIRE ESPs were assigned to this group:

- Shrubland Alliance
- Inter-mountain Basins Montane Sagebrush Steppe
- Inter-mountain Basins Big Sagebrush Steppe
- Inter-mountain Basins Big Sagebrush Shrubland

This ESP group connects with the greatest number of other forest, nonforest, and riparian cover types and consists of large, widely distributed blocks. This group occurs in the precipitation zone from 14 to over 18 inches, on well-drained sites, and on soils with high rock or gravel content. Sites generally have high ground cover and few cryptogams. Fires can be frequent (ranging from 20 to 60 years), with a mixed1 to mixed2 fire regime. Historical vegetation disturbances were related to ungulate grazing of southern exposures, which have less snow and an early green-up. Forb and grass species can vary. Bitterbrush, grey horsebrush and green rabbitbrush are frequently present. Snowberry is present on moister sites.

Montane Shrub—The following LANDFIRE ESPs were assigned to this group:

- Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
- Rocky Mountain Lower Montane-Foothill Shrubland

This cover type is usually interspersed as stringers and patches within the Mountain and Wyoming Big Sagebrush, aspen, and conifer cover types. Its patchiness is strongly related to mesic soils with high water-holding capacities and/or northerly exposures. Typically, this group has multiple vegetation layers dominated by sprouting species, including chokecherry, snowberry, serviceberry, and wild rose. Several other browse species may occur. This group usually has a rich and diverse herbaceous component and extremely diverse wildlife habitats. Fire intervals are typically 20–40 years, with a mixed2 fire regime. Ungulate and grazing disturbances are common components. Insects and diseases may be common, with occasional outbreaks.

Grassland Environmental Site Potentials Groups

Perennial Grass Slopes—The following LANDFIRE ESPs were assigned to this group:

- Columbia Basin Foothill and Dry Grassland
- Columbia Basin Palouse Prairie
- Inter-mountain Basins Semi-desert Grassland
- Inter-mountain Basins Semi-desert Shrub Steppe

This ESP group connects with dry forested cover types and Mountain and Wyoming Big Sagebrush communities and is more prevalent in the northern and northwestern foothills and Forest canyonlands. The group usually occurs in the precipitation zone from 10 to 18 inches on southern and western aspects. The group predominantly consists of bluebunch wheatgrass. Perennial grasses are dominant on the sites, comprising 80–90 percent of production. Sandberg bluegrass is a lesser but constant associate. The forb component contains a large number of species, few of which are common throughout. The most common forbs are Indian wheat , shining chickweed, salsify, yarrow , lupine, balsamroot, biscuit root, (hawksbeard, fleabane, milkvetch, and phlox. This ESP group can be susceptible to damage under very hot and dry conditions, and stand recovery is very difficult and slow in the Idaho Batholith. Historical fire intervals are short (20 years), typically with a mixed1 to mixed2 fire regime depending on the amount of Idaho fescue present. This group is highly susceptible to several invaders, including annual bromes, rush skeletonweed, yellow starthistle, several knapweeds, dyer's woad, and Dalmatian toadflax.

Perennial Grass Montane—The following LANDFIRE ESPs were assigned to this group:

- Columbia Plateau Steppe and Grassland
- Northern Rocky Mountain Lower Montane Foothill-Valley Grassland

This ESP group connects with numerous forested, Mountain and Wyoming Big Sagebrush, and bluebunch communities. In terms of ecotone diversity, it is very highly rated. The group usually occurs in the precipitation zone from 18 to 30 inches on southern aspects and 14 to 30 inches on northern aspects. The group represents slightly moister and cooler conditions than Perennial Grass Slopes. Idaho fescue is the predominant grass in this group, but other grass species include slender wheatgrass, sedges, intermediate oatgrass, western needlegrass, and Richardson needlegrass. Forbs compose 40–65 percent of overall production. Common forbs are yarrow, bessaya, Indian paintbrush, lupines, phlox, and balsamroot. Historical fire intervals are short (20 years), typically with nonlethal to mixed1 regimes. Certain species within the community are susceptible to fire damage under very hot and dry conditions, but recovery occurs in a few years. Trampling damage is minimal to nonexistent and primarily occurs at higher elevations. Bluegrass is a common invader, but this group is highly susceptible to several invaders, including annual bromes, rush skeletonweed, yellow starthistle, several knapweeds, dyer's woad, and Dalmatian toadflax.

Riparian Cover Types

No comprehensive riparian classifications or vegetative community descriptions exist for the Forest. However, a riparian classification is being developed and is forthcoming. Hall and Hansen (1997) have developed a riparian habitat type classification for Bureau of Land Management districts in southern and eastern Idaho that includes portions of the South Hills on the Sawtooth National Forest. Riparian community type classifications have been developed by Youngblood et al. (1985) for eastern Idaho and western Wyoming and by Padgett et al. (1989) for Utah and southeastern Idaho. Due to the lack of comprehensive classification information for our area, the Forest Plan Revision Team chose to use the Utah Landsat cover types to describe these communities.

Riverine Riparian

This cover type consists of vegetative communities dominated by conifer species and shrubs. The primary conifers are subalpine fir, Engelmann spruce, and Douglas-fir, with some aspen. Other trees and shrubs include mountain maple, serviceberry, chokecherry, thinleaf alder, currants, and willows. These communities generally occur on steep slopes and occupy edges of riparian zones with A and B stream channel types. Padgett et al. (1989) and Youngblood et al. (1985) stated that these community types, in their areas, likely represent successional stages within described forested communities. For this reason, Padgett et al. (1989) recommended consulting available forest habitat type classifications for additional information.

Deciduous Tree

This cover type consists predominantly of black cottonwood or narrowleaf cottonwood tree cover. Associated tree species include thinleaf alder, mountain maple, water birch, and aspen. Primary shrub species include chokecherry and willows. This cover type is generally below 5,500 feet along stream channels in lower canyons and usually requires a moist and coarse substrate.

Shrub Riparian

This cover type is dominated by willow species. Primary associated tree and shrub species include cottonwoods, swamp birch, thinleaf alder, mountain maple, shrubby cinquefoil , and chokecherry. Grasses and forbs include sedges, tufted hairgrass , Geranium, louseworts, and American bistort This cover type is found in mid-to-upper elevations in broad, wet meadows and alluvial terraces on relatively low gradients (1–3 percent).

Herbaceous Riparian

This cover type is typically found in mountain meadows where soil moisture is abundant throughout the growing season. Principle species include sedges, woodrush,reedgrass, pinegrass, timothy, bluegrass, tufted hairgrass, saxifrage, and fireweed. This cover type occurs widely and is typically found in broad, flat meadows.

Other Vegetation

Wetlands

Wetlands are areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, wet meadows, seeps, and similar areas. These lands are transitional between terrestrial and aquatic systems. Vegetative species found in wetlands are heavily influenced by local site conditions.

Marshes—This cover type is permanently or semipermanently flooded and dominated by hydric species adjacent to small streams, beaver ponds, lakes, and meadows. Sedges are the most common species. This cover type usually occurs around the 7,000-foot elevation level. Sites are dominated or co-dominated by bulrushes, cattails, woodrushes, or sedges.

Bogs, Fens, and Peatlands—These wetlands typically have subirrigated, cold water sources. Peatlands are generally defined as wetlands with waterlogged substrates and at least 12 inches of peat accumulation (Moseley et al. 1994). The vegetation in these wetlands is often dense and dominated by low-growing perennial herbs (Skinner and Pavlick 1994).

Wet Meadows and Seeps—These wet openings contain grasses, sedges, rushes, and herbaceous forbs that thrive under saturated, moist conditions. These habitats can occur on a variety of substrates and may be surrounded by grasslands, forests, woodlands, or shrublands (Skinner and Pavlick 1994).

Alpine

Alpine habitats are defined as the area above the tree line in high mountains. Rocky or gravelly terrain is generally prevalent and grasses and sedges often form thick, sodlike mats in meadows. Most alpine plant species have unique adaptations to survive the harsh conditions of this habitat (Billings 1974). Many plants grow in mats or cushions. Perennials predominate in the alpine floras, as the growing season is often too short for annuals to complete their life cycle (Strickler 1990).

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SOUTHWEST IDAHO ECOGROUP MATRIX OF PATHWAYS AND WATERSHED CONDITION INDICATORS - "THE MATRIX"

Overview Of The Matrix

The revised Forest Plan management direction (goals, objectives, standards, and guidelines) found in Chapter III of this document replaces direction in the Forest's Land and Resource Management Plan, as amended by Pacfish/Infish, and the 1995 and 1998 Biological Opinions (BOs) for listed fish species. Appendix B was created and tied to direction in Chapter III of this Plan, and it incorporates components of Pacfish/Infish, the 1995 and 1998 Opinions, the Endangered Species Act (ESA), and the Clean Water Act (CWA) important to the Forests long-term Aquatic Conservation Strategy (ACS).

Specifically, Appendix B combines the separate matrices [NMFS (NOAA Fisheries), 8/96; FWS 2/98] identified for use in the 1995 and 1998 BOs. In order to combine the two original matrices, modifications were made to provide consistency and efficiency in application. Within Forest Plan documents, Appendix B may be referred to as Appendix B, the Southwest Idaho Ecogroup Matrix of Pathways and Watershed Condition Indicators, or the "Matrix". The Matrix is the second component of the ACS.

Information and process guidance provided in this Appendix comprise a decision support tool that has been developed to assist land managers in assessing how well management actions designed to implement the Forest Plan move toward related resource goals. Specifically, the Matrix and related Watershed Condition Indicators (WCIs) discussed in this appendix will assist in:

1. Identifying how management actions may potentially influence the condition and trend of soil, water, riparian, and aquatic resources, including native and desired non-native fish.

2. Making ESA Determinations of Effects to Listed Fish Species important to assessing ESA compliance.

3. Identifying how management actions may potentially influence beneficial uses associated with native and desired non-native fish habitat and the importance of that influence to assessing CWA compliance.

The Matrix has been designed for application during project-specific NEPA assessments to assist in project design and analysis. A hierarchal sequence is followed to ascertain which fish species and/or beneficial uses the Matrix is focused on, ensuring the most imperiled fish species or most limiting designated beneficial use is considered first. Project-level analyses are generally conducted at the watershed or subwatershed scale (5th or 6th field hydrologic units or HUs), which are the typical scales at which aquatic and water resource cumulative effects analyses are completed in a project NEPA analysis. Analyses may also be conducted at the subbasin scale (4th field HU) depending on the geographic extent and scope of the proposed action(s), and the scale at which cumulative effects need to be addressed in any project-specific NEPA analysis. The ID team and the appropriate line officer (District Ranger or Forest Supervisor) for each project (i.e., management action) determine the analysis scale(s). Where the action may influence listed fish species directly, indirectly or cumulatively, the line officer should determine the appropriate scale of analysis in conference with the Level 1 streamlining team.

As stated above, Appendix B is referenced within specific Forest-wide objectives, standards, and guidelines related to Forest Plan goals found in two resource sections: (1) Threatened, Endangered, Proposed and Candidate (TEPC) Species, and (2) Soil, Water, Riparian and Aquatic (SWRA) Resources.

Additional objectives, standards, and guideline are included in specific Management Area direction, but are not referenced here.

The direction statements for TEPC Species and SWRA Resources directly or indirectly relate to multiple goals, objectives, standards and guidelines under many resource sections in Chapter III. For example, an action that proposes to revise an allotment management plan would need to comply with all applicable Forest-wide standards and guidelines in Chapter III. For instance, standards such as Rangeland Resources 1 ("Livestock trailing, driving, bedding, watering, and other handling efforts shall be limited to those acres and times that maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat") and SWRA Resources 1 ("Management actions shall be designed in a manner that maintains or restores water quality to fully support beneficial uses and native and desired non-native fish species and their habitat") would need to be met before the action could proceed. To assist in determining whether this action will maintain or allow for restoration of beneficial uses and native and desired non-native fish habitat, and meet both standards, the land manager would use the Matrix at the appropriate scale in Appendix B.

Forest-wide Standards SWRA 1 and SWRA 4, along with other protections, are intended to improve aquatic and riparian functions and processes over the life of the Plan. The Matrix can be an important tool in tracking how management actions, over time, are trending "functioning at unacceptable risk" (FUR) and "functioning at risk" (FR) indicators toward a "functioning appropriately" (FA) condition, or are maintaining already FA indicators at multiple scales. How quickly WCIs obtain a FA condition depends on the baseline, the kinds of management actions that are implemented and their effects over time, and the types of natural disturbances that occur.

Not every project, even in a degraded baseline, will be restorative. Some management actions will be proposed in a watershed with a FUR baseline that will result in a temporary or possibly short-term "degrade" in the Matrix. These management actions are appropriate as long as they do not retard the attainment of riparian processes and functions, have measurable long-term ecological benefits, and do not have substantially measurable short-term effects to important subwatersheds or to the overall watershed (5th field HU) scale. If riparian and watershed processes are to be restored over time within watersheds that have a FR or FUR baseline, it is critical that management actions individually and collectively do not further degrade or retard attainment of WCIs. It is also critical that management actions in ACS priority subwatersheds provide some degree of restoration to WCIs at the appropriate temporal and spatial scales if desired conditions are to be achieved. For example, if after ten years management actions in an ACS priority subwatershed have only maintained FUR or FR WCIs, then restoration would not be realized and the intent of the long-term ACS would not be realized.

The Matrix is designed to be applied over a range of analysis scales and account for a variety of environmental conditions. It provides flexibility and allowances for addressing localized information and/or project-specific variability. A certain degree of professional judgment is required and is an essential element for effectively interpreting and applying evaluation results.

It is expected that improvements to the Matrix will occur in the future and periodically result in refinement and updates to the WCI range of values and processes found in this appendix. Improvements may include, but are not limited to, changes to the parameters or indicator values within the various WCIs, additions or deletions of WCIs, or replacement of this Matrix with a different process that meets the same intent through more efficient and effective means.

Description Of The Matrix

Introduction

There are four components/tables in the Matrix (see Figure B-1). Tables B-1, B-2, and B-3 should be used when evaluating actions that would affect SWRA resources, regardless of whether listed fish species would also be affected. Table B-4 should only be used when ESA-listed fish species may be affected.

- Table B-1: Pathways for WCIs, "Reference Conditions"
- Table B-2: Environmental Baseline, "Current Conditions"
- Table B-3: Effects of Management Actions
- Table B-4: Dichotomous Key for Making ESA Determinations of Effect and Documentation of Expected Incidental Take for Listed Fish Species.

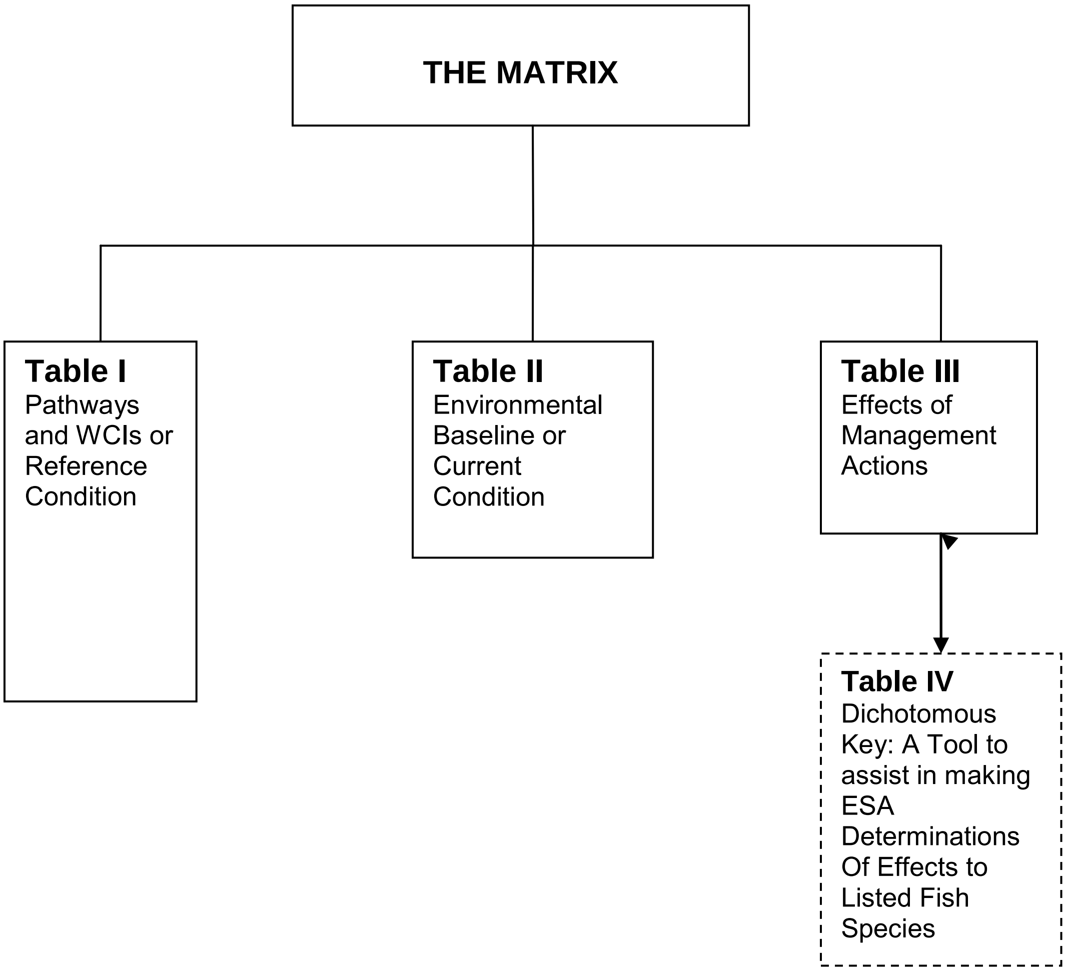
Tables B-1, B-2, and B-3 are divided into 8 overall pathways (major rows). Each of these rows represents a significant pathway by which actions can have potential effects on native and desired non-native fish species, their habitats, and associated beneficial uses. Pathways are further broken down into WCIs. WCIs are described in terms of functionality (Appropriate, At Risk, At Unacceptable Risk). The Functioning Appropriately column represents the desired condition to strive toward for each particular WCI. These WCIs improve upon and update the Riparian Management Objectives identified in Pacfish and Infish. The process outlined later in this Appendix will help land managers determine what the relevant WCIs are that should be considered where proposed management actions are expected to affect beneficial uses, and anadromous, inland native, or desired non-native fish or their habitat.

The evaluation of WCIs provides a consistent and logical line of reasoning to recognize when, where and why adverse, beneficial or no effects may occur to related resources. WCIs are not independent from other components of the aquatic conservation strategy but provide a starting point to describe the current and desired condition for upland watershed condition, water quality, and aquatic habitat. Evaluation procedures consider the suite of WCIs that are likely to be affected by proposed management actions, not just effects to any individual WCI. WCIs are not always sensitive to immediate effects and may instead exhibit response to cumulative effects within subwatersheds over time. In some cases, adverse effects to one WCI in the temporary or short term may be acceptable in order to improve another WCI in the short and/or long term. The duration of an adverse impact that may be allowed in the temporary or short term in order to improve another WCI and provide for long-term benefits will depend on site-specific conditions and resources of concern. Results from the evaluation of WCIs affected by a proposed action can be used to help modify the design of the actions, including mitigating adverse impacts, and developing strategies for restoration of degraded conditions.

The Dichotomous Key included as Table B-4 of this Matrix is used to assist in making ESA effects determinations where effects to listed fish species are likely to occur. It is important to note that use of Table B-4 of this Matrix will not, in itself, result in effects determinations for listed fish species from management actions. The purpose of the Key is to provide indicators as to what the effect is likely to be relative to results from evaluations in Tables B-1, B-2, and B-3. Information obtained from this Matrix should be used in biological assessments to support ESA determinations relative to the potential site-specific effects of the proposed activities evaluated.

Figure B-1. Southwest Idaho Ecogroup Matrix of Pathways and Watershed Condition Indicators

Pathways For Watershed Condition Indicators (WCIs), Environmental Baseline, Effects Of Management Actions, and Dichotomous Key: A Tool To Assist In Making ESA Determinations Of Effects To Listed Fish Species



Appropriate Matrix Scale

The Matrix can be used at several (multi) scales. Riparian functions and ecological processes represented by the Matrix operate at multiple scales, including site, subwatershed, watershed, and subbasin. Similarly, the effects of land management activities on these functions and processes can occur at multiple scales, depending on the scope and magnitude of the action, and the baseline, sensitivity, and watershed recovery trajectory of the affected resources. Assessment of management action effects should address the spatial and temporal scales that are relevant to the proposed action and to the WCIs that would be affected.

The project (i.e., management action) scale will generally be the smallest scale that the Matrix is used. Typically the project scale is equivalent to the 7th or 6th field HU. However, smaller scales (e.g., site) may be appropriate in some cases. If a site is determined to be the appropriate scale to assess, the user should be aware that some indicators (e.g., refugia, disturbance history, road density, etc.) may not be appropriate or relevant and should not be evaluated. If little information is available at the site scale, it may be acceptable to use, and note appropriately, information collected at the 7th or 6th field HU scale as a surrogate for the baseline condition portion of the Matrix. Impacts of the action should be assessed at the actual site scale. Ultimately, the ID team and appropriate line officer for each project should determine the analysis scale(s). Where the action may influence listed fish species directly, indirectly or cumulatively, the line officer should determine the appropriate scale of analysis in conference with the Level 1 streamlining team.

The Matrix may often be prepared at two or more spatial and temporal scales. When an indicator is likely to be degraded (temporary, short term or long term) by the impacts of an action or actions, a second Matrix at the next larger scale should be prepared to evaluate the impacts of the actions to the larger WCIs. Typically this analysis would be completed at the watershed (5th field HU) scale. The larger-scale matrix may also be relevant when assessing the aggregate effects of several actions with "degrade" checkmarks within a watershed during batched and programmatic consultations. Not all indicators or their values may be appropriate at a 4th field scale. For example, pool frequency is a good indicator at the project or subwatershed scale. But at the subbasin scale it may be more appropriate to stratify pool frequency by geomorphic landtypes, or aggregate the total number by local populations to look for landscape patterns. Completion of a 4th field HU (subbasin) Matrix will be uncommon, but, when needed, the user should work with either the Level 1 team or the Continuous Assessment Planning Team (CAP) to develop appropriate indicators and values.

Table B-1: Pathways and WCIs "Reference Conditions"

Table B-1 of the Matrix is similar to "Step 4: Description of Reference Conditions" section for soil, water, riparian and aquatic resources described in *Version 2.2 of the Federal Guide for Ecosystem Analysis at the Watershed Scale* (Regional Interagency Executive Committee 1995). The eight pathways described in this table represent a suite of ecological indicators identified as WCIs. The reference condition values of ecological indicators, or WCIs, found in Table B-1 are diagnostic tools to assist in comparing and evaluating current SWRA watershed conditions to be described in Table B-1I. The WCI values provided in Table B-1 were largely taken from the original matrices tied to the 1998 BOs for steelhead and bull trout. These values are considered the default values that should be used, unless better subwatershed or project-specific information is available to update these values (refer to the "How to Modify this Matrix" section in this appendix).

The WCIs are generally arranged from a finer to a broader scale. For example, under the pathway "Habitat Elements," the WCIs refer to information from the channel unit level (substrate); to the stream reach level (large woody debris, pool frequency and quality/large pools), to the valley segment (off-channel habitat), and finally the complete watershed (refugia). Definitions for the WCIs are found at the end of this appendix.
Units of measure specific to each WCI are provided, followed by functionality definitions for each WCI that are represented as ranges within their respective units of measurement. There are three functional condition levels identified for each WCI: (1) "functioning appropriately, or FA," (2) "functioning at risk, or FR," and (3) "functioning at unacceptable risk, or FUR."

The quantitative and qualitative default WCI values provided are not intended to be absolute values that precisely define desired conditions or to define data standards. The values and descriptions are a diagnostic tool to promote discussions and evaluations of the environmental functional relationships specific to the watershed being considered for management actions. WCIs are criteria to assist in evaluating progress towards an attainment of SWRA goals. They do not replace state and federal water quality standards under the Clean Water Act or state laws, nor do they make determination of effects for proposed management actions under ESA. However, WCIs do address several important objectives of the Clean Water Act by determining whether designated beneficial uses are attainable and to what degree these uses are supported (Bauer and Ralph 1999). WCIs complement existing laws and standards by providing measurable criteria for water quality and aquatic habitat.

If local data relating to a specific WCI are not available for comparison and verification, then proposed management actions should be designed to minimize adverse impacts to the WCI based on the default value provided in Table B-1. If local data are available to help define a more site- or watershed-specific WCI value, follow procedures in *the "How to Modify the Matrix"* section to document the basis for the change. Likewise, if a default WCI value is not functionally attainable given the inherent characteristics of the watershed being considered, follow procedures outlined in *the "How to Modify the Matrix"* section to document the basis for varying from the default WCI value provided.

Table B-2: Environmental Baseline "Current Conditions"

Table B-2 of the Matrix is similar to "Step 3: Description of Current Conditions" section for soil, water, riparian and aquatic resources described in *Version 2.2 of the Federal Guide for Ecosystem Analysis at the Watershed Scale* (Regional Interagency Executive Committee 1995). Completion of Table B-2 also provides the supporting documentation and rationale for the evaluations and determinations of the environmental baseline condition included in a watershed or project- specific NEPA analysis. The environmental baseline, or current condition, can be assessed at multiple spatial scales; typically at the project scale representing a 7th or 6th field HU. The baseline can be recorded at larger scales (e.g., 5th or 4th field HUs) to address cumulative effects of a proposed management action or actions. When evaluating the baseline condition, all landownerships should be included at the relevant spatial scale for which the Matrix is completed.

The current condition of each WCI is represented as falling within its respective functionality class as described in Table I, including any refinements to the default values for that class. Thus, this evaluation documents whether a WCI is "functioning appropriately", "functioning at risk" or "functioning at unacceptable risk". The units of measure for WCIs are generally reported in one of two ways: (1) quantitative metrics that have associated numeric values (for example, "large woody debris: > 20 pieces per mile"); or (2) qualitative descriptions based on field reviews, professional judgment, etc., (e.g., "physical barriers: man-made barriers present"). Different approaches are needed because numeric data are not always readily available for every WCI, or there are no reliable numeric values. In such cases, a qualitative description of overall functionality may be the only appropriate method to describe the value. Ideally, the baseline condition determination is based on site measurements, but if data are not available another form of measurement and/or professional judgment must be applied. It is not anticipated that new field surveys would be required for every project. The level of information collected should be commensurate with the scope and scale of project being proposed. Those projects that have a greater chance of causing negative effects in subwatersheds with no to little baseline information should conduct the appropriate level of field surveys to support the decision.

When documenting the baseline condition in the Matrix the rationale for that condition must be supported with a quantitative and/or narrative description. Biologists are encouraged to reference this rationale by citing existing documentation, such as NEPA analyses, whenever possible. When professional judgment is required to document the existing condition, a "PJ" for professional judgment should be included next to the indicator in the baseline column in Table B-2. For example, if pool frequency is believed to be "functioning at risk", a FR – PJ should be noted. Other data sources should also be noted according to the following criteria: WA - Watershed Analysis; NEPA – CE, EA or EIS; SR – Surveys; M – Monitoring; FR – Field Reviews; O – Other.

The suite of relevant WCIs, considered together, encompasses the environmental baseline or current condition for the subwatershed and associated aquatic resources. The user must realize not every indicator may be relevant to every area assessed. For example, indicators specific only to bull trout (e.g., life history, genetic characteristics, etc.) would not be completed if bull trout were currently or historically absent in the assessment area. In these situations a "not applicable" should be recorded under the desired and existing condition columns.

In most cases, the "Functioning Appropriately" values in Table B-1 will be displayed in the desired condition column in Table B-2. However, as described in the "*How to Modify the Matrix*" section, WCIs can be refined to better reflect conditions that are functionally attainable in a specific subwatershed or stream reach based on local geology, land and channel form, climate, and potential vegetation. If WCI values are modified, then the referenced value or its range should be included in the desired condition column with a footnote listing what process was used.

Table B-3: Effects of Management Actions

Table B-3 of the Matrix is the assessment of potential impacts of the action. The Matrix provides a synthesis of the collective effects of a proposed or ongoing action(s) on WCIs. This information and evaluation will assist the land manager in determining if native and desired non-native fish habitat important to fish populations will be sustained, and if water and aquatic resource beneficial uses identified by the State will continue to be supported.

The effects of management actions described in Table B-3 are represented as a change in the functionality of the WCI(s) that would likely result from proposed or ongoing management actions. Effects are identified on the basis of the amount of restoration or degradation for each WCI. Table B-3: Effects of Management Actions is designed to be used in conjunction with both Table I: Pathways and WCIs, and Table II: Environmental Baseline. Together they document the effects on a WCI in terms of being "restored", "maintained", "degraded", or "not applicable". A positive, negative, or "no" trend is then noted for three time periods (temporary, short term, and long term) for that particular WCI. A brief narrative or reference to an existing NEPA document is included in the Matrix. As with baseline conditions, each action impact in the Matrix must be supported with a quantitative and/or narrative description. Users must remember that the Matrix is merely a tool to summarize the NEPA analysis. A thorough description of how an action affects WCIs, at different spatial and temporal scales, in NEPA analysis is critical. All terms are defined in the Glossary of this appendix.

The suite of WCIs must be considered together, both those affected by a proposal and those not affected, in order to fully describe the condition and trend of the subwatershed and associated aquatic resources and designated beneficial uses that would result from implementation of a proposed management action or continuation of ongoing actions. Completion of Table B-3 provides supporting documentation and rationale for the evaluations and determinations of effects included in biological assessments and/or project-specific NEPA analyses. When Table B-3 is completed to support findings in a biological assessment or project-specific NEPA analysis, it should be appropriately referenced within the body of the document.

In some cases it may be appropriate to note both short-term impacts and long-term benefits in the Matrix at the project or subwatershed scales. When this is needed, a "degrade" and "restore" would be recorded in the Effects column, and the appropriate temporal scale would be indicated.

Table B-4: Description of Dichotomous Key for Making ESA Determinations of Effect and Documentation of Expected Incidental Take for Listed Fish Species

The Dichotomous Key for Making Determinations of Effect is the fourth component of the Matrix. It is specifically designed to aid in the determination of effects relative to proposed management actions that **require** a Section 7 consultation or conference, or a permit under Section 10 of the ESA. Evaluations that use the Dichotomous Key draw from information generated in Tables B-1, B-2, and B-3, including any modifications to WCIs completed through procedures that incorporate better subwatershed or site-specific data that are available. The findings from evaluations using the Dichotmous Key are used to help make related ESA determinations of effect.

Table B-4 was not designed to be used to aid in the determination of effects for proposed management actions that **do not require** a Section 7 consultation or conference of the ESA.

How And When To Use The Matrix

The Matrix has been developed to help design, and estimate the effects of, management actions to WCIs used as indicators of soil, hydrologic, water quality, riparian and aquatic resource conditions within the subwatershed, as well as to ESA-listed fish species where applicable. A Matrix can be completed for one action or a set of actions specific to a particular spatial and temporal scale. To determine when the Matrix should be used and which tables should be completed, use the following criteria:

1. Management actions will have no effect on listed species and WCIs will be maintained.

2. Management actions **WILL** result in quantifiably measurable, or clearly defined qualitative, negative effects (temporary, short term, or long term) on WCIs, and the proposed management action **does not require** a Section 7 consultation or conference of the ESA. **COMPLETE MATRIX TABLES B-1, B-2, and B-3 only.**

3. Management actions **WILL** result in small effects, beneficial effects, or quantifiably measurable, or clearly defined qualitative, negative effects (temporary, short term, or long term) on WCIs and the proposed management actions **require** a Section 7 consultation or conference of the ESA. **COMPLETE ALL MATRIX TABLES.**

If it is determined that all or some of the tables in the Matrix should be completed, use the following criteria to determine which aquatic species or water quality beneficial use evaluations the Matrix user should focus on:

1. If the watershed has ESA-listed fish species, sensitive fish species, and non-listed fish species, the Matrix for the ESA-listed species should be completed.

2. If the watershed has sensitive fish species and non-listed fish species, but no ESA-listed species, use the Matrix for sensitive species, with modified parameters (or criteria) for the WCIs appropriate for those species.

3. If there are only non-listed and non-sensitive fish species in the watershed, use the Matrix for native, or desired non-native fish species, with modified parameters (or criteria) for the WCIs appropriate for those species and associated beneficial uses.

4. If there is a TMDL or 303(d) listed water quality limited water body, and the management action may have impacts on the WCI value(s) for which it was listed, and only non-listed and non-sensitive aquatic species are present, use the Matrix for native or desired non-native fish species, with modified parameters (or criteria) for the WCIs appropriate for those species and associated beneficial uses.

Table B-2 linkage to Table B-1

For each project area, determine the environmental baseline by describing the conditions for the WCIs listed under the pathways that may be affected by the management action against the reference condition for the WCI described in Table I. This will result in each WCI in Table II being classified as either: "Functioning Appropriately" (FA), "Functioning at Risk" (FR), or "Functioning at Unacceptable Risk" (FUR). It is preferred that the WCI values used to determine FA, FR and FUR be based on local data collected over time that either validates the default value or refines the value to better reflect local conditions following procedures in described in the "*How to Modify the Matrix*" section, below. If local data are lacking, consider the biophysical characteristics of the subwatershed when determining functionality categories, and use local databases and/or related literature to discern the most appropriate WCI values for the Matrix.

Table B-3 linkage to Table B-2

Use Table B-3 to evaluate the expected effects of management actions (or groups of actions) on the WCIs by comparing the expected effects on the WCIs against the environmental baseline in Table B-2. Where conditions are FR or FUR, actions that affect WCIs that are not fully functioning will not retard attainment of WCIs unless to meet the exceptions in SWRA Standard 4. For example, management actions that have temporary or short-term effects can still be consistent with Forest-wide TEPC and SWRA objectives, standards, and guidelines if they do not retard the attainment of riparian processes and functions, have significant long-term benefits, and do not have significant short-term effects to important subwatersheds or to the overall watershed scale. Actions that have long-term impacts to important subwatershed and/or watershed-scale processes would likely prevent the attainment of WCIs and be inconsistent with Forest Plan direction. Where conditions are FA, the action(s) should be designed to maintain those conditions in the short and long term.

It is important to understand that all effects are not the same just because they may occur within the same temporary, short-term, or long-term time period. The duration or repetition of an effect within that time period can vary greatly, as can the intensity, location, or type of effect. The Matrix allows Forest personnel the flexibility to determine these differences during project-level analysis and provides a means to display if the temporary, short-term, or long-term effect has a positive, negative, or no trend. If WCIs within a pathway are not evaluated in Table B-2 or B-3, documentation describing why they were not evaluated should be included in the project record.

Table B-4 linkage to Tables B-2 and B-3

Use evaluations in Tables B-2 and B-3 to answer the questions in the dichotomous key contained in Table B-4. Written documentation of rationale and logic substantiating answers to questions generated through interdisciplinary and Section 7 consultation or conference discussions should be included in the project record and used to support determinations reached in biological assessments and NEPA documents.

Examples Describing the Use of the Matrix

The following are some brief examples to assist in describing the intended use of the Matrix.

Example 1 - Thinning and prescribed fire are proposed as vegetation treatments over a large portion of a 6th field HU. Current large woody debris (LWD) frequency is 10 pieces per mile, below the FA value of >20. Assuming the values for a FA call are appropriate for the geoclimatic setting, the proposed activity should be designed in such a way that desired conditions would be reached and lead to attainment of Functioning Appropriately conditions over the long term. At the stream reach level, site-specific project design features to promote FA conditions might include increased RCA widths, adjustment of the treatment unit boundaries, or changes in how the specific treatment tool (prescribed fire ignitions or mechanical thinning) is implemented.

Example 2 - The action is to replace a damaged culvert in a 6th field HU with a FR baseline. Currently, surface fines are between 12 and 20 percent, and embeddedness is between 20 and 30 percent. This action will cause temporary degradation to turbidity and embeddedness indicators downstream, but impacts will not go beyond the 6th field HU. The action will also restore the fish passage indicator, and will maintain all remaining indicators. This action will be appropriate because it does not retard the attainment of riparian processes and functions, has measurable long-term ecological benefits by providing fish passage, and does not have substantially measurable short-term effects.

Example 3 - Existing fine sediment levels in bull trout spawning gravels ($\leq$ 6.0 mm) are approaching the desired condition of $\leq$ 12 percent, and the local bull trout population is small and isolated. A temporary increase in sediment from one individual project could yield signficant adverse effects to bull trout that could be significant in both short- and long-term effects on the isolated local population. Also, temporary inputs of sediment could have short- and long-term consequences if channel morphology and stream gradient are associated with infrequent flushing. Low-gradient stream channels might retain sediment for decades.

The question to be answered is whether or not temporary effects from any proposed action will sustain the local isolated population of bull trout and associated beneficial uses. For instance, proposed restoration activities may be appropriate for short-term or long-term recovery, but the timing may not be right if existing stream habitat conditions would be degraded. If the isolated bull trout population would be at risk from temporary effects, it may be prudent to delay project implementation until stream conditions improve, or implement management actions incrementally, using more restrictive BMPs. The over-riding objective is to avoid or minimize temporary jeopardy risks to the bull trout population while striving to recover the habitat that will allow for increasing the bull trout population in the short and long term.

Example 4 - A new placer mine, timber sale, and road restoration project are planned over several 6th field HUs in the same 5th field watershed. The placer mine occurs in a 6th field HU where most indicators are FA. The timber sale and road projects occur in HUs where many baseline indicators are FUR or FR. Even though the placer mine will have short- and long-term adverse effects to pool quality and streambank indicators, it is allowed to proceed due to the 1872 mining law. The other two projects are designed to restore WCIs in the long term, but will cause degradation in the temporary and short term to sediment and peak flows at the 6th field scale.

Cumulative effects from these actions are expected to occur in a low-gradient reach downstream of each project. A second Matrix is prepared to see if cumulative effects will degrade WCIs at the watershed scale and over what timeframe. If cumulative effects are determined not to degrade or retard indicator functions, the actions can proceed. If cumulative effects degrade indicators at the subwatershed scale, then projects are modified to reduce effects or delayed until baseline conditions improve to be consistent with the Forest Plan.

How To Modify The Matrix

When a WCI value identified in the Matrix is not physically or biologically appropriate, given the inherent characteristics (geoclimatic setting) of the subwatershed, the WCI should be modified. WCIs should be refined to better reflect conditions that are functionally attainable in a specific watershed or stream reach based on local geology, land and channel form, climate, historic and potentially recoverable fish species habitat, and potential vegetation. Modification of interim default WCIs may be completed through a variety of methods such as mid-level analysis, Forest-wide monitoring results, and collection and evaluation of watershed and/or stream reach specific data.

Ideally, when modifying WCIs, suitable reference conditions should be used to adopt more functionally attainable indicator values. Reference conditions should be as representative as possible of historical values prior to significant management disturbance. However, since pristine subwatersheds are uncommon, there will need to be agreement on what constitutes an acceptable site to determine suitable reference conditions. Reference conditions may be established using a combination of methods including surveys, historical data, and inferences made from literature, professional judgment, and local landscape conditions. Regardless of what methods are used, written documentation of the methods and procedures, quality and source of data, and rationale supporting the modifications should be included in record documentation for the project or mid-level analysis. In watersheds with ESA-listed fish species, modification of WCIs will be coordinated with NMFS and/or USFWS through Section 7 consultations.

The Matrix Tables

(Note: Parameters were taken from the 8/96 NMFS and 2/98 FWS Matrices)

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Bull Trout Local Population Characteristics within Core Areas			
Local Population Size	Mean total local population size or local habitat capacity more than several thousand individuals. Adults in local population > 500. All life stages are represented within the local population.	Adults in local populations < 500 but > 50.[1]	Adults in local population < 50.
Growth and Survival	Local population has the resilience to recover from temporary or short-term disturbances (e.g., catastrophic events, etc.) or local population declines within 1 to 2 generations (5-10 years). The local population is characterized as increasing or stable. At least 10 years of data support this estimate.[2]	When disturbed, the local population will not recover to pre-disturbance conditions within 1 generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The local population is reduced in size, but the reduction does not represent a long-term trend. At least 10 years of data support this characterization. If less data are available and a trend cannot be confirmed, a local population will be considered at risk until enough data is available to accurately determine its trend.	The local population is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the local population condition will not improve with 2 generations. This is supported by a minimum of 5 years of data.
Life History Diversity and Isolation	The migratory form is present and the local populations are in close proximity to each other. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring local populations are large with high likelihood of producing surplus individuals or straying adults that will mix with other local populations.	The migratory form is present but the local population is isolated or fragmented.	The migratory form is absent and the local population is isolated to the local stream or a small watershed not likely to support more than 2,000 fish.

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[1] Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S.D.A. Forest Service, Intermountain Research Station, Boise ID.

[2] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biology 11(4): 1015-1018.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Bull Trout Local Population Characteristics within Core Areas (continued)			
Persistence and Genetic Integrity	Connectivity is high among multiple (5 or more) local populations with at least several thousand fish each. Each of the relevant local populations has a low risk of extinction. The probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple local populations does occur, but habitats are more fragmented. Only 1 or 2 local populations represent most of the fish production. The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for re-founding local populations in low numbers, in decline, or nearing extinction. Only a single local population, or several local populations that are very small or that otherwise are at high risk remain. Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.
Water Quality			
Temperature (steelhead, chinook)	7-day average maximum. Spawning, rearing and migration: 50-57°F (10-13.9°C)[3]	Spawning: 57-60 °F (13.9-15.5°C) Migration and rearing: 57-64°F (13.9-17.7°C)[4]	Spawning: >60 °F (>15.5°C) Migration and rearing: >64°F (>17.7°C)
Temperature (bull trout)	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: 2-5°C or 35.6-41.0°F Rearing: 4-12°C or 39.2-53.6°F Spawning: 4-9°C or 39.2-48.2°F Also temperatures do not exceed 15°C or 59.0°F in areas used by adults during migration (no thermal barriers)	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: <2°C or 6°C or <35.6°or 42.8°F. Rearing: <4°C or 13-15°C or <39.2°F or 55.4-59.0°F Spawning: <4°C or 10°C or 39.2°F or 50.0°F. Also temperatures in areas used by adults during migration sometimes exceed 15°C or 59.0°F.	7-day average maximum temperature in a reach during the following life history stages:[5] Incubation: <1°C or >6°C or <33.8°F or > 42.8°F. Rearing: >15°C or > 59.0°F Spawning: <4°C or >10°C 39.2°For > 50.0°F Also temperatures in areas used by adults during migration regularly exceed 15°C or 59.0°F (thermal barriers present)

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[3] Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19.83-138. Meehan, W.R., ed.

[4] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.

[5] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other coldwater species in Oregon, W.C. Mackay, M.K. Brewen, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, held in Calgary, Alberta, May 5-7, 1994

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Water Quality (continued)			
Temperature (other fish species: i.e., redband, rainbow, wood river sculpin, etc.)	Use 7-day average maximum temperature. Species-specific criteria should be developed.		
Sediment/Turbidity (steelhead, chinook)	Low turbidity is indicated by < 12% surface fines (< 0.85 mm)[6]	Moderate turbidity is indicated by 12-20% surface fines (< 0.85 mm)[4]	High turbidity is indicated by > 20% surface fines (< 0.85 mm)[4]
Sediment/Turbidity (in areas of spawning and incubation; rearing areas will be addressed under substrate) (bull trout)	< 12% fines (< 0.85 mm) in gravel.[6] Surface fines (≤6mm) ≤ 12%[7], [8]	12-17% fines (<0.85mm) in gravel.[6] Surface fines (≤ 6mm) are 12-20%.	>17% fines (< 0.85mm) in gravel;[6] Surface fines (< 6mm) or depth fines (< 6mm) in > 20% in spawning habitat
Sediment/Turbidity (other fish species: i.e., red band, rainbow, wood river sculpin, etc)	Species-specific criteria should be developed.		
Chemical Contamination/Nutrients	Low levels of chemical contamination from agricultural, industrial, and other sources; no excess nutrients, no 303(d) water quality limited water bodies.[9]	Moderate levels of chemical contamination from agricultural, industrial, and other sources; some excess nutrients, one 303(d) water quality limited water body.[9]	High levels of chemical contamination from agricultural, industrial, and other sources; high excess nutrients, >1 303(d) water quality limited water bodies.[9]

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[6] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

[7] Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitewell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.

[8] Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.

[9] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2). 1994.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access			
Physical Barriers (address subsurface flows impeding fish passage under the pathway "Flow/Hydrology)	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows.	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows.	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.
Substrate Embeddedness (Bull trout rearing areas. Spawning and incubation areas are addressed under the Sediment/Turbidity WCI)	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness is < 20%.[6], [10], [11]	Gravel and cobble is subdominant, or if dominant, embeddedness is 20-30%[6], [10]	Bedrock, sand, silt, or small gravel dominant, or if gravel and cobble dominant, embeddedness is > 30%[4], [10]
Large Woody Debris (Consider variations based on local biophysical elements, i.e., vegetation habitat type/community type, ecological processes, stream channel width and type, landform, etc., appropriate to the site.)	> 20 pieces per mile, > 12 inches in diameter, > 35 feet length;[4], [12] and adequate sources of large woody debris for both long and short-term recruitment in RCAs.	Currently meets standards for functioning appropriately, but lacks potential sources of short or long-term large woody debris recruitment from RCAs to maintain that desired condition.	Does not meet standards for functioning appropriately and lacks potential large woody debris for short and/or long-term recruitment.

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[10] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service. Northwest Region, January 23, 1995.

[11] Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life histories of westslope cutthroat and bull trout in the Upper Flathead River Basin, MT. Environmental Protection agency Rep. Contract No. R008224-01-5.

[12] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access (continued)			
Pool Frequency and Quality: consider variations based on local biophysical elements i.e., vegetation habitat type/community type, ecological processes, stream channel width and type, landform etc., appropriate to the site.	Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment. Large woody debris recruitment standards for functioning appropriately (above) are met and pool frequency in a reach closely approximates:[7], [13] **Steelhead and chinook**: Channel Width (ft.) No. Pools/Mile 0-5 184 5-10 96 10-15 70 15-20 56 20-25 47 25-50 26 50-75 23 75-100 18 **Bull Trout**: Wetted Width (ft.) No. Pools/Mile 0-5 39 5-10 60 0-15 48 15-20 39 20-30 23 30-35 18 35-40 10 40-65 9 65-100 4 Can use the formula: pools/mile = 5280/wetted channel width = # pools/mi # channel widths per pool	Pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature,[6] and/or there has been a moderate reduction of pool volume by fine sediment. Large woody debris recruitment is inadequate to maintain pools over time.	Pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate,[6] and there has been a major reduction of pool volume by fine sediment.

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[13] USDA Forest Service. 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Habitat Access (continued)			
Large Pools/Pool Quality (All Fish Species) In adult holding, juvenile rearing, and over wintering reaches where streams are 3.0 meters in wetted width at base flow.	Each reach has many large pools > 3.28 feet (1 meter deep).[6] Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment.	Reaches have few large pools > 3.28 feet (>1 meter) present[6] or inadequate cover/temperature. Moderate reduction of pool volume by fine sediment.	Reaches have no deep pools > 3.28 feet (> 1 meter)[6] and inadequate cover/temperature. There is a major reduction of pool volume by fine sediment.
Off-channel Habitat (Appropriate to the watershed and associated stream system; is the stream capable of using its floodplain similar to an unmanaged stream system?)	Watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; side channels are low energy areas.[6]	Watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side channels are generally high-energy areas.[6]	Watershed has few or no ponds, oxbows, backwaters, or other off-channel areas.[6]
Refugia (steelhead, chinook) (see glossary for definition of steelhead and chinook refugia)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian conservation areas); existing refugia are sufficient in size, number, and connectivity to maintain viable populations or sub-populations.[14]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian conservation areas); existing refugia are insufficient in size, number, and connectivity to maintain viable populations or sub-populations.[14]	Adequate habitat refugia do not exist.[14]
Refugia (bull trout) (see glossary for definition of bull trout refugia)	Habitats capable of supporting strong and significant local populations are protected and are well distributed and connected for all life stages and forms of the species.[14], [15]	Habitats capable of supporting strong and significant local populations are insufficient in size, number, and connectivity to maintain all life stages and forms of the species.[14], [15]	Adequate habitat refugia do not exist.[14]

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[14] Frissell, C.A., W.J. Liss, and David Bayles. 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[15] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of aquatic Species and Habitats. In T.M. Quigley and S.J. Arbelbide eds “An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III.” U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech. Rep PNW-GTR-405.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Channel Conditions and Dynamics			
Average Wetted Width/Maximum Depth Ratio in scour pools in a stream reach. (Consider variation in ranges based on stream channel type).	≤10 [4], [7], [10]	11-20 [7]	>20 [7]
Streambank Condition (Consider variation in ranges based on stream channel type).	>90% of any stream reach has stable banks[4],[7] relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.	80-90% of any stream reach has stable banks relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.	<80% of any stream reach has stable banks relative to the percent of inherent stable streambanks associated with a similar unmanaged stream system.
Floodplain Connectivity (Consider local landform, stream channel type, climatology, vegetation, etc.)	Within RCAs, floodplains and wetlands are hydrologically linked to the main channel; overbank flows occur and maintain wetland/floodplain functions; and riparian vegetation succession.	Within RCAs, reduced linkage of wetlands and floodplains to the main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland/floodplain function and riparian vegetation succession.	Within RCAs, severe reduction in linkage of wetlands, floodplains and riparian areas to the main channel; overbank flows are drastically reduced relative to historic frequency, as evidenced by substantial reduction of wetland/floodplain function and riparian vegetation succession.
Flow/Hydrology			
Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of a similar size, geomorphology and climatology.	Some evidence of altered peak flow, base flow, and/or flow timing relative to an undisturbed watershed of similar size, geomorphology and climatology.	Pronounced changes in peak flow, base flow, and/or flow timing relative to an undisturbed watershed of similar size, geomorphology and climatology.
Change in Drainage Network	Zero or minimum change in active channel length correlated with human caused disturbance.	Low to moderate change in active channel length correlated with human caused disturbance.	Greater than moderate change in active channel length correlated with human caused disturbance.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Watershed Conditions			
Road Density/Location[16]	Total road density < 0.7 miles/square mile of subwatershed,[16] no roads within RCAs.	Total road density 0.7-1.7 miles/square mile of subwatershed,[16] few roads within RCAs.	> 1.7 miles/square mile of subwatershed,[16] many roads within RCAs.
Disturbance History	< 15% ECA (entire watershed) with no concentration of disturbance in areas with landslide or landslide prone areas, and/or refugia, and/or RCAs.	< 15% ECA (entire watershed) but disturbance concentrated in landslide or landslide prone areas, and/or refugia, and/or RCAs.	> 15% ECA (entire watershed) and disturbance concentrated in landslide or landslide prone areas, and/or refugia, and/or RCAs.
Riparian Conservation Areas	The riparian conservation areas within the subwatershed(s) have historic and occupied refugia for listed, sensitive or native/desired nonnative fish species which are present and provide: adequate shade, large woody debris recruitment, sediment buffering, connectivity, and habitat protection and connectivity to adequately minimize adverse effects from land management activities (>80% intact). All vegetative components are within desired conditions identified in Appendix A of the Forest Plan. RCA functions and processes are intact, providing resiliency from adverse affects associated with land management activities. Conditions fully support habitat for aquatic species.	The riparian conservation areas within the subwatershed(s) contain known historic refugia for listed, sensitive, or native/desired nonnative fish species that are currently absent (but could be re-colonized). Land management activities have resulted in moderate loss to shade, large woody debris recruitment, sediment buffering, connectivity, and habitat protection. (Refugia < 70-80% intact.) Some vegetative components are outside desired conditions in Appendix A of the Forest Plan. RCA functions and processes are still generally intact, providing some resiliency from adverse affects associated with land management activities. Conditions generally support habitat for aquatic species.	Riparian conservation areas as a result of land management have resulted in loss of or substantially fragmented historic refugia, and provide inadequate protection of habitats for listed, sensitive, native or desired non-native fish species (< 70% intact). Historical refugia are currently absent of listed, sensitive, or native/desired non-native fish species. Most vegetative components are outside desired conditions in Appendix A of the Forest Plan. RCA functions and processes are not sufficiently intact, to mitigate adverse affects from land management activities. Conditions may not support habitat for aquatic species

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[16] ICBEMP Science Assessment, Supplemental Roads Analysis

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Watershed Conditions (continued)			
Disturbance Regime	Disturbance resulting from land management activities are negligible or temporary. Streamflow regimes are appropriate to the local geomorphology, potential vegetation and climatology resulting in appropriate high quality habitat and watershed complexity that provide refugia and rearing space for all life stages or multiple life-history forms. Ecological processes are within historical ranges. Resiliency of habitat to recover from land management disturbances is high.	As a result of land management activities, scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Ecological processes are moderately outside of historical ranges. Resiliency of habitat to recover from land management disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Ecological processes are substantially outside of historical ranges. Resiliency of habitat to recover from land management disturbances is low.
Integration of Pathways (steelhead, chinook)			
	Habitat quality and connectivity among subpopulations is high. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival and growth are consistent with the desired conditions for the habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5-10 years). The subpopulation is fluctuating around an equilibrium or is growing.	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to pre-disturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend.	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will improve within two generations (5 to 10 years. Subpopulation survival and recruitment responds sharply to normal environmental events.

Table B-1. Pathways and Watershed Condition Indicators (WCIs) - Reference Conditions (continued)

Pathways and WCIs	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Integration of Pathways (bull trout)			
	Habitat quality and connectivity among local populations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival and growth are consistent with pristine habitat. The local population has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years). The local population is fluctuating around an equilibrium or is growing.	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to pre-disturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The local population is reduced in size, but the reduction does not represent a long-term trend. The local population is stable or fluctuating in a downward trend. Connectivity among the local populations occurs but habitats are more fragmented.	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will improve within two generations (5 to 10 years). Little or no connectivity remains among local populations. Local population survival and recruitment responds sharply to normal environmental events.
Integration of Pathways (other fish species, i.e., redband, rainbow, wood river sculpin, etc.)			
	Species-specific criteria should be developed.		

Table B-2. Environmental Baseline – Current Conditions

Agency/Unit:		HU Code & Name:	
Fish Species Present:		Spatial Scale of Matrix:	
(Anad. Sp.) Population:		Subpopulation:	
(Bull trout) Core Area:		Local Population:	
Management Action(s):			

Pathways **Indicators** [a, c]	**Population and Environmental Baseline**		
	Desired Condition	☒ = Data **Baseline** [b]	**Discussion of Baseline – Current Condition**
Subpopulation Character			
Subpopulation Size			
Growth and Survival			
Life History Diversity and Isolation			
Persistence and Genetic Integrity			
Water Quality			
Temperature			
Sediment			
Chemical Contaminants/Nutrients			
Habitat Access			
Physical Barriers			
Habitat Elements			
Substrate Embeddedness			
Large Woody Debris			
Pool Frequency			
Pool Quality			
Off-Channel Habitat			
Refugia			

a. Matrix checklist adapted from USFWS and NMFS 1998.
b. FA = Functioning Appropriately, FR = Functioning at Risk, UR = Functioning at Unacceptable Risk, N = Not Applicable
note: "☒" in baseline discussion indicates actual data were used as the primary source of baseline assessment, otherwise reflects a professional estimate of condition.
c. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-2. Environmental Baseline – Current Conditions (continued)

Pathways Indicators [a, c]	**Population and Environmental Baseline**		
	Desired Condition	**☒ = Data Baseline** [b]	**Discussion of Baseline – Current Condition**
Channel Condition and Dynamics			
Width/Depth Ratio			
Stream bank Condition			
Floodplain Connectivity			
Flow/Hydrology			
Change in Peak/Base Flows			
Drainage Network Increase			
Watershed Conditions			
Road Density and Location			
Disturbance History			
Riparian Conservation Areas			
Disturbance Regime			
Integration of Species and Habitat Conditions			

a. Matrix checklist adapted from USFWS and NMFS 1998.
b. FA = Functioning Appropriately, FR = Functioning at Risk, UR = Functioning at Unacceptable Risk, N = Not Applicable
note: "☒" in baseline discussion indicates actual data were used as the primary source of baseline assessment, otherwise reflects a professional estimate of condition.
c. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-3. Effects of Management Actions

Agency/Unit:		HU Code & Name:	
Fish Species Present:		Spatial Scale of Matrix:	
(Anad. Sp.) Population:		Subpopulation:	
(Bull trout) Core Area:		Local Population:	
Management Action(s):			

Pathways Indicators [a, d]	**Effects of the Management Action(s)**				
	Effects [b, c]	**Temporary trend/effect (+/-/none)**	**Short-term trend/effect (+/-/none)**	**Long-term trend/effect (+/-/none)**	**Discussion of Effects**
Subpopulation Character					
Subpopulation Size (bull trout only)					
Growth and Survival (bull trout only)					
Life History Diversity and Isolation (bull trout only)					
Persistence and Genetic Integrity (bull trout only)					
Water Quality					
Temperature					
Sediment					
Chemical Contaminants/ Nutrients					
Habitat Access					
Physical Barriers					
Habitat Elements					
Substrate Embeddedness					
Large Woody Debris					
Pool Frequency					
Pool Quality					
Off-Channel Habitat					
Refugia					

a. Matrix checklist adapted from USFWS and NMFS1998.
b. This displays the potential effects of the action on habitats or individuals, and not on the status of the entire local population/ watershed. I = Improve, M = Maintain, D = Degrade, N = No Influence
c. Effects that “Maintain” or “Improve” indicators are compliant with Pacfish and Infish objectives (see USFWS 1998 for crosswalk).
d. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-3. Effects of Management Actions (continued)

Pathways Indicators [a, d]	Effects of the Management Action(s)				
	Effects [b, c]	Temporary trend/effect (+/-/none)	Short-term trend/effect (+/-/none)	Long-term trend/effect (+/-/none)	Discussion of Effects
Channel Condition and Dynamics					
Width/Depth Ratio					
Stream bank Condition					
Floodplain Connectivity					
Flow/Hydrology					
Change in Peak/Base Flows					
Drainage Network Increase					
Watershed Conditions					
Road Density and Location					
Disturbance History					
Riparian Conservation Areas					
Disturbance Regime					
Integration of Species and Habitat Conditions					

a. Matrix checklist adapted from USFWS and NMFS1998.
b. This displays the potential effects of the action on habitats or individuals, and not on the status of the entire local population/watershed. R = Restore, M = Maintain, D = Degrade, N = No Influence
c. Effects that "Maintain" or "Improve" indicators are compliant with Pacfish and Infish objectives (see USFWS 1998 for crosswalk).
d. Evaluated against local criteria where appropriate and available (see IV.C)

Table B-4. Dichotomous Key For Making ESA Determination Of Effects

(Circle the conclusion at which you arrive)

Name and location of action:

1. Are there any proposed/listed fish species and/or proposed/designated critical habitat in the watershed or downstream from the watershed?

   NO . . . . No Effect
   YES . . . . .Go to 2[1]

2. Will the proposed action(s) have any effect whatsoever[1] on the species and/or critical habitat?

   NO . . . . No Effect
   YES . . . . Go to 3

3. Does the proposed action(s) have the potential to hinder attainment of relevant properly functioning indicators (from Table II)?

   NO . . . . Go to 4
   YES . . . . Likely to adversely affect[2]

4. Does the proposed action(s) have the potential to result in “take”[2] of proposed/listed fish species or adversely affect proposed/designated critical habitat?

   a) There is a negligible (extremely low) probability of take of proposed/listed fish species, or of adversely affecting proposed/designated critical habitat…Not likely to adversely affect

   b) There is more than a negligible probability of take of proposed/listed fish species or of adversely affecting proposed/designated critical habitat…Likely to adversely affect[2]

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[1] “Any effect whatsoever” includes small effects, effects that are unlikely to occur, and beneficial effects (all of which are recognized as “may affect” determinations). A “no effect” determination is only appropriate if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect, an effect that is unlikely to occur; or a beneficial effect.

[2] “Take” – The ESA (Section 3) defines take as “to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect, or attempt to engage in any such conduct”. The USFWS (USFWS, 1994) further defines “harm” as “significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering”, and “harass” as “actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering”. ”. In 1999, NMFS (64 FR 60727) further defined harm to include “spawning” and “rearing” as additional behavioral patterns.

[3] Document expected incidental take on next page of this key.

Modification Considerations For Pathways And WCIs

This section is intended to provide a basis for general modification of the WCIs contained in the Matrix and recommendations for data sources or evaluation.

WCIs are an integrated suite of aquatic (including biophysical components), riparian (including riparian-associated vegetation species), and hydrologic (including uplands) condition measures that are intended to be used at the a variety of watershed scales. They assist in determining the current condition of a watershed and should be used to help design appropriate management actions or alter or mitigate proposed and or ongoing actions to move watersheds toward desired conditions. Common sources of information are likely to include Forest Service and other agencies' habitat and population surveys, walk-through surveys, professional judgment, and monitoring and remote sensing data.

The following descriptions are generated to stimulate discussions on Level I teams associated with listed fish species, and Interdisciplinary Teams on evaluations of all the WCIs/Pathways through which riparian functions and ecological processes, aquatic habitat, and fish populations can be altered. These descriptions are not all inclusive, and it is recommended that both field review and literature review be conducted to better understand the inherent variability and interactions of the biophysical resources for any management action within a given watershed.

Use of fairly comprehensive databases such as the "Natural Conditions Dataset" (Overton et al. 1995), may be useful in developing more localized values. Where appropriate, refinement of WCI values can be stratified by several geoclimatic variables, some of which include: geomorphology, landform, stream type and size, climate historic, and potential vegetation.

Pathway: Bull Trout Local Population Characteristics Within Core Areas

WCI–1: Local Population Size. DATA AND ANALYSIS: Determinations of baseline will reflect the known status of the local population as compared against the numeric criteria. Definitions of functionality are derived from Rieman & McIntyre (1993). Determination of baseline "current condition" will reflect the known status of the local population as compared against the numeric criteria.

Utilize primarily professional judgment, or data where available. No criteria for species other than bull trout are needed. Most information sources will reflect only confirmed presence or assumed absence. Where population surveys exist, the data may be sufficient to apply the numeric criteria in Table I, but will unlikely represent the true "population". It may be difficult in some watersheds to separate historic non-use from contemporary non-use, that is, was the species ever present? For the purpose of consistency, the numeric criteria should be applied as written, unless evidence exists to demonstrate historic non-use.

WCI–2: Growth and Survival. DATA AND ANALYSIS: It is unlikely that 5 to 10 years of data exists to support any baseline assessment, as identified in Table I; therefore, analysis should use available data and information to arrive at a professional estimate of the condition. Inferences may be derived from related information such as water temperature or macro-invertebrate data. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed. Use professional judgment.

The ratio of adults to pre-adults and the extent of the available habitat are used to estimate productivity for growth and survival. Bull trout greater than 6 inches in length are assumed to be adult fish (based on age analyses of resident fish collected on the Forest).

WCI–3: Life History Diversity and Isolation. DATA AND ANALYSIS: Utilize primarily professional judgment, or data where available. Most information sources will reflect only confirmed presence or assumed absence. Known connectivity and past observation of larger migratory bull trout can assist in estimating the current condition. Where neighboring local population surveys exist, the data may be sufficient to apply the matrix standards. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed.

WCI–4: Persistence and Genetic Integrity. DATA AND ANALYSIS: Utilize primarily professional judgment, or data where available. Most information sources will reflect only confirmed presence or assumed absence. Where neighboring local population surveys exist, the data may be sufficient to apply the Matrix criteria. Unknowns suggest a conservative application of the numeric criteria as written. No criteria for species other than bull trout are needed.

Pathway: Water Quality

WCI–1: Temperature. DATA AND ANALYSIS: Recording thermographs, both within the habitats of concern and during the applicable timeframes (e.g., spawning, rearing, and migration periods), will be required to directly evaluate the Matrix parameters. Spot measurements are typically not sufficient, but could be used to indicate a temperature extreme that warrants further examination. Daily thermograph maximums need not be further processed into 7-day average unless necessary to discriminate between baseline conditions. For spawning temperature criteria, conditions need to meet the criteria throughout the spawning period.

WCI–2: Sediment/Turbidity. DATA AND ANALYSIS: Unless sufficient data/information is available to determine otherwise, no baseline condition will be identified as "functioning appropriately" for any reach within a watershed that is currently included on the 303(d) impaired water body list with sediment identified as the pollutant. If sufficient information is available to dispute the listing, it may be considered "functioning at risk"; otherwise, a 303d listing for sediment will be considered "functioning at unacceptable risk". The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting). Modification of the sediment criteria can utilize the more localized Natural Conditions Dataset (Overton et al. 1995) to incorporate the local geomorphology, landform, stream type and size, potential vegetation type for the stream reach or subwatershed. Surface fines are currently being used as a surrogate for turbidity. If surface fine information is not available, naturally erosive soils and/or stream bank condition indicator may be used in it place. In watersheds with ESA-listed fish species, consult with the Level 1 consultation team before making changes.

WCI–3: Chemical Contamination/Excess Nutrients. DATA AND ANALYSIS: Consider rates of chemical and a nutrient source of contamination only; do not include sediment or temperature (the basis for listing most 303d streams). Where available, utilize appropriate state and federal water quality rules and regulations.

Pathway: Habitat Access

WCI–1: Physical Barriers. DATA AND ANALYSIS: This indicator identifies the known and or potential barriers to fish movement both within a local population and among core areas. This includes but is not limited to dams, culverts, bridges, and fords, as well as barriers associated with thermal or chemical alterations to the water column. Estimation on the amount and extent of fish barriers may be completed using GIS layers of roads (classified and unclassified) and the 1:24,000 streams layer. Natural barriers such as waterfalls, cascades, and elevated stream temperatures from hot springs are important to identify, but should not have an influence on the functionality rating.

Pathway: Habitat Elements

WCI–1: Substrate Embeddedness. DATA AND ANALYSIS: This indicator identifies the extent to which larger particles are embedded or buried by fine sediment. A commonly used procedure for measuring embeddedness is by selecting particles from the streambed and then measuring both the particle height and embedded height perpendicular to the streambed surface. Percent embeddedness is calculated for each particle until at least 100 particles are measured. The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting).

WCI–2: Large Woody Debris. DATA AND ANALYSIS: The indicator considers the number and size of in-channel wood, as well as future recruitment of wood in RCAs. A number of methods can be used to collect in-channel wood data. Most surveys count only those pieces that extend below the waterline at bankfull discharge and exceed some minimum size limit over a specific stream distance. Sometimes spanners or bridged pieces are also included in the count. An adequate source of wood recruitment is generally an estimate of the number of pieces that may fall into the stream in the future. This information is commonly collected through a walk-through survey or intensive riparian survey. Several studies have shown that most (70 to 90 percent) large wood recruited to streams is from trees growing within 65-100 feet of the channel on flat terrain (Murphy and Koski 1989, McDade et al. 1990). Potential wood recruitment should at a minimum be considered within one site potential tree height. This height will vary by potential vegetative group (PVG), and can range from 50 feet in PVG 11 to 120 feet in PVG 1. Analysis should be cognizant of the distribution of terrestrial vegetation habitats within the watershed. For example, stream reaches flowing through broad shrub-dominated meadows lack natural sources of LWD, and would not be expected to meet the numeric criteria. Generally, watersheds or stream reaches with a mosaic of conifer and shrub habitats would be considered at desired conditions unless evidence displays manipulation or disturbance of streamside forests, regardless of LWD numeric levels.

WCI–3: Pool Frequency and Quality. DATA AND ANALYSIS: This indicator is based on the number of pools meeting a minimum size criteria defined by the appropriate methodology by channel width. It also considers the amount of cover in each pool, water temperature, and filling by sediment. Most stream surveys have typically considered this habitat element. "Pocket pools" or other such quantified microhabitat can also be appropriately considered as pools. Where data is lacking, use professional judgment with inference from related mechanisms such as known disturbance within the watershed (e.g., an increase in sediment loads will generally result in a decrease in pool frequency and quality).

WCI–4: Large Pools. DATA AND ANALYSIS: This indicator is based upon the number of pools with maximum depth greater than 3.28 feet. It also considers the amount of cover in each pool, water temperature, and filling by sediment. Most stream surveys have typically considered this habitat element. The values for this indicator may vary greatly and should be refined to better reflect local conditions (geoclimatic setting).

WCI–5: Off-Channel Habitat. DATA AND ANALYSIS: This indicator is based upon the number of side channels, ponds, oxbows, and other backwater areas. Typically this is a measure of either the total number of these habitat types or the total linear distance over a specific reach. Utilize available data and information with professional judgment. Some habitat surveys have quantified conditions in off-channel habitats, and most have at least commented about the existence of such. However, no numeric standard exists.

WCI–6: Refugia. DATA AND ANALYSIS: This is a large-scale indicator based upon the quality, uniqueness, and importance of the 6th or 5th field HU the project being analyzed falls within. Utilize available data and tools, such as aerial photos, with professional judgment. This indicator speaks to the current situation of habitats within the local –population--that is, within the watershed.

Pathways: Channel Conditions and Dynamics

WCI–1: Average Width/Maximum Depth Ratio. DATA AND ANALYSIS: The determination of channel width and channel depth is problematic because both parameters are flow-dependent. Depth tends to increase with flow more rapidly than width, but this relationship may not be constant at any given cross-section. Recent surveys have typically evaluated only wetted channel conditions. Maximum depth identification requires specialized abilities in identifying bankfull features and so has not been consistently collected. Ideally these parameters should be measured at specific discharges and locations. Where no data exists, those familiar with the stream can compare visual observations of it with stream references such as found in the Natural Conditions Dataset (Overton et al. 1995), or Applied River Morphology (Rosgen 1996). The values for this indicator may vary greatly by channel type and should be refined to better reflect local conditions (geoclimatic setting). Utilize available data and information, or professional judgment.

WCI–2: Streambank Condition. DATA AND ANALYSIS: Many stream surveys have evaluated streambank condition (stability), although until recently it was rarely quantified. Where quantified, if summarized by habitat type, this indicator can be evaluated as in the USFWS matrix; that is, what portion of the habitat units have at least 90 percent stable banks. However, if summarized only by reach, simply consider the portion of the total length that is "stable". Engineered revetment should generally not be considered "stable". Where no quantitative data exists, qualitative assessments common in the 1980s such as the Stream Reach Inventory and Channel Stability Evaluation (Pfankuch 1975) can provide considerable inference. Utilize available data and information, or professional judgment.

WCI–2: Floodplain Connectivity. DATA AND ANALYSIS: This indicator is based on whether floodplains and wetlands are hydrologically linked to the main channel. Evidence of channel entrenchment, manipulation, levees, revetment, or alteration should be absent to be considered "functioning appropriately". This indicator is closely related to variations in local geomorphology, landform, stream size and type, climate, and potential vegetation. Utilize primarily professional judgment, or data, information, or photographs if available.

Pathway: Flow/Hydrology

WCI–1: Change in Peak or Base Flows. DATA AND ANALYSIS: This indicator is typically based on field observations and an assessment of management impacts at the 6th or 5th field HU scales. In-channel observations may include channel adjustments such as nick points; scour marks, and eroding banks to dewatered streams. Larger-scale measurements may include past harvest history, road densities and location, and acres burned. Utilize primarily professional judgment, or data and information if available.

WCI–2: Changes in Drainage Network. DATA AND ANALYSIS: This indicator is typically based on field observations and an assessment of management impacts at the 6th or 5th field HU scales. Management activities typically observed are roads with extensive inside ditches and few relief culverts, dewatered or expanded streams below roads, compacted ground within harvest units, and intensive livestock grazing. Utilize primarily professional judgment, or data and information if available.

Pathway: Watershed Conditions

WCI–1: Road Density and Location. DATA AND ANALYSIS: Classified and unclassified road densities and miles within the RCAs can quickly be evaluated, particularly with GIS tools. Utilize available data and information, or professional judgment. Road density default values are from the "Supplemental Roads Analysis of Road Impacts pages 1253-1260 in Volume III of Quigley and Arbelbide, 1997.

WCI–2: Disturbance History. DATA AND ANALYSIS: This indicator is typically based on vegetative recovery from disturbance. The values for this indicator may vary greatly from the default values and should be refined to better reflect local conditions. Local refinements of these indicator values should consider local research data (e.g., Silver Creek Watershed Research Projects, King 1989). It is difficult to predict how much a particular change in ECA will affect watershed function and effect on salmonids; therefore professional judgment will be required.

WCI–3: Riparian Conservation Areas. DATA AND ANALYSIS: Actions and historic disturbance within an RCA can help infer RCA condition and trend. Classified and unclassified roads and number of stream crossings can also be quickly evaluated within a given watershed, particularly with GIS tools. Utilize primarily professional judgment, or data, tabular information, or aerial photographs if available.

WCI–4: Disturbance Regime. DATA AND ANALYSIS: Ecological processes including the disturbance processes that create dynamic soil, water, and hydrologic, riparian and aquatic habitats within watersheds. The results of these processes determine the physical and biological capability within watersheds, including water quality and aquatic habitat. Differences in climate, geomorphology, soils, and potential vegetation (geoclimatic setting) greatly influence the amount and recurrence of disturbance process (disturbance regimes), as well as the ability and rate for a subwatershed to recover (resiliency). The intent of this indicator is to determine the amount of effect that land management activities have or may have on the overall watershed function and resiliency. Utilize primarily professional judgment, based on available data and information when available.

Pathway: Integration of Species and Habitat Conditions

No individual WCIs identified. DATA AND ANALYSIS: This pathway is an integration of the biophysical and aquatic habitat conditions. Individual WCIs represent a starting point to describe the current and desired conditions for water quality and aquatic habitat. This pathway synthesizes the information evaluated for individual indicators to determine the overall functional status of the subwatershed. Utilize professional judgment and reference specific WCIs that have a major influence on the overall condition.

GUIDANCE FOR DELINEATION AND MANAGEMENT OF RIPARIAN CONSERVATION AREAS

Introduction

The third component of the ACS is the delineation of RCAs. Naiman et al. (2000) identifies that recent discoveries about the structure and dynamics of riparian zones have extended the scope of understanding about this portion of the landscape and have important implications for stream and watershed management. The following guidance has been developed to assist interdisciplinary teams in becoming familiar with and consistently applying criteria to: (1) appropriately delineate RCAs; and (2) analyze important considerations in developing appropriate management actions within or affecting RCAs. The objective is to ensure that interdisciplinary teams adequately consider riparian functions and ecological processes in both the delineation of RCAs and determination of appropriate management actions within or affecting RCAs.

The revised Forest Plan direction (goals, objectives, standards, and guidelines) found in Chapter III of this document replaces direction in the 1990 Boise National Forest Land and Resource Management Plan, as amended by Pacfish/Infish, NMFS' 1995 LRMP Biological Opinion (BOs), and the NMFS' and USFWS' 1998 Biological Opinions for steelhead and bull trout. With that replacement, the definitions and delineations of Pacfish/Infish Riparian Habitat Conservation Areas are replaced by the definitions and delineations of RCAs.

Overview Of The RCA Delineation Guidance

Aquatic and riparian systems are easily affected by land management activities on the surrounding hillslopes. RCAs provide both a linkage and transitional habitat between hillslopes and upland terrestrial habitats and the aquatic habitats within stream channels.

In general, there is little controversy over the need to define RCAs in order to maintain riparian functions and ecological processes. The controversy is over the width of the RCA, the extent and type of management activities that can occur within them, and the purposes for those activities. Management activities that occur within, or adjacent to, an RCA are subject to specific goals, objectives, standards and guidelines. Forest plans and the associated management direction regulate two major features of RCAs: (1) their width; and (2) the kind and amount of activity that can take place within or influence them (Spence et al. 1996, Quigley and Arbelbide 1997).

Riparian zones are among the biosphere's most complex ecological systems and also among the most important for maintaining the vitality of the landscape and its rivers (Naiman et al. 2000). Evaluating the effectiveness of RCAs to manage for riparian functions and ecological processes is difficult because of: the complexities of such areas, the extended time over which impacts can occur; and the resiliency and rate of recovery. The RCA should be designed to maintain riparian functions and ecological processes with consideration of multiple scales (stream reach, subwatershed, and watershed scale).

RCA Delineation Criteria For the Boise National Forest

The following are criteria to be used to delineate RCAs for perennial and intermittent streams, ponds, lakes, reservoirs, and wetlands.

I. Forested Streams*

Perennial streams (and intermittent streams providing seasonal rearing and spawning habitat) –
In the absence of local field data, 300-foot slope distance from the ordinary high water mark,
OR
Flood-prone width or two site-potential tree heights, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

II. Forested Streams*

Intermittent streams – In the absence of local field data, 150-foot slope distance from the ordinary high water mark,
OR
Flood-prone width or one site-potential tree height, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

III. Ponds, Lakes, Reservoirs, and Wetlands*

In the absence of local field data, 150-foot slope distance from the ordinary high water mark,
OR
Outer edge of seasonally saturated soils, outer edge of riparian vegetation, or one site-potential tree height, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

IV. Non-Forested Streams*

Perennial and intermittent streams –
The extent of the flood prone width, or riparian vegetation, whichever is greatest,
OR
Defined based on a site-specific analysis by a qualified specialist with expertise in the field of riparian function and ecological processes.

*Note: Sediment delivery distances vary based upon the combination of proposed management actions and the inherent site characteristics. Because sediment delivery distances may exceed the selected option, RCAs may need to be adjusted to avoid or minimize delivery to the associated water body under any option.

Step-Down Process For RCA Delineation

Effective use of the RCA delineation requires a full understanding of the selection criteria options within each of the four Categories.

Delineating an RCA requires two decisions to be made. First, the area needs to be correlated with one of the four Categories (I, II, III, or IV). The second decision is identifying which option, or criteria, within that Category to use.

The decision as to which option or criteria should be chosen should occur through discussions with the interdisciplinary team, resource specialists, and/or the line officer. In general, determining the level of analysis that best suits the needs of the project will be driven by the potential effects of the project, baseline conditions, management direction, and issues associated with the project/area of interest that were identified through scoping, the work of the interdisciplinary team, or the line officer.

Written documentation of the chosen RCA delineation option within a category, and the rationale behind the choice, should be included in record documentation for the project.

The options within a given Category have varying levels of associated analysis that are involved with delineating the RCA. Category IV, Non-forested Streams, differs from the other Categories in that it does not designate a set distance and therefore has two options rather than three.

Option 1

In lieu of field data, selection of the first option provides a conservative boundary--generally in excess of two site-potential tree heights in the case of the 300-foot slope distance, and greater than one site-potential tree height in the case of the 150-foot slope distance--that would be expected to account for most riparian processes including stream shading, LWD recruitment, fine organic litter input, bank stabilization, sediment filtration, wind-throw, riparian microclimate and productivity, and wildlife habitat. Again, selection of this option is expected to provide land managers with the option of delineating an RCA in the absence of field confirmation, with the expectation that the distances would account for most riparian functions andecological processes in a system.

Option 2

The second criteria option, which is used similarly in Categories I-IV, requires field verification of certain site characteristics and provides a more site-based delineation of an RCA boundary for a specific location. Depending on which Category (I, II, III, or IV) is involved, options include use of flood-prone width, site-potential tree height, or riparian vegetation, whichever is greatest given the category.

Flood-prone width is a relatively easily surveyed geomorphic feature in the field, and it accounts for riparian processes, such as fine organic litter input or bank stabilization, and for various degrees of sediment delivery distances.

Site-potential tree height is spoken to in the literature and correlated with the protection of riparian functions and ecological processes such as stream shading, LWD recruitment, fine organic litter input, bank stabilization, sediment filtration, wind-throw, riparian microclimate and productivity, and wildlife habitat (Spence et al. 1996, Quigley and Arbelbide 1997, FEMAT 1993).

Riparian vegetation is defined through classification of the vegetation associated with the aquatic habitat and its outer extent (see glossary), and it generally influences riparian processes such as fine organic litter input, bank stabilization, sediment filtration, stream shading, and wildlife habitat.

Option 2 requires the use of certain field data to be collected from the project area and analyzed to determine the RCA boundary. It is considered an option requiring potentially less than a site-specific analysis (Option 3), but it is more appropriately tied to the landscape than a default distance might be (Option 1).

Option 3

The third option, which is used in Categories I-IV, is the use of a site-specific analysis to define the RCA. This option requires potentially the most analysis of the three options. When defining the RCA, the specialist conducts an on-site analysis of the riparian functions and ecological processes associated with the stream, pond, lake, reservoir or wetland, and defines the RCA based on the distance that best encompasses the extent of those functions and processes. The value gained from this effort is a site-specific RCA delineation appropriate to the functions and processes between upland terrestrial habitats and adjacent aquatic habitats for that area. This information potentially provides more opportunities for project design because the existing condition is better known, and therefore effects of actions can be better assessed, and projects can be more responsive to needs of the aquatic ecosystem.

In summary, RCA delineation is set up in a manner that provides flexibility for different levels of analysis that, regardless of the option chosen, will provide for riparian functions and ecological processes. The decision on which option to use must involve considerations of the project in regard to potential effects, baseline conditions, and issues and their relationship to riparian functions and ecological process.

The effectiveness of delineating an accurate RCA provides decision-makers with the information necessary for sound decisions regarding management activities within a watershed. With an understanding of the riparian functions and ecological processes of a system, and the means by which actions may affect them, decision makers are provided an opportunity to design activities to maintain or restore listed fish species, their habitats, and other SWRA resources.

Flood-Prone Width For Use In Identifying RCAs

Rosgen (1996) identifies an acceptable field methodology for determining the flood-prone area width. To measure the width of the flood-prone area, select the elevation that corresponds to twice the maximum bankfull channel depth as determined by the vertical distance between bankfull stage and the thalweg of a riffle. The flood-prone area generally includes the active floodplain and the low terrace (Rosgen 1996). This area can assist to varying degrees in the protection for: stream shading, LWD recruitment, fine organic litter, bank stabilization, sediment filtration, nutrients and other dissolved materials, riparian microclimate and productivity, wildlife habitat, and windthrow.

Flood-prone width, as defined by Rosgen (1996), will vary greatly depending on valley form and channel entrenchment. For example, flood-prone widths would be expected to be narrower in confined, entrenched streams, and wider in broad valley forms with less entrenched streams. Because site-potential tree heights will typically provide a wider RCA in confined, entrenched streams, flood-prone width will not typically be used to define RCAs in these stream types. Similarly, flood-prone width will be more likely to be used in the broad valley forms with low channel entrenchment.

Site-Potential Tree Heights For Use In Identifying RCAs

When planning and implementing vegetation management projects, distances equivalent to one or two site-potential tree heights may be used to determine RCA boundaries, provided a site visit has been completed. Current conditions and dominant potential vegetation group (PVG) for the site/project area must be verified in the field.

Once the dominant PVG has been field-verified, the site-potential tree height criteria in the following table will be used to determine RCA widths in the management units. See the glossary in this appendix for definitions of site-potential tree height, site tree, and seral tree species. For more information about forested vegetation and PVGs, refer to Appendix A of the Forest Plan.

Table B-5. Site Potential Tree Heights by Potential Vegetation Group

Potential Vegetation Group	Age	1 Site Tree Height (feet)	2 Site Tree Heights (feet)
1 - Dry Ponderosa Pine/Xeric Douglas-fir	200	110	220
2 - Warm Dry Douglas-fir/Moist Ponderosa Pine	200	120	240
3 - Cool Moist Douglas-fir	200	120	240
4 – Cool Dry Douglas-fir	200	100	200
5 – Dry Grand Fir	200	110	220
6 – Cool Moist Grand Fir	200	130	260
7 – Cool Dry Subalpine Fir	200	100	200
8 – Cool Moist Subalpine Fir	200	100	200
9 - Hydric Subalpine Fir	200	100	200
10 - Persistent Lodgepole Pine	*	80	160
11 - High Elevation Subalpine Fir	200	70	140

*In PVG 10 individual trees and stands normally do not achieve an average of 200 years. However, mature lodgepole pine site trees can achieve an average height of approximately 80 feet.

Riparian Functions And Ecological Processes: Considerations

The determination of RCA widths must consider the various riparian functions and ecological processes that exert an influence on the adjacent aquatic and terrestrial environment. Integral to the success of proper management, is an understanding of riparian functions and ecological processes, and local knowledge of the site being managed. With field data in hand, design of an appropriate RCA width can focus on conservation of appropriately functioning processes and restoration of damaged processes of concern based on the existing conditions of the site, proposed activities, and issues at hand.

Megahan and Hornbeck (2000) state that a properly designed and managed riparian area can provide a variety of amenities, while protecting riparian functions and ecological processes and diversity of species composition. They further state that a properly designed and managed riparian area includes careful management of forests both within, and outside of the riparian area.

Spence et al. (1996) and Quigley and Arbelbide (1997) identify several important considerations when appropriately delineating and designing management activities within or affecting RCAs. These are as follows:

a) A stream requires predictable and near-natural energy and nutrient inputs.
b) Many plant and animal communities rely on streamside or wetland forests and vegetation for migratory or dispersion habitat.
c) Small streams are generally more affected by hillslope activities than are larger streams.
d) As adjacent slopes become steeper, the likelihood of disturbance resulting in discernable instream effects increases.
e) Riparian vegetation 1) provides shade to stream channels; 2) contributes large woody debris; 3) adds small organic matter; 4) stabilizes stream banks; 5) controls sediment inputs from surface erosion; 6) and regulates nutrient and pollutant inputs to streams.

Taking a functional approach to delineating an RCA by looking at "zones of influence" (Spence et al. 1996) allows the qualified specialist to focus on specific riparian functions where a relationship between those functions and RCA widths are known. The 'zone of influence' approach provides the qualified specialist a means to distinguish between those riparian functions and ecological processes potentially affected by the proposed actions and those that, regardless of the RCA delineation, the proposed actions will not impair. The functions and processes that would be unaffected by the proposed action, regardless of the RCA delineation, could then be dropped from further discussion. When defining the RCA through site-specific analysis this rationale should be documented.

The riparian functions and processes that may be affected by the proposed action(s) (given the existing conditions and associated issues) should then be addressed through the RCA delineation. In general, the riparian functions and ecological processes that should be considered during delineation of RCAs through site-specific analysis include (taken primarily from Spence et al. 1996):

- Stream Shading
- Large Woody Debris Recruitment
- Fine Organic Litter
- Bank Stabilization
- Sediment Control
- Nutrients and Other Dissolved Materials
- Riparian Microclimate and Productivity
- Wildlife Habitat
- Windthrow
- Importance of Small Streams
- Importance of Hillslope Steepness

The following are brief discussions on some of the riparian functions and ecological processes that are intended to assist the practitioner in a thorough analysis.

Stream Shading (excerpted from Spence et al. 1996)
The ability of riparian forests to provide shade to stream channels is a function of numerous site-specific factors including vegetation composition, stand height, stand density, latitude (which determines solar angle), topography, stream width, and orientation of the stream channel. These factors influence how much incident solar radiation reaches the forest canopy and what fraction passes through to the water surface. The shading influence of an individual tree can be expressed geometrically as a function of tree height, slope, and solar angle. In natural forests, stand density and composition may moderate the shading influence of trees within this zone, with trees closer to the stream channel and understory shrubs providing the majority of stream shade.

More research on riparian influences on shading for all ecosystems east of the Cascades is needed; however, in most instances, RCA widths designed to protect other riparian functions (e.g., LWD recruitment) are likely to be adequate to protect stream shading.

Large Woody Debris Recruitment (excerpted from Spence et al. 1996)
Large wood enters stream channels by a variety of mechanisms, including toppling of dead trees, windthrow, debris avalanches, deep-seated mass soil movements, undercutting of streambanks, and redistribution from upstream. In some systems, wood delivered from upslope areas (via land-sliding) or upstream reaches (via floods or debris torrents) may constitute a significant fraction of the total wood present in a stream reach. When evaluating RCAs, consideration should be given to potential recruitment of wood from upslope areas and non-fish-bearing channel in addition to wood delivered by toppling, windthrow, and bank undercutting.

The potential for a tree or portions of a tree to enter the stream channel by toppling, windthrow, or undercutting is primarily a function of slope distance from the stream channel in relation to tree height and slope angle. Consequently, the zone of influence for large wood recruitment is defined by the particular stand characteristics rather than an absolute distance from the stream channel or floodplain. Other factors, including slope and prevailing wind direction, may influence the proportion of trees that fall in the direction of the stream channel.

Fine Organic Litter (excerpted from Spence et al. 1996)
Smaller pieces of organic litter (leaves, needles, branches, tree tops, and other wood) enter the stream primarily by direct leaf or debris fall, although organic material may also enter the stream channel by overland flow of water, mass soil movements, or shifting of stream channels in unconstrained reaches. Little research has been done relating litter contributions to streams as a function of distance from the stream channel; however, it is assumed that most fine organic litter originates within 30 meters, or 0.5 potential tree heights from the channel.

Bank Stabilization (excerpted from Spence et al. 1996)
Roots of riparian vegetation help to bind soil particles together, making streambanks less susceptible to erosion. In addition, riparian vegetation provides hydraulic roughness elements that dissipate stream energy during high or overbank flows, further reducing bank erosion. In most instances, vegetation immediately adjacent to the stream channel is most important in maintaining bank integrity; however, in wide valleys with shifting stream channels, vegetation throughout the floodplain may be important over longer time periods. Although data quantifying the effective zone of influence relative to root strength is scarce, most of the stabilizing influence of riparian root structure is probably provided by trees within 0.5 potential tree heights of the stream channel. Consequently, delineating RCA widths to provide for other riparian functions (e.g., LWD recruitment, shading) are likely to maintain bank stability. In addition, consideration should be given to the composition of riparian species within the area of influence because of differences in the root morphology of conifers, deciduous trees, and shrubs. Specific relationships between root types and bank stabilization have not been documented; however, if the purpose of riparian protection is to restore natural bank characteristics, then retaining natural species composition is a reasonable target for maintaining bank stabilization function of riparian vegetation.

Sediment Control and Importance of Hillslope Steepness (excerpted from Quigley & Arbelbide 1997)
The ability of RCAs to control sediment input from surface erosion depends on several site characteristics including the presence of vegetation or organic litter, slope steepness and slope roughness, soil type, and drainage characteristics. These factors influence the ability of vegetation to trap sediments by determining the infiltration rate of water and the velocity (and hence the erosive energy) of overland flow.

The likelihood of disturbance resulting in discernible instream effects increases as adjacent slopes become steeper. Thus, greater preventive measures to avert negative effects to streams, or restore riparian function and ecological processes on steeper slopes may be required to prevent or reduce instream effects. The designation of RCA widths can easily incorporate the major topographic driver of surface erosion and slope steepness.

Prior research on a variety of wildland and agricultural settings has demonstrated that surface erosion increases with increasing slope steepness, although the increase is not linear. The effect of slope has generally been modeled empirically, and has taken the shape of a power function where the exponent is less than 1, so that slope effects are large for gentle slopes and decline, as slopes get steeper. Megahan and Ketcheson (1996) found that sediment travel distances from road cross drains in the Idaho Batholith are proportional to slope gradient (in percent) raised to the 0.5 power.

Megahan and Ketcheson (1996) and Ketcheson and Megahan (1996) present equations for estimating sediment travel distance below road fills (non-channelized flow) and cross drains (channelized flow) that incorporate sediment volume, obstructions, slope angle, and source area as significant explanatory variables. Slope is a significant predictor of distance, and it is not unreasonable to adjust an RCA width to slope when lacking other intensive site-variable information. At slopes greater than 50 percent, other screening tools that incorporate landslide prone hazards are needed (refer to the Guidelines for Management on Landslide and Landslide Prone Areas in this Appendix).

The strongest single variable affecting sediment travel distance from soil disturbing activities is the volume of material displaced, or delivered to a point on a slope from a culvert, drain, etc. Over 78 percent of the variance in sediment travel distance is explained by volume in the culvert model (channelized flow) of Megahan and Ketcheson (1996).

They suggest that, except on steep slopes, RCAs be designed to protect other riparian functions will generally control sediments to the degree that they can be controlled by riparian vegetation. It is essential, however, that riparian protection be complemented with practices for minimizing sediment contributions from outside the riparian area, particularly those from roads and associated drainage structures, where large quantities of sediment are often produced. In addition, activities within the RCAs that disturb or compact soils, destroy organic litter, remove large down wood, or otherwise reduce the effectiveness of RCAs as sediment filters should be avoided.

Nutrients and Other Dissolved Materials (excerpted from Spence et al. 1996)
Riparian vegetation takes up nutrients and other dissolved materials as they are transported through the riparian zone by surface or near-surface water movement. However, the relationship between RCA width and filtering capacity is less well understood than other riparian functions and ecological processes. Those studies that have been published indicate substantial variability in the effectiveness of RCAs in controlling nutrient inputs. Identifying an appropriate RCA width that can function as a filter for nutrients and other dissolved materials depends on the specific type and intensity of land use, type of vegetation, quantity of organic litter, infiltration rate of soils, slopes, and other site-specific characteristics.
Because of the variability observed in the effectiveness of RCAs in controlling input of nutrients and other dissolved materials, it is difficult to recommend specific criteria for this function. Spence et al. (1996) suggest that for most forestlands, RCAs designed to protect other riparian functions (e.g., LWD recruitment, shading) are probably adequate for controlling nutrient inputs to the degree that such increases can be controlled by RCAs. Exceptions may occur when fertilizer or other chemical applications result in high concentrations of nutrients in surface runoff.

RCA widths for nutrient and pollution control on rangelands should be tailored to specific site conditions, including slope, degree of soil compaction, vegetation characteristics, and intensity of land use. In many instances, RCA widths designed to protect LWD recruitment and shading may be adequate to prevent excessive nutrient or pollution concentrations. However, where land use activity is especially intense, RCAs for protecting nutrient and pollutant inputs may need to be wider than those designed to protect other riparian functions and ecological processes, particularly when land-use activities may exacerbate existing water quality problems.

Riparian Microclimate and Productivity (excerpted from Spence et al. 1996)
Changes in micro-climatic conditions within the riparian zone resulting from removal of adjacent vegetation can influence a variety of riparian functions and ecological processes that may affect the long-term integrity of riparian ecosystems. However, the relationship between RCA width and riparian

microclimate has not been documented in the literature. FEMAT (1993) and Spence et al. (1996) suggest using the generalized curves in FEMAT 1993, relating protection of microclimatic variables relative to distance from stand edges into forests.

Wildlife Habitat (excerpted from Spence et al. 1996)
The importance of riparian areas to many wildlife species is well documented. However, generic recommendations for riparian RCAs to protect wildlife are not justifiable because each species has unique habitat requirements. Some terrestrial and aquatic plant and animal communities rely on the forest and shrubs adjacent to streams and wetlands for all or parts of their life cycles. Animals such as beavers, otters, dippers, and some amphibians are obligate stream and riparian vegetation dependent organisms. Other bird and mammal species and many bat species need the RCAs at crucial life history periods or seasonally for feeding or breeding. Wildlife has a disproportionally high use of riparian areas and streamside forests compared with the overall landscape. RCAs provide habitat needs such as water; cover; food; plant community structure, composition, and diversity; increased humidity; high edge-to-area ratios; and migration routes. When identifying RCAs it is important to also consider the needs of wildlife species.

Windthrow (excerpted from Spence et al. 1996)
Trees within RCAs that are immediately adjacent to clearcuts have a greater tendency to topple during windstorms than trees in undisturbed forests. Extensive blowdown can potentially affect aquatic ecosystems in a number of ways, both positive and negative. In stream systems that lack wood because of past management practices, blowdown may immediately benefit salmonids by providing structure to the channel. Over the long term, however, blowdown of smaller trees may hinder the recruitment of large wood pieces that are key to maintaining channel stability and that provide habitats for vegetation and wildlife within the riparian zone. In addition, soil exposed at the root wads of fallen trees may be transported to the stream channel, increasing sedimentation. Other riparian functions, including shading, bank stabilization, and maintenance of riparian microclimates may also be affected.

Importance of Small Streams
Small streams are more affected by hillslope activities than are larger streams because there are more smaller than larger streams within watersheds (actual area and extent); smaller channels respond more quickly to changes in hydrologic and sediment regimes; and streamside vegetation is a more dominant factor in terms of woody debris inputs and leaf litter and shading. Small perennial and intermittent non-fish-bearing streams are especially important in routing water, sediment, and nutrients to downstream fish habitats.

Channelized flow from intermittent and small streams into fish-bearing streams is a primary source of sediment in mountainous regions. In steep, highly dissected areas, intermittent streams can move large amounts of sediment hundreds of meters, through RCAs, and into fish-bearing streams. In-channel sediment flows are limited primarily by the amount and frequency of flow and by the storage capacity of the channel. Flows in forested, intermittent streams are generally insufficient to move the average-sized wood piece, allowing large wood to accumulate in small channels. These accumulations increase the channel storage capacity and reduce the likelihood of normal flows moving sediment downstream.

Additional Considerations
The publication *Riparian Reserve Evaluation Techniques and Synthesis* (USDA Forest Service 1997) provides an optional toolbox of analysis methods and techniques that addresses the physical and biological elements that are necessary to delineate appropriate widths and appropriate and inappropriate management activities within or that may effect riparian functions and ecological processes. Additional literary references to consider when delineating RCAs are the following:

1) Quigley and Arbelbide (1997) An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Volume III (PNW-GTR-405, 1997); An Ecosystem Approach to Salmonid Conservation (NMFS TR-4501-96-6057, 1996);

2) Naiman et al. (2000) Riparian Ecology and Management in the Pacific Coastal Rain Forest Bioscience November 2000 Vol. 50 No. 11, pages 996-1011

3) Megahan and Hornbeck (2000) Lessons Learned in Watershed Management: A Retrospective View USDA Forest Service Proceedings Rocky Mountain Research Station – P – 13. 2000

4) Spence et al. (1996) An Ecosystem Approach to Salmonid Conservation December 1996 TR-4501-96-6057

5) USDA Forest Service (1997) Riparian Reserve Evaluation Techniques and Synthesis, Supplement to Section II of Ecosystem Analysis at the Watershed Scale: Federal Guide For Watershed Analysis. Version 2.2.

IMPLEMENTATION GUIDE FOR IDENTIFYING AND MANAGING LANDSLIDE AND LANDSLIDE PRONE AREAS

Introduction

This implementation guide describes the basis for Forest-wide landslide-prone (LSP) area management direction and provides a multi-scale step down approach to implementing management actions on LSP areas.

This implementation guide describes the basis for Forest-wide LSP area management direction and provides information for how to implement management actions on LSP areas.

Landslides are a part of a watershed's natural disturbance regime and contribute to proper watershed function and development of aquatic habitat by providing coarse sediment and LWD. The potential for accelerating landslides above some natural level should be minimized (Frissel et al. 1996). This can be accomplished in three ways: (1) Delineating LSP areas with both coarse and fine filters; (2) Developing Forest-wide management direction to properly manage these sensitive areas; and (3) Mitigating management practices based on the relative landslide hazard and associated risk(s).

Identification and development of Forest-wide management direction for LSP areas is a relatively recent requirement for implementing land management actions on the Forest. Development of the Forest-wide management direction incorporated the intent of reducing the threats associated with management actions that might initiate landslides. This Forest-wide direction is similar to the direction identified in recent documents including: Pacfish EA (USDA FS and USDI BLM 1994); INFISH EA (USDA Forest Service 1995); Steelhead Biological Opinion (US Dept of Commerce NMFS 1998); and Bull Trout Biological Opinion (USDI FWS 1998). Chapter III in this Forest Plan has goals, objectives, standards, and guidelines related to identification and management of landslide and LSP areas.

Background

The process for determining LSP areas needs to be consistent, based on the most recent science and literature, applicable from mid-scale to the site or project level, at both broad scale and fine scale, and reproducible over large geographic areas. The use of a physically based model to provide a practical alternative to using riparian buffers for the purpose of protecting potentially unstable ground was identified by Tang and Montgomery (1995). The process needed to be based in a GIS environment in order to be reproducible over large geographic areas. Ground slope and contributing drainage area obtained from Digital Elevation Model (DEM) in the GIS would also be important. Personnel at the Rocky Mountain Research Station (RMRS) in Boise, Idaho recommended several computer models (some of which are GIS based) for determining land slope stability. These models included: LISA, SHALSTAB, and SINMAP. The SINMAP (Stability INdex MAPping) model was found to be to best meet the needs identified above after testing with assistance from Boise State University, Utah State University, and RMRS personnel (Dixon et al. 1999). SINMAP is a terrain stability mapping tool that has application in areas that experience shallow translational landsliding, the dominate type of landslide found within the Forest (Megahan et al.1978, Clayton 1983, Dixon 2001).

SINMAP Model

LSP maps/coverages were developed using the SINMAP model (Pack et al. 1997) and a relatively large database of actual landslides to assist in the calibration of the model. The SINMAP model has accurately delineated the pattern of landsliding in British Columbia (Pack et al. 1997) and meets the intent of the 1998 Steelhead BO that states, "To define landslide prone areas, utilize methods described by Prellwitz et al. (1994), or use at least an equivalent peer reviewed methodology with at least a 90 percent probability of identifying landslide prone slopes." SINMAP is also mentioned as a tool for analyzing shallow landsliding potential in the recent publication, *Roads Analysis: Informing Decisions About Managing The National Forest Transportation System* (USDA Forest Service 1999).

SINMAP is an Arc View extension that implements the computation and mapping of a slope stability index based upon geographic information, primarily digital elevation data. SINMAP has its theoretical basis in the infinite plane slope stability model with wetness obtained from a topographically based steady state model of hydrology. The SINMAP model uses landslide initiation points (identified in the field or through aerial photos) in GIS and three input parameters (T/R; C'; and Phi) to calibrate the model. The term T/R is the ratio of transmissivity to the effective recharge rate of the storm being modeled. T/R may be abstractly thought of as the slope distance required for soil saturation on a straight slope. The term C' is dimensionless cohesion of soil. The term is a combination of root and soil cohesion divided by soil depth. The term Phi is the internal angle of friction of the soil. The SINMAP model uses uniform probability distributions of the input parameters using a lower and upper limit. This approach reflects the uncertainty associated with estimating parameters in terrain stability mapping (Prellwitz et al 1994, Dixon et al. 1999).

DEM methods are used to obtain slope and catchment areas for each individual pixel mapped. Input parameters are allowed to be uncertain following uniform distributions between specified limits. Input parameters are adjusted and calibrated for geographic "calibration regions" based upon landform, soil, vegetation, climatic, and/or geologic data. The calibration involves an interactive visual calibration that adjusts parameters while referring to observed landslides (mapped in GIS). The calibration involves adjustment of parameters so that the stability map "captures" a high proportion of observed landslides in regions with low stability index, while minimizing the extent of the low stability regions. The SINMAP modeling produces a stability index for each pixel of the DEM analyzed. The pixels are then grouped into four relative hazard classes (stable, low, moderate, and high) based on their calculated stability index.

Step-Down Implementation Process

This guide is not intended to be a decision-making process but will assist in informing land managers in making decisions related to management of LSP areas and potential hazards and risks to other resources. It is to be used in conjunction with the Forest-wide management direction associated with landslide and LSP areas (see Chapter III of the revised Forest Plan). A step-down process for using information at multiple scales to aid in decision-making will be implemented using a coarse filter and fine filter approach to ensure that decisions on management actions will be informed.

The coarse-filter programmatic LSP hazard coverage can be used qualitatively to make relative comparisons between areas, and to identify those that should be targeted for additional fine-filter verification associated with proposed management actions. The SINMAP model and the associated Forest-wide programmatic coarse-scale LSP maps (as well as other appropriate methodologies) are to be used by investigators who have some knowledge and experience concerning landslide behavior and geotechnical properties of soils. The model requires professional judgment and common sense (in the field and office), both in developing input coefficients and interpreting the results. It does not give a unique “right” answer. This is a tool to help understand slope stability processes; to quantify/qualify observations and judgments; and to document and communicate those observations and judgments to land managers. The computer modeling should be used to focus on specific areas of concern for on-the-ground field verification of LSP areas.

SINMAP or other appropriate methodologies do not provide a complete risk analysis; the risk or consequence of potential failures needs to be evaluated by the user. The user may want to assess the potential damage to aquatic habitat and soil productivity, or to roads and structures, or the potential for injury or loss of life resulting from landslides. As an example, two slopes may have the same estimated LSP hazard. However, if an anadromous spawning area or bridge lies below one of the slopes and not the other, the risks associated with the failure of the first slope are much greater than are those associated with the other slope. This guidebook is not intended to serve as a comprehensive risk analysis tool.

Coarse Filter Process and Intended Use

The LSP coarse filter has been completed and the results are in the form of a Forest-wide GIS coverage that has rated each 30-meter topographic cell a relative LSP hazard rating (stable, low, moderate and high) (Dixon et al. 1999). This coarse-filter modeling effort results in a relatively conservative estimate and identifies where additional field verification (fine filter) is warranted for proposed management actions.

This coarse-filter process utilized numerous landslide initiation points and a stratification of the Forest’s land base (approximately 2-3 million acres) using groupings of landtype associations. The relatively rich landslide inventory database on the Forest, combined with 15 groupings of landtype associations to assist in the calibration of the SINMAP model, enabled a relatively accurate identification of LSP areas for the coarse filter.

Additional landslide hazard modeling at finer scales (project or watershed areas) allows for more detailed analysis based on site-specific parameters. Locally based landslide inventories are important for developing site-specific parameters for modeling, as well as criteria for field verification of LSP areas.

Accurate landslide locations in GIS greatly assist in the calibration of the SINMAP model. Inventoried landslide data gathered on the ground--such as ground slope, soil depth, soil texture, vegetation, slope shape, slope position, and contributing area--provide valuable information for both modeling and field verification of LSP areas. The accuracy in identification of LSP areas and their relative hazards will increase as more data is available through fine-filter analysis. When considering the percentage of land area involved in landslides, we must realize that LSP areas may actually occur on a relatively small portion of the landscape. Published landslide inventories indicate values on the order of 0.5 to 15 percent of the area inventoried (Ice 1985). As more fine-filter data (field verification and data from landslide inventories) become available, the certainty in identifying LSP areas should increase.

The following Forest-wide management direction based on the coarse and fine filters applies to both Forest-wide and project-level analysis:

> *SWRA Standard 12* - Site-specific analysis or field verification of broad-scale landslide-prone models shall be conducted in representative areas that are identified as landslide prone during site/project-scale analysis involving proposed management actions that may alter soil-hydrologic processes. Based on the analysis findings, design management actions to avoid the potential for triggering landslides. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas"* located in Appendix B to help determine compliance with this standard.
>
> *SWRA Guideline 3* - Where proposed management actions may alter soil-hydrologic processes, representative sample of landslides and landslide-prone areas should be field-verified to identify and interpret controlling and contributing factors of slope stability. Integrate the resulting information with supporting data to provide a final stability assessment and identification of appropriate land management actions in landslide and landslide-prone areas. Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.
>
> *SWRA Guideline 4* - General Field Verification Procedures for Landslide and Landslide-Prone Areas: Six major groups of known characteristics should be investigated to supply information adequate to characterize unstable conditions. These are:
> - Landform
> - Overburden
> - Geological Processes on the Hillslope
> - Bedrock Lithology and Structure
> - Hydrology
> - Vegetation
>
> Refer to the *Implementation Guide for Management on Landslide and Landslide Prone Areas*, located in Appendix B.

Fine-Filter Process and Intended Use

Verification through a combination of field work, aerial photograph analysis, and further SINMAP modeling, will reclassify the relative slope stability hazard rating for a given area. This reclassification increases the accuracy/probability of identifying LSP hazards and assists in the development of management practices appropriate for the site, thereby greatly reducing the threats of negative effects to other resources.

The fine-filter process is intended for field verification and reclassification of the coarse filter LSP area coverage. Field evaluation of slope stability is warranted along road corridors, for timber sale areas and associated harvest units, and other site-specific management actions with the likelihood of modifying landslide processes. Proper management of LSP areas is not based solely on the effects to fish habitat but also effects to long-term soil productivity, water quality, and watershed function, and identifying risks to life and property.

Measures for Avoidance and Prevention of Landslides on LSP Areas

Measures for avoidance and prevention of landslides associated with management actions on LSP areas are improved through fine-filter verification. Recognition and avoidance of high-risk LSP areas are the most effective and cost-efficient methods in implementing management actions. On extreme slopes, abandonment of the area may be the best environmental and economic solution. In most instances within the Forest, the LSP portion of a slope covers only a small area. Megahan et al. (1978) found that, of more than 1,400 landslides inventoried, 90 percent occurred in drainages of four hectares (about 10 acres) or less. Careful field verification can locate the LSP areas. Often they may be easily avoided during road location or deleted from the timber harvest units. Slight changes in the road location or changes in road grade are often adequate to bypass the LSP area. Chapters 3 and 4 of the publication, *A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest* (Chatwin et al. 1994) provide good assistance in both field-identifying landslide prone areas and developing site-specific management practices and mitigation on LSP areas.

In order to avoid or prevent landslides, it is important to understand what disturbances (management-related or natural) have a greater potential to initiate landslides. Road construction is the main destabilizing activity related to forest management actions. Megahan et al. (1978) found that 58 percent of management-related landslides were related solely to roads, while forest vegetation removal accounted for only 9 percent of landslides. Roads in combination with logging or wildfire accounted for 88 percent of all management-related landslides. Gucinski et al. (2001) identified several studies where landslide erosion from roads was one to several orders of magnitude higher than forest vegetation management.

The effects of wildfire may also greatly influence occurrence of landslides. Shaub (2001) found that, of 246 landslides inventoried in the South Fork Payette River watershed near Lowman, Idaho, occurrences of landslides within the burned area of the 1989 Lowman wildfire was 2.5 times greater than in the unburned area. None of these landslides was attributed to past or current management actions. Megahan et al. (1978) postulates that careful land use decisions, considering the amount and nature of disturbance and various site factors, can substantially reduce the occurrence of landslides and the magnitude of their effects.

Fine-filter LSP areas are more accurately identified, allowing for increased accuracy and probability of identifying LSP hazards and assisting in the development of management practices appropriate for the site. Depending on the proposed management action and the associated relative LSP rating, a variety of management practices may be developed. These practices vary based on the type and potential effect of management action and the relative landslide prone hazard in which actions will occur. In general, land managers should consider the following contributing factors when designing and implementing management actions that might initiate or contribute to landslides.

- Altering vegetation can affect landsliding potential. Large blocks of tree mortality caused by wildfire, insects and disease, or logging can decrease evapotranspiration and raise ground water tables (T/R). The increased ground water can add to the slope instability on LSP areas during storm events that may initiate landsliding.

- Rooting strength of vegetation in LSP areas is a major factor adding stability to the slopes. Altering the vegetation by management practices such as timber harvest and controlled burning has the potential to affect rooting strength (C'). Wildfires also alter vegetation (sometimes greatly with uncharacteristic wildfires), causing tree mortality and affecting rooting strength. Trees provide the greatest amount of rooting strength on forested slopes. Generally the larger trees have a more developed root system and provide more stability to the slopes. Tree species such as ponderosa pine that have a deep tap root provide deeper rooting strength and more stability than similar size species like Douglas-fir that do not have a deep tap root. Burroughs and Thomas (1977) indicates that since a relatively high percentage of mass failures (landslides) occur on areas burned over by wildfires compared with undisturbed forests, that declining root strength following death of trees is an important factor in mass failure of shallow soils on steep slopes in the Idaho Batholith.

- Soil depth influences landslide potential. Deeper soils tend to slide on less steep of a slope than shallow soils. Soil properties affect landslide potential. Rocky soils with angular rock fragments have a higher internal angle of friction than soils with only minor amounts of rock fragments. The soils with a higher internal angle of friction will be more stable than soils with low internal angle of friction on the same slope gradient. Soils with coarse angular sands have a higher internal angle of friction than soils composed of fine sands. For example, oversteepened granitic canyonlands with shallow non-cohesive soils are more susceptible to landslides than maturely dissected mountain slopes with deep loamy skeletal soils.

- The water collection area above a potential landslide prone area has a major influence on landslide potential. Areas where water tends to collect--such as the head of ephemeral draws, bowl shaped areas, and hollows--tend to have high groundwater levels during storm events (T/R) that initiate landslides. Soils at or near saturation tend to have less strength and are more prone to landslides than soils with lower groundwater levels. For example, 3 feet of soil at the head of and ephemeral draw on a 60 percent slope at or near saturation would be much more prone to landslides than 3 feet of soil on a 60 percent slope where the groundwater table is lower.

- Roads have the potential to affect landsliding in several ways. Roads alter the natural ground slope with cuts and fills. Road cuts may destabilize slopes above the cuts by removing material that provided stability to the slope above. Road fills place additional material on slopes that tends to load the slope below the road, increasing the risk of mass failures. Road drainage features such as dips and culverts tend to collect water and concentrate it on slopes below. The additional water can add instability to the slopes. Care should be taken with road drainage so that water is not collected and concentrated on LSP areas below roads.

Other risks should be considered when proposing practices on LSP areas. One major factor is what lies within the path of the landslide that it could potentially affect. Landslides that initiate in the heads of ephemeral draws often trigger channel-scouring debris torrents that can disturb a larger area within a stream channel than the landslide itself. Landslides and their associated debris torrents can and have blocked highways, damaged homes, and other facilities. Deeply scoured channels can take several decades to recover, and are persistent sediment sources due to the raw and oversteepened banks. This sediment may have a lasting effect on water quality and fisheries habitat. Existing and proposed facilities should be located in areas away from the mouths of steep-gradient streams and draws where there is potential for damaging debris torrents initiated by landsliding.

Methods for avoidance and preventing landslides may include but are not limited to:

- Standard Practices – (In Stable and Low Hazard Areas) No special restrictions on management actions are needed as long as the actions are in compliance with other Forest-wide or management area direction.

- Limited Practices – (In Moderate Hazard Areas with Low to Moderate Relative Risk) Management actions are designed with review and guidance of appropriate resource specialists. Limited practices may include but are not limited to: reducing yield or basal area removal of forested vegetation, increased rotation lengths, selective harvest with full suspension yarding, relocating existing or proposed road alignment, improving road drainage design, etc.

- Restricted Practices – (In High Hazard or Moderate Hazard Areas with High Relative Risks) Management actions are severely restricted or eliminated so as to minimize initiation of landslides and effects to other resources.

Chapter 2 in the publication, *A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest* (Chatwin et al. 1994) has a good discussion and field evaluation forms that may serve as a good reference to assist in completing fine-scale field verification.

AQUATIC CONSERVATION STRATEGY

Introduction

The Aquatic Conservation Strategy (ACS) strategy provides direction to maintain and restore characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. How these components are applied at the subwatershed and site-specific levels will affect the types and outcomes of management actions and will therefore be an overriding factor that influences potential effects for SWRA resources.

The intent of this section is to examine the eight components of the ACS and the level of protection to demonstrate how they address the threats associated with the factors of decline and provide for recovery and restoration of listed species, their habitat, and SWRA resources. For further detailed description of the eight ACS components refer to Section III.E in the Biological Assessment for the SWIE Revision.

The Forest Plans were developed to provide direction (i.e., goals, objectives, standards and guidelines) for broad classes of management activities and land and water management practices that may affect SWRA resources. Embedded within the ACS, Forest Plans provide policy guidance and requirements. The ACS is a long-term strategy to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within lands administered by this National Forest. It is a refinement and furtherance of approaches outlined in the ICBEMP Implementation Strategy and the USFWS and NMFS 1998 Biological Opinions.

The eight ACS components are identified below. Each component is discussed in detail, including its role in addressing reduction of threats associated with factors of decline and/or its role in a comprehensive recovery and restoration strategy for listed fish species and their habitats. Any of these components has the potential to influence any of the factors of decline or the recovery/restoration strategy.

1. Goals to Maintain and Restore SWRA Resources
2. Watershed Condition Indicators for SWRA Resources
3. Delineation of Riparian Conservation Areas (RCAs)
4. Objectives, Standards, and Guidelines for Management of SWRA Resources, including RCAs
5. Determination of Priority Subwatersheds within Subbasins

6. Multi-Scale Analyses of Subbasins and Subwatersheds
7. Determination of the Appropriate Type of Subwatershed Restoration and Prioritization
8. Monitoring and Adaptive Management Provisions

The ACS provides a scientific basis for protecting aquatic ecosystems; providing for a comprehensive short and long-term recovery of listed fish species; restoration of aquatic habitats and surrounding terrestrial uplands; de-listing of water quality impaired water bodies; and planning for sustainable resource management. In essence, this strategy integrates many of the goals and objectives of both the ESA and the Clean Water Act.

The eight components of the ACS are designed to work in concert to maintain and restore the productivity and resilience of watersheds and their associated aquatic systems. The following discussion reviews each of the eight ACS components and how they reduce threats and or assist in the recovery/restoration of listed fish species, their habitats, and SWRA resources.

ACS Component 1. Goals To Maintain And Restore SWRA Resources

ACS Component 1 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. The ACS goals, objectives, and management actions are integrated with the other resource and social-economic components of the ecosystem. Ecosystems are healthy and sustainable when their intertwined components and processes are functioning properly, in the context of the desires and needs of society. The ACS components and processes are woven together by the thread of succession/disturbance regimes (e.g., wildfire, landslides, floods, insects and disease) and ecological processes (e.g., flows and cycles of energy, nutrients, and water). Intact succession/disturbance regimes provide for aquatic and terrestrial habitats, intact hydrologic processes, and the continuous and predictable flow of products and land uses. These landscape considerations and their dynamics are the cornerstone of the combined Forest-wide SWRA goals.

The goals to maintain and restore SWRA resources establish a vision of management direction that reduces threats associated with the factors of decline with the expectation that this will promote the characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. Because the quality of water and fish habitat in aquatic systems is inseparably related to the integrity of upland and riparian areas within the subwatersheds, the goals encompass both aquatic and terrestrial processes and functions.

The long-term ACS and associated goals to maintain and restore SWRA resources greatly reduce threats and risks of negative effects to listed fish species, resident fish, and water quality conditions in several ways. Primarily, the goals provide the basis for management direction that will be applied to all activities that can affect SWRA and related resources, including listed fish species and their habitats. Other ways that the goals reduce threats and contribute to recovery/restoration include:

- Goals to restore and maintain SWRA resources have been coordinated and integrated with the goals of other resource areas.

- The predicted production of goods and services for key resources has been adjusted to show a more realistic potential for achieving resource goals. For example, RCAs and high landslide prone areas were removed from the suited timber base to indicate that these areas will not be used as a source of predictable timber supply.

- Forest vegetation management goals and their associated management actions (mechanical harvest, fire use and road-related activities) were analyzed using the Cumulative Watershed Effects (Menning et al. 1996) approach for each subbasin to determine their feasibility and compatibility with aquatic resources and water quality beneficial uses.

- Goals identify the destination toward which objectives move baseline conditions during the life of the planning period. There are numerous Forest-wide and Management Area riparian-related goals with associated objectives that spatially and temporally identify restoration prioritization based on the long- and short-term recovery needs of listed fish species and the de-listing of water quality impaired water bodies.

- Goals to restore and maintain SWRA resources were developed with an interdisciplinary team approach to make them understandable, consistent, and capable of being implemented. This approach will further reduce the potential for negative effects from misinterpretation in the planning and implementation of management actions.

- Goals have been developed to achieve the desired conditions described in the TEPC Species and SWRA Resources sections in Chapter III of the Forest Plan, and in the Desired Conditions Common to All Resources section. These desired conditions, in general, envision a landscape that maintains and restores productive and sustainable ecosystems, of which SWRA and TEPC resources are inextricably linked.

ACS Component 2. Watershed Condition Indicators For SWRA Resources

ACS Component 2 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats WCIs represent diagnostic indicators of the health and trend of watersheds and associated aquatic systems. The WCIs identify various biological and physical components of aquatic systems and associated terrestrial uplands that influence riparian functions and ecological processes. The WCIs are organized into eight Pathways that represent the processes or mechanisms by which management actions can potentially affect watersheds, listed fish species, native and desired non-native fish species and their habitats, and beneficial uses.

The evaluation of WCIs provides a consistent and logical line of reasoning to recognize when, where, and why adverse, beneficial, or no effects may occur to related resources. WCIs are not independent from other components of the ACS but provide a starting point to describe the current and desired conditions for uplands, riparian areas, water quality, and aquatic habitat.

Evaluation procedures consider the suite of WCIs that are likely to be affected by proposed management actions, not just effects to any individual WCI. WCIs are described in terms of how they are functioning (Functioning Appropriately, At Risk, or At Unacceptable Risk), with Functioning Appropriately representing the range of desired conditions to strive toward for each WCI. The WCIs incorporate riparian functions and ecological processes of the entire watershed.

The step-down implementation process is outlined later in this Appendix. This process will assist land managers with making informed decisions by determining the relevant WCIs that should be considered when proposed management actions may affect the habitat of listed fish species; inland native; or desired non-native fish; or water quality beneficial use status.

The Matrix of Pathways and Watershed Condition Indicators is a combined matrix based upon individual USFWS and NMFS Matrices. It assesses potential threats of management actions. The use of this matrix can greatly reduce the risk of negative effects to listed fish species, resident fish and water quality conditions by providing:

- A process to identify how management actions may potentially influence the condition and trend of SWRA resources, including native and desired non-native fish species and their habitats, and beneficial uses;
- A decision framework to assist decision makers in ensuring that management actions will not retard or prevent attainment of properly functioning SWRA desired conditions;
- A tool to assist in making ESA determinations of effects to listed fish species important to assessing ESA compliance;
- A clear and comprehensive set of terms/definitions and Forest-wide standards and guidelines to help prevent degradation of areas that currently surpass the WCIs range of desired conditions, are within the range of, and are currently below the range of WCIs;
- A benchmark by which changes to landscape conditions through management activities can be measured over time;
- Criteria against which attainment or progress toward attainment of multiple goals, standards and guidelines in Chapter III of the Forest Plans can be directly or indirectly measured;
- Criteria for different scales of evaluation, important for assessing effects of project-level management in context of multiple scales.

ACS Component 3. Riparian Conservation Areas – Delineation

ACS Component 3 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. Aquatic and riparian systems are easily affected by land management activities within RCAs and on the surrounding terrestrial uplands. RCAs contribute to maintaining the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter and woody debris to streams; (2) providing root strength for channel stability; (3) shading the stream; and (4) protecting water quality. Additional processes and functions provided by RCAs can include wildlife habitat and riparian microclimate and productivity.

Because of the importance of riparian systems on the integrity of aquatic ecosystems that support listed fish habitat, appropriate delineation of RCAs is needed. Recent discoveries about the structure and dynamics of riparian zones have extended the scope of understanding about this portion of the landscape and have important management implications for streams, riparian areas, and adjacent uplands (Spence et al. 1996, Quigley and Arbelbide 1997). The process and methodology for RCA delineation is described in detail earlier in this Appendix.

Implementation of the "Guidance for Delineation and Management of Riparian Conservation Areas" in this Appendix would substantially reduce threats associated with the design and implementation of management actions. This implementation guide provides a consistent and thorough procedure in the delineation of appropriate RCAs across the Forest. The reduction of threats is based on the following:

- The range of options that may be used to delineate an RCA allows land managers to determine the level of analysis that best suits the needs of a project based on potential effects, baseline conditions, management direction, and issues. Regardless of the option chosen, the RCA delineation provides for consideration of riparian functions and ecological processes.

- The integration of Forest-wide management direction and guidance for delineation of RCAs defines the type and levels of management actions that are suitable within or adjacent to RCAs.
- The effectiveness of delineating an appropriate RCA provides decision-makers with the information necessary for sound decisions regarding management activities within a subwatershed. An understanding of riparian functions and ecological processes, and the means by which actions may affect them, allows decision makers the opportunity to design activities to maintain or restore listed fish species, their habitats, and other SWRA resources.
- RCA delineation makes use of information obtained through multi-scale analysis (ACS Components 6 and 7) to determine the appropriate scale for assessing the different riparian functions and ecological processes that need to be addressed.
- Delineation of RCAs establishes a network of refugia that promotes the conservation of listed fish species while preserving and restoring riparian function and ecological processes;
- RCA delineation will use data collected at mid-, fine-, or project scales to ensure that site-specific riparian function and ecological processes are maintained or restored.

ACS Component 4. Objectives, Standards, And Guidelines For Management Of SWRA Resources, Including RCAs

ACS Component 4 serves to reduce threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and SWRA resources. Management direction within Chapter III in the Forest Plan includes Forest-wide direction, Management Area direction, and Management Prescription Category direction. Together this direction provides the operating sideboards for implementation of management activities designed to further the achievement of the ACS components as well as other resource goals described in the Forest Plan. Specific objectives designed to achieve Forest-wide management goals are also included in this ACS component.

The development of the long-term ACS and associated objectives, standards, and guidelines to maintain and restore SWRA resources primarily reduces threats and the risks of negative effects to listed fish species, resident fish, and water quality conditions by providing protection necessary to conserve listed fish species and water quality, and direction to maintain or restore priority subwatersheds. The reduction in threats and risks of negative effects is accomplished under this ACS component in a variety of ways:

- The development of the objectives, standards and guidelines to restore and maintain SWRA and other related resources was coordinated and integrated with direction for other resource areas to ensure compatibility and consistency in implementation.
- Forest vegetation management direction and associated management actions (mechanical harvest, fire use and road-related activities) were analyzed using a Cumulative Watershed Effects methodology (adapted from Menning et al. 1996) for each subbasin to determine feasibility and compatibility with the values of aquatic resources and water quality beneficial uses.

- Objectives have been designed that will achieve goals both spatially and temporally, address resource concerns and needs, and move existing conditions toward desired conditions over the life of the planning period.

- The development of objectives, standards, and guidelines to restore and maintain SWRA resources was done through coordination between a Level 1 consultation team and an interdisciplinary team to make them clearly understood, and ensure direction could be implemented when integrated with other resource objectives. This integration reduces the likelihood of delays in movement toward achieving goals due to incompatible direction.

ACS Component 5. Priority Subwatersheds Within Subbasins

Note: The results of ACS Component 5 are a result of the multi-scale PFC assessment and analysis in ACS component 6 and its fine-tuning in ACS Component 7. Therefore, it is important to review all three ACS components (5, 6, and 7) to gain a complete understanding of the effects of these components.

ACS Component 5 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and SWRA resources. Priority subwatersheds have been identified that provide a pattern of protection and restoration across the Forest for the recovery of threatened and endangered fish species, the de-listing of water quality impaired water bodies, and the restoration and maintenance of SWRA resources. The identification and management of these priority subwatersheds are designed to complement other recovery/restoration plans and build on actions already taking place to recover these species and de-list impaired water bodies.

The process used to identify ACS priority subwatersheds for the ACS is described in Section III(E)(6) of the Biological Assessment for the SWIE Revision. ACS priority subwatersheds have the highest priority for restoration, monitoring, and future multi-scale analysis. In addition, each ACS priority subwatershed is identified in its respective management area direction. The management areas have objectives for the priority and appropriate type of restoration/conservation. Additional management area standards and guidelines further reduce potential impacts associated with other resource management actions. ACS priority subwatersheds reduce threats and contribute to recovery or restoration through the following:

- Management area direction applied to ACS priority subwatersheds reduces site-specific threats to aquatic and watershed values from management actions;

- Management Area direction recognizes the ACS priority subwatersheds as meriting specific management consideration of their aquatic and watershed values during the planning and implementation of management actions.

- Specific management area objectives identify and prioritize the need for restoration or conservation;

- Forest-wide management direction requires that the Watershed and Aquatic Recovery Strategy be updated every 2 years, thus contributing to the effectiveness of the recovery plans for listed fish species and de-listing of water quality impaired water bodies.

- The ACS priority subwatershed designation increases the chance to successfully obtain funding and implement restoration by providing out-year project opportunities and a ready source of needed projects that are part of a mid-scale recovery strategy;

- ACS priority subwatersheds are identified for all subbasins regardless of whether listed fish species occur within them. This allows for appropriate conservation of all resident fisheries and de-listing of water quality impaired water bodies.

- ACS priority subwatersheds are identified for each subbasin and provide a "blue print" of short-term recovery while identifying those subwatersheds important for the long-term recovery of the listed fish species.

- The ACS provides a long-term focus for conservation and restoration of high quality strongholds of listed fish species habitat and restoration prioritization of subwatersheds required for further expansion and re-colonization of fish species to adjacent subwatersheds.

ACS Component 6. Multi-Scale PFC Assessment Of Subbasins And Subwatersheds

ACS Component 6 contributes to the comprehensive recovery and restoration strategy for listed fish species, their habitats, and other SWRA resources. The Forest completed a Properly Functioning Condition (PFC) assessment that provides a multi-scale context between each subbasin and its subwatersheds, and identifies current and potential population status, habitat condition and restoration needs, and management risks and opportunities to meet broad-scale and mid-scale objectives through subsequent site-specific management actions. This assessment assessed the current condition of the SWRA resources based on the integration of soil-hydrologic function, dynamic stream equilibrium, associated aquatic habitat, status of listed and native fish populations, and other resource conditions (vegetation hazard, road transportation system, unroaded and undesignated low road density areas, wildland urban interface areas, etc.) for the subbasins and their respective subwatersheds.

The multi-scale assessment provides a step-down implementation process that forms the basis for a much bigger picture of effects (direct, indirect, cumulative effects at a programmatic scale) on the sustainability and recovery of listed fish species and de-listing of water quality impaired water bodies. The assessment shows how an individual subwatershed contributes to recovery of a species within a subbasin. As such, the ACS presents an interim recovery strategy until formal recovery plans are issued for listed fish species.

The multi-scale assessment served as the groundwork in the development of the comprehensive ACS that was used in the development of management direction to support the goals, objectives and requirements of the ESA, CWA, and other fish and water quality statutes. The Forest Plan also requires the update of the WARS environmental baseline, the foundation for the multi-scale assessment, every two years with available data and new science findings. These updates ensure an appropriate, comprehensive, and current ACS to assist in the recovery of listed fish species and de-listing of water quality impaired water bodies.

At a subwatershed scale or site-specific project scale the potential for a management action to contribute to conditions that will positively or negatively contribute to the broader-scale goals and objectives can be completed by viewing project level effects in context to the multi-scale assessment completed in support of Forest Plan revision and other broader-scale assessments (e.g., NWPCC Subbasin Assessments, Final Basinwide Salmon Recovery Strategy, and Final Bull Trout Recovery Plans).

The Multi-scale PFC assessment provides a multi-scale context of each subbasin and its respective subwatersheds' baseline and potential status of population and habitat conditions to develop site-specific management actions to make progress towards attainment of ACS goals. This ACS component provides the appropriate scales to ACS components 5, 7, and 8, that prioritize, design, and evaluate management actions needed to move towards ACS goals and the conservation of the listed fish species, their habitats and other SWRA resources. Other ways that the multi-scale PFC assessment contributes to recovery or restoration include:

- The subbasins and associated subwatersheds on the Forest have had consistent and comprehensive multi-scale PFC analyses that have resulted in identification of priority subwatersheds, the appropriate type of approach to subwatershed restoration, and the prioritization of subwatershed restoration.

- The results of the multi-scale assessment have been incorporated into many facets of the Forest Plan such as Forest-wide objectives, standards and guides; Management Area specific objectives that recognize the importance and value of priority subwatersheds; and development of specific Management Area objectives for restoration and recovery.

- Identification of unroaded and undesignated low road density areas and their use in determining the condition of geomorphic, water quality and aquatic integrities for each subwatershed and their importance to recovery and restoration goals;

- Forest-wide management direction requires that the Watershed and Aquatic Recovery Strategy be updated every two years, which will contribute to a more effective recovery plan for survival and recovery of listed fish species and de-listing of water quality impaired water bodies.

- Multi-scale analyses are required or recommended in support of management actions as identified in the following Forest-wide management direction: Roads Analysis identified in the FSM 7700 – Transportation Analysis; FSM 2671.45 - Consultation and Conference; FSH 2509.22 - SOIL AND WATER CONSERVATION PRACTICES FSH (R-1/R-4 AMENDMENT NO. 1) PRACTICE: 11.01 - Determination of Cumulative Watershed Effects:

- Regional and Forest Program Managers can use this information and work with District Program managers to bring the larger picture (subbasin-scale layer) of restoration into consideration when planning watershed-scale and site-scale analyses and projects.

ACS Component 7. Determination Of The Appropriate Type Of Subwatershed Restoration And Prioritization

ACS Component 7 contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. Identification of both the appropriate type and prioritization of subwatershed restoration/conservation is integrated into all the ACS components. ACS Component 7 identified the appropriate restoration type and subwatershed restoration prioritization for subwatersheds within their respective subbasins.

Inherent in the classification approach of ACS Component 7 is the identification of active, passive, and conservation restoration opportunities based on the subwatershed's geomorphic integrity (GI), water quality integrity (WQI), aquatic integrity (AI), and vulnerability ratings. Together, these ratings provide the information needed to identify the capacity of the subwatershed to restore itself naturally to a desired condition. The ratings also indicate the acceptable or needed time period for restoration in order to determine the type of approach (restoration or conservation) to be used. The determination of types and priorities of restoration activities incorporated information on the entire subwatershed, including the current status and recovery needs of listed fish species.

This restoration priority rating, in conjunction with the restoration type and overall priority watershed classification, provides the focus for the long-term ACS recovery of listed fish species and TMDL watersheds. The spatial display of this restoration strategy is the WARS Map, on file in the Forest's GIS library.

Recovery and restoration activities are prioritized based on the presence and sensitivity of listed fish species, impaired water bodies, and the capacity for response of the subwatershed's ecosystem processes. This restoration prioritization approach formulates the template for recovery and restoration by:

- Consistently applying the restoration type (conservation, active, or passive) and prioritization for subwatershed restoration to all subwatersheds within their respective subbasins across the Forest,
- Providing an efficient means to promote restoration activities and recovery of listed fish species and de-listing of water quality impaired water bodies;
- Increasing the chance to successfully obtain funding and implement restoration by providing out-year project opportunities and a source of needed projects that are part of a mid-scale recovery strategy;
- Influencing the placement of MPCs within a Management Area's subwatersheds.

ACS Component 8. Monitoring And Adaptive Management Provisions

ACS Component 8 serves to reduce the threats associated with the factors of decline and contributes to the comprehensive recovery and restoration strategy for listed fish species and their habitats. One of the lessons learned from implementing the original Forest Plan is that it must be dynamic to account for a multitude of issues. The Forest monitoring plan accomplishes five items: (1) it bases the level of monitoring on the commensurate level of management actions; (2) it provides feedback on the effects of activities; (3) it has a mechanism for monitoring accountability and oversight, (4) it evaluates the implementation and effectiveness in the recovery/restoration of listed fish species, their habitats, and other SWRA resources; and (5) it incorporates the monitoring goals identified in the ICBEMP Implementation Strategy and associated MOU.

This plan has a feedback loop that provides management with the information necessary to make appropriate adjustments to individual activities and Forest-wide programs. The feedback loop allows management adjustments as needed to continue moving towards attainment of ACS goals, recovery of listed fish species, restoration of their habitats, and to assist in the delisting of water quality limited waterbodies. If monitoring concludes a specific restoration practice is ineffective or riparian conditions are not being maintained over a number of sites, changes to management practices will be implemented. Those threats that are easily recognized will be dealt with quickly. Monitoring and adaptive management would reduce threats and contribute to recovery or restoration by the following:

- In some cases, low levels of negative effects from either an individual action or aggregate effects from multiple actions may persist until monitoring can alert managers to the need to change management practices or an adjustment in forest plan direction. The adaptive management process will use monitoring results to ensure forest plan direction is effectively reducing threats to listed fish species, their habitats, and other SWRA resources. If not effective, adaptive management will adjust forest plan direction as necessary;

- Adaptive management provides the mechanism to modify management actions in response to monitoring and evaluation results, changes in laws or regulations, or new information. This includes the ability to make appropriate modifications to restoration direction, mitigation measures, budgets, and monitoring approaches;

- The monitoring program will be complementary with ongoing broad- and mid-scale monitoring programs, for example the Pacfish and Infish Interagency Implementation Team monitoring program. This will allow Forest monitoring to be included with basin-level assessments of recovery/restoration activities for listed fish species and their habitats. Monitoring will be conducted at multiple scales to ensure that management actions are consistent with the context of broad and local recovery and restoration goals and objectives;

- Effectiveness, implementation, and validation monitoring over the life of the plan will be key to determining if individually and collectively management actions have maintained or improved SWRA resources. Multiple sites, representing various ecological conditions, across the Forest will be used. A similar approach will also address changes in TEPC species distributions and abundance, and success of restoration and conservation measures in moving subwatersheds toward their desired conditions.

- Accountability and oversight provided by the monitoring plan will allow adjustments needed to ensure the appropriate rate in achieving restoration goals and objectives is being accomplished. This could include, but not be limited to, adjusting budget allocations, shifting restoration prioritizations, or changing management direction or level of activity for a given area.

Definitions Of ESA Effects Thresholds And Examples

The following are definitions of ESA effects or effects determinations, including thresholds and examples.

Adverse Effect - For Forest Plan revision, “adverse effect” is used in the context of the Endangered Species Act relative to effects on Threatened, Endangered, Proposed, and Candidate (TEPC) species. Definitions are from the *Final Endangered Species Consultation Handbook* (USDI FWS and US Dept of Commerce NMFS 1998). They include both “likely to adversely effect” and “not likely to adversely effect”. Both of these definitions are needed to clearly understand the intent of the phrase “adverse effect” when applied to Forest-wide and management area direction involving TEPC species.

The following is a definition specific to anadromous salmonids developed by NMFS, the Forest Service, and the BLM during the Pacfish consultation and is given as example: “Adverse effects include short- or long-term, direct or indirect management-related, impacts of an individual or cumulative nature such as mortality, reduced growth or other adverse physiological changes, harassment of fish, physical disturbance of redds, reduce reproductive success, delayed, or premature migration, or other adverse behavioral changes to listed anadromous salmonids at any life stage. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival and recovery of listed anadromous salmonids" (US Dept of Commerce NMFS 1995).

No Effect - This determination is appropriate only "…if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect or an effect that is unlikely to occur" (USDI FWS and US Dept of Commerce NMFS 1998). Furthermore, actions that result in a "beneficial effect" do not qualify as a "no effect" determination. If a "no effect" determination is derived, conference/consultation does not need to proceed, but it is recommended that these determinations be shared within the Level 1 consultation team. Documentation to substantiate this determination must be filed in the project record.

May Affect, Not Likely To Adversely Affect - "The appropriate conclusion when effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur" (USDI FWS and US Dept of Commerce 1998). The term "negligible" has been used in many ESA consultations in the Snake River Basin. This term is considered synonymous with "insignificant" as described above. Consultation/conference is required for this effect determination, but can proceed as informal.

May Affect, Likely To Adversely Affect - The appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action is "likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. A "likely to adversely affect" determination requires the initiation of formal Section 7 consultation.

For the purposes of Section 7, any action that has more than a negligible potential to result in "take" (see definition below) is likely to adversely affect a proposed/listed species. It is not possible for NOAA Fisheries or USFWS to concur on a "not likely to adversely affect" determination if the proposed action will cause take of the listed species. Take can be authorized in the Incidental Take Statement of a Biological Opinion after the anticipated extent and amount of take has been described, and the effects of the take are analyzed with respect to jeopardizing the species or adversely modifying critical habitat. Take, as defined in the ESA, clearly applies to individuals; thus actions that have more than a negligible potential to cause take of individual eggs and/or fish are "likely to adversely affect."

Likely To Jeopardize The Continued Existence Of - The Code of Federal regulations define jeopardy as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct [ESA §3(19)]. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR § 17.3).

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Table C-1. Federal and State Status, Forest Service, and Global Distribution of the TEPCS Plant Species for the Boise National Forest

Species Name	Common Name	Global Rank[1]	State Rank[2]	Forest Service Status[3]		Global Distrib.[4]
Botrychium lineare	slender moonwort	**C** –G1	SH	Candidate for federal listing		sd
Lepidium papilliferum	slickspot peppergrass	**C** – G2	S2	Candidate for federal listing		le
Silene spaldingii	Spalding's silene	**T** - G2	S1	Fed. listed		re
Spiranthes diluvialis	Ute ladies'-tresses	**T** - G2	S1	Fed. listed		sd
				Current	Proposed	
Allium tolmiei var. *persimile*	Tolmie's onion	G4/T3	S3	S	S	le
Allium madidum	swamp onion	G3	S3	W	W	re
Allium validum	tall swamp onion	G4	S3	W	W	re
Allotropa virgata	candystick	G4	S3	W	W	d
Astragalus atratus var. inceptus	mourning milkvetch	G4/T3	S3	N	W	le
Botrychium simplex	least moonwort/grapefern	G5	S2	N	S	w
Bryum calobryoides	Bryum moss	G3	SH	S	S	w
Carex aboriginum	Indian Valley Sedge	G1	S1	N	W	le
Carex bubaumii	Buxbaum's sedge	G5	S3	W	W	w
Carex livida	pale sedge	G5	S2	W	S	cb
Carex straminiformis	Mt. Shasta sedge	G4	S2	W	S	d
Cicuta bulbifera	bulb-bearing water hemlock	G5	S2	W	S	d
Cypripedium fasiculatum	clustered lady's-slipper	G4	S3	N	W	d
Douglasia idahoensis	Idaho douglasia	G2	S2	S	S	re
Drosera intermedia	spoon-leaved sundew	G5	S1	W	S	d
Epipactis gigantea	giant helleborine orchid	G3	S3	W	S	sd
Haplopappus insecticruris	bugleg goldenweed	G3	S3	S	S	le
Helodium blandowii	Blandow's helodium	G5	S1	W	S	cb
Lewisia kelloggii	Kellogg's bitteroot	G4	S2	W	S	re
Mimulus clivicola	bank monkeyflower	G4	S3	W	W	re
Phacelia minutissma	least phacelia	G3	S2	S	S	re
Rhynchospora alba	white beakbrush	G5	S2	W	S	cb
Sanicula graveolens	Sierra sanicle	G4	S1	N	W	w
Scheuchzeria palustris	pod grass	G5	S2	W	S	w
Sedum borschii	Borch's stonecrop	G3	S2	W	S	sd
Sphaeromeria potentilloides	cinquefoil tansy	G5	S1	N	W	le
Stylocline filaginea	stylocline	G4	S2	W	S	re

[1] **Global** - Global ranking as assigned by Natural Heritage Program and Idaho Native Plant Society. **T** = Threatened, **C** = Candidate.

[2] **State** - Idaho State ranking, Idaho Native Plant Society Rare Species list 2000.

[3] **Forest Service Status** - **S** = Region 4 Sensitive, **W** = Forest Watch plants, **N** = No current status.

[4] **Global Distribution** - **d** =disjunct, **le** = local endemic (< 100 square miles), **re** = regional endemic (distribution 100-10,000), **sd** = sparsely distributed (isolated populations), **p** = peripheral, **w** = widespread, **cb** = circumboreal, circumpolar.

Table C-2. Habit, Lifeform, Population Trend, and Habitat Grouping of the TEPCS Plant Species for the Boise National Forest

Species Name	Common Name	Habit	Lifeform	Trend[1]	Habitat Group
Botrychium lineare	Slender moonwort	Perennial	Fern	U	Forest understory, meadow
Lepidium papilliferum	slickspot peppergrass	Perennial	Herb	D	Shrubland – slick clay playas
Silene spaldingii	Spalding's silene	Perennial	Herb	D	Grassland, low elevation
Spiranthes diluvialis	Ute ladies'-tresses	Perennial	Herb	U	Aquatic/riparian
Allium tolmiei var. *persimile*	Tolmie's onion	Perennial	Herb	S	Grassland, low elevation
Allium madidum	swamp onion	Perennial	Herb	S	Riparian -vernally wet
Allium validum	tall swamp onion	Perennial	Herb	S	Riparian – meadows, wet
Astragalus atratus var. inceptus	mourning milkvetch	Perennial	Herb	D	Shrublands
Botrychium simplex	least moonwort/ grapefern	Perennial	Fern	S	Grassland, high elevation
Bryum calobryoides	Bryum moss	N/A	Moss	D	Riparian, forest
Carex aboriginum	Indian Valley Sedge	Perennial	Sedge	U	Riparian – vernally wet
Carex bubaumii	Buxbaum's sedge	Perennial	Sedge	S	Riparian - meadows
Carex livida	pale sedge	Perennial	Sedge	S	Riparian – bog, fen
Carex straminiformis	Mt. Shasta sedge	Perennial	Sedge	S	Alpine
Cicuta bulbifera	bulb-bearing water hemlock	Perennial	Herb	S	Riparian - streamside
Cypripedium fasiculatum	clustered lady's-slipper	Perennial	Herb	U	Forest - understory
Douglasia idahoensis	Idaho douglasia	Perennial	Herb	S	Subalpine, open
Drosera intermedia	spoonleaved sundew	Perennial	Herb	S	Riparian - bog fen
Epipactis gigantea	giant hellaborine orchid	Perennial	Herb	D	Riparian - streamside
Haplopappus insecticruris	bugleg goldenweed	Perennial	Herb	S	Shrubland
Helodium blandowii	Blandow's helodium	N/A	Moss	S	Riparian, forest
Lewisia kelloggii	Kellogg's bitteroot	Perennial	Herb	S	Rock - outcrops
Mimulus clivicola	bank monkeyflower	Annual	Herb	S	Forest – gap species
Phacelia minutissima	least phacelia	Annual	Herb	D	Shrubland, riparian
Rhynchospora alba	white beakbrush	Perennial	Rush	D	Riparian, bog, fen
Sanicula graveolens	Sierra sanicle	Perennial	Herb	U	Rock outcrops
Scheuchzeria palustris	pod grass	Perennial	Herb	S	Riparian, bog, fen
Sphaeromeria potentilloides	cinquefoil tansy	Perennial	Herb	U	Riparian – alkaline meadows
Sedum borschii	Borch's stonecrop	Perennial	Herb	U	Rock talus/scree
Stylocline filaginea	stylocline	Annual	Herb	U	Grassland, low elevation

[1] **Trend - D** = declining on National Forest lands, **S** = stable on National Forest Lands, **I** = increasing on National Forest lands, and **U** = unknown at this time.

Table C-3. Rare Communities, Federal and State Status, Rarity Class, Threats, Trends, and Research Natural Area Distribution for the Boise National Forest

Community Name	Global[1]	State[2]	Rarity Class[3]	Threats[4]	Trend[5]	Research Natural Area Distribution
Abies lasiocarpa/Caltha biflora	G3	S3	I	Unknown	U	Back Creek, Chilcoot Peak
Artemisia arbuscula ssp. thermopola/Festuca idahoensis	G2Q	SQS2	B	DV, GZ, MN, RD	D	
Artemisia tridentata wyomingensis/Stipa comata	G2	S2	M	AG, GZ, EX, FS	D	
Betula occidenalis/Mesic Forb	G3	S3	M	GZ, RD	D	
Cerocarpus ledifolius/ Symphoricarpos oreophilus	G2	S2	B	GZ, FI	U	
Pinus contorta/Festuca idahoensis	G3	S2	M	RD, LO	U	Back Creek
Pinus flexilis/Purshia tridentata	G1	S2	I	EX, RC	S	
Pinus ponderosa/Purshia tridentata	G3G5	S3	M	Unknown	S	Bannock Creek, Monumental Creek
Pinus ponderosa/Stipa occidentalis	G4	S1	M	Unknown	S	Raspberry Gulch
Pinus ponderosa/ Symphoricarpos oreophilus	G3	S1	I	FX	D	Bannock Creek, Raspberry Gulch;
Purshia tridentata/Agropyron spicatum	G3	S1	B	FX	U	Monumental Creek, Raspberry Gulch, Roaring River
*Salix geyeriana/*Mesic Forb	G3	S2	M	GZ	U	

[1] **Global** - Global ranking as assigned by Natural Heritage Program and Idaho Native Plant Society.

[2] **State** - Idaho State ranking, Idaho Native Plant Society Rare Species list 2000.

[3] **Rarity Class** - **I** = intrinsically rare, **M** = managed rare, **B** = both, intrinsically rare communities that are also affected by management.

[4] **Threats** - **AG** = agriculture, **DV** = development, **EX** = exotic plant species, **FI** = fire increased frequency, **FS** = Fire, stand replacing, **FX** = fire exclusion, **GZ** = livestock grazing, **LO** = logging, **MN** = mining, **RC** = recreation, **RD** = road construction.

[5] **Trend** - **D** = declining on National Forest System lands, **S** = stable on National Forest System lands, **I** = increasing on National Forest lands, and **U** = unknown at this time.

Table C-4. Plant Species of Cultural Importance for the Boise National Forest

Scientific Name	Common Name
Abies spp. Mill.	fir
Achillea millefolium L.	yarrow
Alectoria spp. Ach.	pine moss
Allium accuminatum Hook.	wild onion
Allium geyeri Wats.	wild onion
Allium spp. L.	wild onions
Alnus incana (L.) Moench	alder
Alnus sinuata (Regel) Rydb.	alder
Amalanchier alnifolia Nutt.	serviceberry
Apocynum cannabinum L.	dogbane
Arcostaphylos nevadensis Gray	manzanita
Arcostaphylos uva-ursi (L.) Spreng.	kinnikinnick
Artemisia ludivciana Nutt.	prairie sage
Artemisia tridentata Nutt.	sagebrush
Asclepias spp. L.	milkweed
Atriplex confertifolia (Torr. & Frem.) Wats.	shadscale
Balsamorhiza hookeri Nutt.	Hooker's balsamroot
Balsamorhiza sagittata (Pursh) Nutt.	arrow-leaf balsamroot
Berberis repens Lindl.	Oregon grape
Brodiaea douglassii Wats.	brodiaea
Bryoria fremontii (Tuck) Brodo & Hawksw.	tree lichen
Calocortus macrocarpus Dougl.	mariposa lily
Calocortus nutalli T. & G.	sego lily
Calocotus spp. Pursh	lilies
Camassia quamash (Pursh) Greene	camas
Chenopodium spp. L.	goosefoot, pigweed
Celtis leavigata var. reticulata Torr.	hackberry
Cercocarpus spp. H.B.K.	mountain mahogany
Claytonia lanceolata Pursh	spring beauty
Cornus stolonifera Michx.	red-osier dogwood
Chemophila umbellata (L..) Bart.	pipsissewa
Chrysothamnus nauseosus (Pall.) Britt.	rubber rabbit-brush
Cirsium scariosum Nutt.	elk thistle
Cirsium spp. Mill.	thistle
Crategus douglasii Lindl.	black hawthorn
Delphinium spp. L.	larkspur
Descurania spp. Webb & Berth.	tansy mustard
Dicenta uniflora Kell.	steer's head
Elymus cinerius Scribn. & Merr.	giant wild rye
Erythronium grandiflorum Pursh	glacier lily
Evernia vulpina (L.) Ach.	pine moss

Table C-4. Plant Species of Cultural Importance for the Boise National Forest (continued)

Scientific Name	Common Name
Fragaria vesca L.	strawberry
Fragaria virginiana Duchesne	strawberry
Fritillaria pudica (Pursh) Spreng.	yellow bell
Helianthus annuus L.	sunflower
Heracleum lanatum Michx.	cow parsnip
Huechera cylindrica Dougl.	alumroot
Iris missouriensis Nutt.	wild iris
Larix occidentalis Nutt.	western larch
Ledum glandulosum Nutt.	Labrador tea
Lewisia redivia Pursh	bitterroot
Ligusticum canbyi Coult. & Rose	lovage
Lomatium cous (Wats.) Coult. & Rose	biscuitroot
Lomatium canbyi Coult. & Rose	biscuitroot
Lomatium dissectum (Nutt.) Math. & Const.	fern-leaf desert parsley
Lomatium grayi Coult. & Rose	Gray's desert parsley
Lomatium macrocarpum (Nutt.) Coult. & Rose	large-fruited biscuitroot
Lomatium nudicaule (Pursh) Coult. & Rose	bare-stem desert parsley
Lomatium salmoniflorum (Coult. & Rose) Math. & Const.	salmon-flower desert parsley
Lomatium spp. Raf.	desert parsley, biscuitroot
Lygodesmia juncea (Pursh) D. Don	rush skeletonweed
Matricaria matricarioides (Less.) Porter	pineapple weed
Mentha arvensis L.	Canada mint
Mentzelia albicaulis Dougl.	blazing star
Mimulus guttatus DC.	yellow monkey-flower
Mushrooms	a variety of edible mushrooms
Nicotiana attenuata Torr.	wild tobacco
Nuphar variegatum Englem.	yellow pond lily
Orobanche uniflora L var. *purpurea* (Heller) Achey	broomrape
Oryzopsis hymenoides (R. & S.) Ricker	Indian rice grass
Opuntia spp. Mill.	prickly pear cactus
Penstemon wilcoxii Rydb.	Wilcox's penstemon
Perideridia bolanderi (Gray) Nels. & Macbr.	yampah
Perideridia gairdneri (H. & A.) Math.	yampah
Phragmaties australis L.	reed grass
Picea spp. A. Dietr.	spruce
Pinus albicaulis Englem.	whitebark pine

Table C-4. Plant Species of Cultural Importance for the Boise National Forest (continued)

Scientific Name	Common Name
Pinus contorta Dougl.	lodgepole pine
Pinus ponderosa Dougl.	ponderosa pine
Poa sandbergii Vasey	Sandberg's bluegrass
Populus tremuloides Michx.	quaking aspen
Populus trichocarpa T. & G.	cottonwood
Prunus virginiana L.	chokecherry
Rhamnus purchiana DC.	cascara
Rhus glabra L.	smooth sumac
Ribes aureum Pursh	golden currant
Ribes lacustre (Pers.) Poir.	swamp gooseberry
Ribes viscossisimum Pursh	sticky currant
Rosa gynocarpa Nutt.	wild rose
Rosa spp. L.	wild rose
Rubus ideaus L.	raspberry
Rubus spp. L.	bramble, blackberry
Rumex crispus L.	curly-leaved dock
Salix spp. L.	willow
Sambucus cerulea Raf.	blue elderberry
Sambucus racemosa L.	red elderberry
Sarcobatus vermiculatus (Hook.) Torr.	black greasewood
Scirpus spp. L.	bulrush
Sheperdia canadensis (L.) Nutt.	russet buffaloberry
Smilacina stellata (L.) Desf.	false Solomon's seal
Symphoricarpos albus (L.) Blake	snowberry
Typha latifolia L.	cattail
Urtica dioica L.	stinging nettle
Vaccinium caespitosum Michx.	dwarf huckleberry
Vaccinium globure Rydb.	blue huckleberry
Vaccinium membranaceum Dougl.	mountain bilberry
Vaccinium scoparium Leiberg	grouse whortleberry
Valeriana edulis Nutt.	tobacco root
Veratrum viride Ait.	false helleborine
Wyethia amplexicaulis Nutt.	mule's ears
Zigadenus spp. Michx.	death camas

INTRODUCTION

The Wild and Scenic Rivers Act (Public Law 90-542; 16 U.S.C 1271-1287) was enacted by Congress to address the need for a national system of river protection on October 2, 1968. As an outgrowth of a national conservation agenda in the 1950s and 1960s, the Wild and Scenic Rivers Act (Act) was in response to the dams, diversions, and water resource development projects that occurred on America's rivers between the 1930s and 1960s. The Act concluded that selected rivers should be preserved in a free-flowing condition and be protected for the benefit and enjoyment of present and future generations. Since 1968, the Act has been amended many times, primarily to designate additional rivers and authorize the study of other rivers for possible inclusion.

As of September 2002, some 160 river segments comprising 11,292 miles have been protected in the National Wild and Scenic Rivers System (National System). These nationally recognized rivers comprise a valuable network of natural and cultural resources, scenic beauty, and recreational opportunities. The focus of this appendix is on the study initiated by the Forest and the rivers identified as eligible for Wild and Scenic River designation.

INTENT OF THE WILD AND SCENIC RIVERS ACT

The Wild and Scenic Rivers Act seeks to protect and enhance a river's natural and cultural values and provide for public use consistent with its free flowing character, water quality, and outstandingly remarkable values. Designation affords certain legal protection from development. For instance, no new dams can be constructed, nor are federally assisted water resource development projects permitted that might negatively affect the designated river values. Where private lands are involved, the federal managing agency works with local governments and owners to develop protective measures.

There are two ways rivers are designated into the National System: 1) by Act of Congress, or 2) by the Secretary of Interior if the river has first been designated into a valid state river protective system by state law and the appropriate Governor has applied for a Wild and Scenic River designation. To be eligible for designation, a river must be free flowing and contain at least one outstandingly remarkable value that can be scenic, recreational, geological, fish, wildlife, historic, cultural, botanical, hydrological, paleontological, or scientific.

There are two ways rivers can be identified for study as potential additions to the National System; by Act of Congress under Section 5(a) or through an agency-initiated study under Section 5(d)(1) of the Act which requires that "in all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential wild, scenic, and recreational areas."

Through Section 5(d)(1) the Forest Service is required to assess rivers under its management jurisdiction and determine whether these rivers are eligible by applying standardized criteria through a documented evaluation process. River areas that are found to be eligible are then classified as wild, scenic, or recreational, based on the development of shoreline, watercourse, and access. Proposed boundaries and/or river areas and protective management requirements are developed at the time of eligibility determination. For river segments on federal lands determined to be eligible under Section 5(d)(1) of the Act, direction to protect the river as a potential addition to the National System is in effect until such a time as a "suitability" evaluation and subsequent decision is made. A Wild and Scenic River suitability analysis involves determining the best use of the eligible river and the best method to protect the ORV within the river corridor. Rivers subsequently determined suitable will continue to be protected as potential additions to the National System.

Protective management of federal lands in the river area begins at the time the river segment is found eligible. Specific management prescriptions for eligible river segments provide protection, pending a suitability determination, in the following ways:

- **Free-flowing values.** The free-flowing characteristics of eligible river segments cannot be modified to allow stream impoundments, diversions, channelization, and/or rip-rapping to the extent authorized under law.

- **River-related values.** Each segment is managed to protect outstandingly remarkable values (subject to valid existing rights) and, to the extent practicable, such values are enhanced.

- **Classification impacts.** Management and development of the eligible river and its corridor cannot be modified, subject to valid existing rights, to the degree that its eligibility or classification would be affected.

REVIEW OF ELIGIBILITY METHODOLOGY

1990 Boise National Forest Land and Resource Management Plan

A Wild and Scenic River Eligibility Study was completed as part of the 1990 Boise National Forest Land and Resource Management Plan (USDA Forest Service 1990). The Forest used the National Rivers Inventory, the Pacific Northwest River Study, the Statewide Water Plan, and public comments as sources of possible eligible rivers. Of the rivers evaluated 32 rivers segments were found to be free flowing and have at least one outstandingly remarkable value.

2000 Boise Forest Draft Land and Resource Management Plan

In 1997, the Forest Supervisor approved the need for a Wild and Scenic River eligibility study based on new information and changed conditions. In May 1997, the Southwest Idaho Ecogroup Wild and Scenic River Assessment Team was formed to develop alternative strategies for the completion of Wild and Scenic River eligibility and suitability studies and interim management direction. This effort was designed to provide a basis for the Wild and Scenic Rivers analysis in the Forest Plan Revision process or in amendments to the Forest Plan

In the fall of 1997, the Ecogroup established an interdisciplinary process to review over 600 streams on the Forest for potential Wild and Scenic River eligibility. The process incorporated the Interagency Wild and Scenic River Reference Guide; FSH 1909.12, Chapter 8, "Wild and Scenic River Evaluation"; the Region 4 Desk Guide – Bridge to Revision (USDA Forest Service 1993); the Washington Office Wild and Scenic River Protocol; and the Intermountain Region Wild and Scenic River Protocol. For the review, a corridor of approximately one-quarter mile on either side of the river was used when evaluating eligibility.

The Wild and Scenic River Act states that, in order to be found eligible, a river segment must be free-flowing and contain at least one outstandingly remarkable value (ORV). The Forest determined rivers eligible for inclusion into the Wild and Scenic River System through a process of elimination. That is, if a river did not have a potential ORV in at least one resource, it was not evaluated further. The steps used for this inventory are as follows:

- Determine and document potential ORVs;
- Determine and document ORVs and free-flowing status;
- Determine and document drainage segmentation; and
- Determine and document river classification(s).

Criteria For Inclusion In The Eligibility Inventory

The Wild and Scenic Rivers Eligibility study inventoried the following rivers, within the Forest's administrative boundaries:

- All perennial rivers represented in the Geographic Information System's (GIS) 1:100,000 scale USGS rivers layer (also known as the "major rivers" layer). These rivers were evaluated first for potential outstandingly remarkable values.
- All rivers included in the Pacific Northwest Rivers Study, or the Norwest Power Planning Council Protected Rivers list. These rivers were also first evaluated for potential outstandingly remarkable values.
- All rivers included in the Nationwide Rivers Inventory, or the State of Idaho Comprehensive Water Plan.
- All rivers currently eligible for inclusion into the Wild and Scenic Rivers System. These rivers were updated during the eligibility process for new information and changed conditions since the previous inventory.
- Any rivers identified as part of the public involvement process.

Three major elements contributed to whether a river was found eligible for further study:

1. **Are there any outstandingly remarkable values present within the river corridor?**
   In order for a river to become eligible for further study as a possible wild, scenic, or recreational river, it must have one or more outstandingly remarkable resource values present on the National Forest System lands. The outstandingly remarkable values fall into categories that are defined in Section 1(b) of the Act as "scenic, recreational, geologic, fish, wildlife, historic, cultural, or other similar values." "Other similar values" include, but are not limited to, hydrologic, ecological/biological diversity, paleontological, botanical, and scientific study opportunities. A defined Region of Comparison was used as context to assess the uniqueness or rarity of the outstandingly remarkable values.

2. **Is the drainage considered a river consistent with the river definition?**
   Using the definition of a river as "a flowing body of water or estuary or a section, portion or tributary thereof, including rivers, streams, creeks, runs, kills, rills, and small lakes," all creeks and rivers on the major river GIS coverage were considered in this evaluation.

3. **Is the river free flowing?**
   In order for a river to become eligible for further study, it must be free flowing. To be considered free flowing, the river must be free of impoundments or diversions.

A public involvement process was initiated to provide the public an opportunity to nominate streams or stream segments on the Forest for potential eligibility. An information packet explaining the evaluation process and a "Frequently Asked Questions" fact sheet were mailed to more than 1,000 individuals or groups. This information was also posted on the Southwest Idaho Ecogroup Forest Plan Revision Project's web page.

An interdisciplinary team from each Ranger District reviewed all the streams on the 1:100,000 major river GIS coverage in order to determine if there were rivers with "potential" outstandingly remarkable values. Each stream was evaluated to first broadly screen for potential outstandingly remarkable values using a generalized set of criteria. Streams that were not identified as having one or more potential outstandingly remarkable value were dropped at that time from further consideration for eligibility.

Draft Land And Resource Management Plan Findings

With an initial inventory of 889 individual rivers considered for eligibility, a first screen using broad criteria and a second, more detailed assessment, using specific criteria for determining the presence of outstandingly remarkable values were applied and resulted in 45 streams identified with potential ORVs. These 45 streams were segmented according to the established criteria to determine tentative classification, and they were presented in the Draft Land and Resource Management Plan (USDA Forest Service 2000).

These streams were listed and identified in the Draft Land Management Plan and Draft Environmental Impact Statement (USDA Forest Service 2000) as potentially eligible for inclusion in the Rivers System. The streams were considered “potentially” eligible because: 1) the identified rivers had not been reviewed and commented on by the public, and 2) further analysis was needed to ensure the ORV criteria had been applied consistently.

Changes from the Draft to Final Land and Resource Management Plan

The Forest received comments on the “potentially” eligible rivers presented in the Draft Land and Resource Management Plan during the public comment period following the release of the documents. Comments urged the Forest to reconsider the Region of Comparison as it appeared to be too narrow in scope or applied inconsistently. The Forest also received comments supporting the eligibility of the draft list or suggesting that none of the rivers were eligible and the study should be discontinued. To address these comments a three Forest interdisciplinary team re-evaluated the Regions of Comparison and the ORV criteria to ensure they were national in scope, as mandated by the Wild and Scenic Rivers Act, and that the criteria had been applied consistently by resource specialists throughout the Ecogroup. During this re-evaluation some changes were made to the Regions of Comparison and outstandingly remarkable values criteria. This re-evaluation also determined that the criteria used to assess ORV’s had been inconsistently applied. The following summary describes the changed criteria used to determine ORV’s and its associated region of comparison. Please refer to the Southwest Idaho Ecogroup Wild and Scenic River Eligibility Inventory User’s Guide (USDA Forest Service 2001) for a full discussion of criteria components.

Scenic Outstandingly Remarkable Values

To define the scenic outstandingly remarkable values resource specialists considered the landscape elements of landform, vegetation, water, color and related factors that result in notable or exemplary visual features and/or attractions within the nation or region. They also considered:

- Whether or not the riverine landscape is distinctive enough to attract visitors from outside the Region of Comparison (Columbia River Basin); and
- If visitors were willing to travel long distances or travel across backcountry specifically to view, photograph, or record the outstanding scenic resource along the riverway.

Additional factors were also considered when determining scenic outstandingly remarkable values, including:

- Whether or not seasonal variations in vegetation exist;
- The scale of cultural modifications; and
- If scenic and visual attractions were highly diverse over the majority of the river or river segment.

Recreation/Interpretive Outstandingly Remarkable Values

To define recreation/interpretive outstandingly remarkable values resource specialists considered:

- Whether or not recreation opportunities are or have the potential to be distinctive enough to attract visitors from outside the Region of Comparison (Columbia River Basin);
- If visitors are willing to travel long distances to use the river resources for recreation purposes. River-related opportunities could include, but are not limited to, sight-seeing, wildlife observation, photography, hiking, fishing, hunting, tubing, and floating, including white-water rafting, kayaking, or canoeing
- If interpretive opportunities were exceptional and attract, or have the potential to attract, visitors from outside the Region of Comparison; and
- Whether or not the river may provide, or have the potential to provide settings for national or regional usage or competitive events.

Geological and Hydrological Outstandingly Remarkable Values

To help define geological/hydrologic outstandingly remarkable values, resource specialists considered:

- If the river or corridor contains an example of a hydrologic or geologic features;
- If the feature is a process or phenomena that is rare to the province or subbasin, or if it is an outstanding example of a commonly occurring feature; and
- If the feature is in an unusually active state of development, represents a “textbook” example, and/or represents a rare or important combination of hydrologic or geologic features or landforms (erosional, volcanic, glacial, drainage patterns, etc.).

The Region of Comparison to determine geologic/hydrologic outstandingly remarkable values is the Province as defined by McNab and Avers in “Ecological Subregions of the United States: Section Descriptions”, USDA publication WO-WSA-5, July 1994 (McNab and Avers 1994). There are three Provinces that occur within the Ecogroup: (1) Province M332-Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow (this encompasses all of the Boise, and most of the Payette and Sawtooth Forests); (2) Province 342-Intermountain Semi-Desert (this encompasses the southern portion of the Sawtooth Forest); and (3) Province 331A-Great Plains - Palouse Dry Steppe (this encompasses the northern central tip of the Payette Forest).

Fish Outstandingly Remarkable Values

When defining outstandingly remarkable fish values resource specialists considered:

- If the river contains more than one fish species listed under the Endangered Species Act;
- If there is sufficient documentation to support the existence of a listed species in the river corridor within the past 20 years, if the fish species was not currently present;
- Whether or not spawning and rearing habitat exists for listed threatened, endangered, and sensitive species;
- If the river provides near natural assemblages of native fish species, including multiple life histories for the same species, or contains one or more unique/narrow endemic fish species;

- If the river is in a watershed designated PACFISH or INFISH high priority (not just key);
- Whether or not the river provides a near-natural condition; and
- If the river represents other habitat for threatened, endangered, and sensitive species in the same types of streams in that geologic setting.

The Region of comparison for determining fishery values is the Columbia River Basin.

Wildlife Outstandingly Remarkable Values

When defining outstandingly remarkable wildlife values resource specialists considered:

- If the river corridor contains one or more "unique"/narrow endemic wildlife species;
- If the river corridor contains wintering range for more than two big game species, such as elk, mountain goat, and big horn sheep;
- If the river corridor contains clustered nesting/denning/calving locations used by wildlife species listed under the Endangered Species Act; and
- If the wildlife resource value is tied to unique features associated with the corridor.

The Region of Comparison for determining wildlife values is the Columbia River Basin.

Heritage Outstandingly Remarkable Values

Heritage values are comprised of three components: Prehistoric, Historic, and Traditional Cultural.

When defining outstandingly remarkable **prehistoric values,** resource specialists considered:

- Whether or not the river corridor contains a site where there is evidence of occupation or use by American Indians or other prehistoric culture; and
- If the sites have national or regional importance for interpreting prehistory; may have been used concurrently by two or more cultural groups or may have been used by cultural groups for rare or sacred purposes.

Of particular significance are sites or features listed in or eligible for inclusion in the National Register of Historic Places (NRHP). The evaluation is based on existing inventory information.

The Regions of Comparison for evaluating prehistoric values are identified as the *Plains, Great Basin, and Columbia Plateau Culture* areas. Generally, prehistoric values have been associated with American Indian prehistory, although other ethnographic groups could be considered if they left traces of their activity on the landscape, or significant events were associated with certain special places.

When defining outstandingly remarkable **historic values**, resource specialists considered:

- If the river corridor contains a site or feature associated with a significant event, an important person, or a cultural activity of the past that was rare, unusual, or important in the region; and
- Whether or not a historic site and/or feature, in most cases, is 50 years old or older.

Of particular significance are national Historic Landmarks or sites or features listed in, or eligible for inclusion in, the NRHP.

The Region of Comparison used to evaluate historic outstandingly remarkable values is the Western United States.

When defining outstandingly remarkable **traditional cultural values**, resource specialists considered:

- Whether or not the river or area with the river corridor contains location(s) of regional importance to Indian tribes (religions activities, fishing, hunting, and gathering). Locations may have unusual characteristic or exceptional cultural value integral to continued pursuit of such activities.

The Regions of Comparison used to evaluate traditional cultural values were the traditional territories of American Indian cultures native to this area.

Ecological/Botanical Outstandingly Remarkable Values

When defining outstandingly remarkable ecological/botanical values resource specialists considered:

- If the river corridor contains an important element in a regional plan to conserve biological diversity while maintaining ecosystem integrity.

The Region of Comparison used to evaluate ecological/botanical values was identical to those used to evaluate geologic and hydrologic outstandingly remarkable values. Please refer to that section for further information.

River Classification

The types and amounts of activities and changes acceptable within an eligible, suitable, or designated river corridor depend on whether it is classified as a Wild, Scenic, or Recreational river. Activity compatibility with classification can be found in the Wild and Scenic Rivers portion of Chapter 3 in the Environmental Impact Statement. Below is a summary of the criteria used to determine tentative river classification.

Table D-1. Criteria Used to Determine Tentative Classification

Tentative Classification	Criteria Used
Wild River	The river is free of impoundments. The shoreline is essentially primitive. The presence of a few inconspicuous structures, particularly those of historic or cultural value, is acceptable. A limited amount of domestic livestock grazing or hay production is acceptable. There is little or no evidence of past timber harvest, and no ongoing timber harvest. The river is generally inaccessible except by trail. There are no roads, railroads, or other provisions for vehicular travel within the river area. A few existing roads leading to the boundary of the river area are acceptable. The river meets or exceeds federal criteria or federally approved state standards for aesthetics, for propagation of fish and wildlife normally adapted to the habitat of the river, and for primary contact recreation (swimming), expect where exceeded by natural conditions.
Scenic River	The river is free of impoundments. The shoreline is largely primitive and undeveloped. There is no substantial evidence of human activity. The presence of small communities or dispersed dwellings or farm structures is acceptable. The presence of grazing or crop production is acceptable. Evidence of past or ongoing timber harvest is acceptable, provided the forest appears natural from the riverbank. The river is accessible, in places, by road. Roads may occasionally reach or bridge the river. Short stretches of conspicuous, or longer stretches of inconspicuous roads or railroads are acceptable.
Recreational River	Low dams, diversions, or other modifications of the waterway are acceptable, provided the waterway remains generally natural in appearance. The shoreline has substantial evidence of human activity. Extensive residential development and a few commercial structures are acceptable. Lands may have been developed for the full range of agricultural and forestry uses. The shoreline may show evidence of past and ongoing timber harvest. The river is readily accessible by road or railroad. Parallel roads or railroads on one or both banks, as well as bridge crossings and other river access points, are acceptable.

FINAL LAND AND RESOURCE MANAGEMENT PLAN FINDINGS

Fifteen rivers with 31 segments were found eligible through this revised process. The rivers and their segments, classification(s), and ORVs are described in Tables D-2 and D-3, below.

Table D-2. Boise National Forest Eligible Wild and Scenic Rivers

River Name	Tributary To	Segment	Segment Location	Class[1]	Scenic[2]	Recreation	Geologic	Hydro	Fish	Wildlife	Heritage	Eco/Bot
Bear Valley Creek	Middle Fork Salmon River	1	Headwaters to confluence with Elk Ck.	R							O	
Bear Valley Creek	Middle Fork Salmon River	2	Elk Creek confluence downstream to Fir Creek Campground	S							O	
Bear Valley Creek	Middle Fork Salmon River	3	Fir Creek Campground to Forest Boundary	W							O	
Burntlog Creek	Johnson Creek	1	Headwaters to junction with FR447 (Sec 27 T16N R8E)	R					O			
Burntlog Creek	Johnson Creek	2	Junction with FR447 (Sec 27 T16N R8E to confluence with Johnson Creek	W					O			
Deadwood River	South Fork Payette River	1	Headwaters to Deadwood Reservoir	R			O					
Deadwood River	South Fork Payette River	2	Deadwood Reservoir to Warm Springs Creek	S	O	O						
Deadwood River	South Fork Payette River	3	Warm Springs Creek to Pine Creek	W	O	O						
Deadwood River	South Fork Payette River	4	Pine Creek to the confluence with South Fork Payette River	S		O						
Elk Creek	Feather River	1	Headwaters to Alta Creek Confluence	W							O	
Elk Creek	Feather River	2	Alta Creek Confluence to confluence with Feather River	S							O	
Elk Creek	Bear Valley Creek	1	Bear Valley confluence upstream to FC-RONR Wilderness boundary	R					O			
Elk Creek	Bear Valley Creek	2	FC-RONR Wilderness Boundary upstream to North Fork Elk Creek	W					O			
Johnson Creek	East Fork South Fork Salmon River	1	Bear Creek to Hansen Creek	R							O	
Middle Fork Boise River	Boise River	1	Forest Boundary to Willow Creek	R	O						O	O
Middle Fork Payette River	Payette River	1	Bell Creek to Boiling Springs Cabin	R	O						O	
Middle Fork Payette River	Payette River	2	Boiling Springs Cabin to Fool Creek	W	O	O						
Mores Creek	Arrowrock Reservoir	1	Granite Creek to Pine Creek	R							O	

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[1] Class = Classification of the river segment. W = Wild, R = Recreational, and S = Scenic

[2] Scenic, Recreation, Geologic, Hydro, Fish, Wildlife, Heritage, Eco/Bot = Outstandingly Remarkable Values. Scenic = Scenic Value, Recreation = Recreation Value, Geologic = Geologic Value, Hydro = Hydrologic Value, Fish = Fish Value, Wildlife = Wildlife Value, Eco/Bot = Ecological/Botanical Value.

River Name	Tributary To	Segment	Segment Location	Class[1]	Scenic[2]	Recreation	Geologic	Hydro	Fish	Wildlife	Heritage	Eco/Bot
North Fork Boise River	Middle Fork Boise River	1	Wilderness Boundary to Johnson Creek	R	O							
North Fork Boise River	Middle Fork Boise River	2	Johnson Creek to Hunter Creek	W	O							
North Fork Boise River	Middle Fork Boise River	3	Rabbit Creek to Middle Fork Boise River	W	O							
North Fork Payette River	Payette River	1	Forest Boundary to confluence with Payette River	R		O						
Payette River	Snake River	1	Boise Forest Boundary (1 mile east of Banks) to Boise Forest Boundary (1 mile south of Banks)	R		O						
Porter Creek	Elk Creek	1	Headwaters to confluence with Elk Creek	W					O			
South Fork Boise River	Boise River	1	Anderson Ranch Dam to Mennecke Creek	R		O	O				O	
South Fork Boise River	Boise River	2	Mennecke Creek to Trail Creek	S		O	O					
South Fork Boise River	Boise River	3	Trail Creek to Crank Creek	W	O	O	O					
South Fork Payette River	Payette River	1	Sawtooth NRA Boundary to Wolf Creek	S	O	O						O
South Fork Payette River	Payette River	2	Wolf Creek to Pine Flats Creek	R	O	O						O
South Fork Payette River	Payette River	3	Pine Flats Creek to Long Gulch	S	O	O					O	O
South Fork Payette River	Payette River	4	Long Gulch to Boise Forest Boundary	R	O	O						O

Table D-3. Outstandingly Remarkable Values of the Eligible Rivers

River Name	ORV Description
Bear Valley Creek	**Heritage:** There are two historic sites and nine prehistoric sites eligible for listing on the National Register of Historic Places. Also being considered eligibility is Forest Road 582, an old wagon road built by miners in Boise Basin to access other gold rush camps in central Idaho. There is also substantial evidence for other sites, including those associated with homesteading, early Forest Service administration, and the post World War II mining industry.
Burntlog Creek	**Fish:** This is a Pacfish/Infish priority watershed that supports spawning and rearing habitat for wild native chinook salmon and steelhead, cutthroat, redband, and bull trout.
Deadwood River	**Scenic:** Portions of this area have an isolated and remote steep-walled forested canyon setting, with little evidence of past management activities. The river is very diverse and includes cascades, rapids, ponds, islands, fast gradients, and large boulders. The river area also includes small meadows. There is a variety of wildlife viewing opportunities, including osprey, river otter, elk, moose, and deer. **Geologic:** The Deadwood Canyon Fault, the first major Basin and Range Structural control west of the Middle Fork Salmon River, extends north to Yellow Pine, where it intersects the East Fork Salmon Fault System. The Cretaceous fault structure is overlain by more recent glaciation. The glacial-produced tributary streams flow west southwest from a series of hanging cirque basin valleys. The area contains hanging cirque basin valleys, kames, potholes, and basin and range fault structures. The area is of educational and scientific value because of the rare physical features being exhibited. **Recreation:** This river offers extremely challenging kayaking opportunities, including several portages and Class III and IV rapids. Portions of the river are very remote and offer opportunities for solitude.
Elk Creek (tributary to Feather River)	**Heritage:** This area includes the South Boise Historic Mining District, which is significant for its contribution to the growth and development of Idaho. The district contains sites representative of the state's gold rush era, and 1860s – 1930s mining technologies. The South Boise Historic Mining District also has outstanding research, educational, and interpretive opportunities.
Elk Creek (tributary to Bear Valley Creek)	**Fish:** This is a Pacfish/Infish priority watershed that supports spawning and rearing habitat for wild native chinook salmon and steelhead, cutthroat, redband, and bull trout.
Johnson Creek	**Heritage:** There are twelve to fourteen historic sites and ten prehistoric sites on Johnson Creek that are eligible for listing on the National Register. They consist primarily of homesteads and sites associated with the Thunder Mountain gold rush, circa 1900-1904. Two of these sites are Forest Service administered compounds: Johnson Creek Guard Station, built in the 1920s and Landmark Ranger Station, built in the 1930s by the Civilian Conservation Corps. One of the Forest's most spectacular sites, a biface cache 4,000 to 6,000 years old, is located in this area.
Middle Fork Boise River	**Scenic:** The river offers diverse settings, from steep narrow canyon walls to wide valley bottoms. The river offers clear water, cascades, pools, small falls, meadows, large river flows, fast and slow water, and varying gradients. The views are continually changing and diverse. **Heritage:** Arrowrock Dam, completed in 1915, Alturas Bar, and Kirby Dam are listed on the National Register of Historic Plances. Arrowrock Dam was the world's tallest dam until Hoover Dam was built in the 1930s. Arrowrock Dam is a remarkable example of construction and technology innovation during this period. Alturas Bar is a remarkable example of Chinese placer mining techniques, which reflect the differences between Chinese and Euro-American attitudes towards the physical environment. This site has outstanding research, educational, and interpretive values. Kirby Dam, a log dam built in 1906, no longer exists but is still listed on the National Register. **Ecological/Botanical:** The river area includes the presence of nine documented population sites for Epipactis gigantea (Giant helleborine orchid). All of these sites are in direct assocation with thermal hot springs, a rare habitat.

River Name	ORV Description
Middle Fork Payette River	**Scenic:** There is strong water movement with diversity and variety of slow-moving water, pools, cascades, ripples, small falls, and rapids. A steep rocky gorge provides a narrow canyon enclosure in one location. Small falls flow from rocky canyon walls. Huge rock boulders in the river create diversity, and large ponderosa pine trees occur at various locations along the river. There is a natural appearing forested setting interspersed with natural openings. There is little evidence of human alteration other than the road corridor in locations. Scattered hot springs occur along the river. **Recreation:** The rivers includes several hot springs, including Boiling Springs, that attract visitors. The Middle Fork Payette River trail offers a non-motorized hiking or horseback opportunity. The trail follows the river, which provides exemplary scenery for the trail user. The area also has one developed campground and one rental cabin that offer highly desired exemplary riverside settings. The Middle Fork Road is a high-use groomed snowmobile and popular cross-country ski route in the winter. Together, the hot spring, camping, and year round recreation opportunities qualify this river for a recreational ORV. **Heritage:** Historically, this river area was a popular transportation corridor linking the agricultural communities along the North and South Fork Payette Rivers. The Middle Fork was also a gateway to Deadwood Basin and Salmon River mining camps. Portions of Forest Road 698 are built on a wagon road constructed in 1902 by Placerville and Garden Valley residents as the “best route” to the Thunder Mountain gold rush. This road is not recorded as a site, but is considered eligible for the National Register of Historic Places. Boiling Springs Guard Station is a National Register eligible site built in the 1930s by Civilian Conservation Corps crews. CCC crews also built the campgrounds along the river. There are eight prehistoric sites that are eligible for listing on the National Register. The prehistoric site at Rocky Canyon Hot Springs was the focus of archaeological test excavations in 1992 and 1993. This site has contributed significant information about wildlife species no longer present in the drainage, and the possible co-existence of Columbia Plateau and Great Basin cultural groups.
Mores Creek	**Heritage:** The area includes Hop Lee’s Placer Claim, which is one of the largest and most intact examples of a Chinese mining operation in the Pacific Northwest. In Boise Basin, where Hop Lee’s Placer Claim is located, nearly fifty percent of the population was Chinese in 1870. This cultural group had a profound impact on the landscape seen today in the basin. Hop Lee’s Placer Claim, in this respect, reflects Chinese attitudes towards the physical environment. This site has outstanding research, educational, and intepretive values. Hop Lee’s Placer Claim is the focus of ongoing archaeological excavations that emphasize public involvement in historic preservation on national forests. The Forest is developing a heritage trails system through the site with interpretive panels and day use facilities.
North Fork Boise River	**Scenic:** The river has a diverse character offering steep-sided, narrow rocky canyons with clear fast water, rapids, cascades, and boulders. The lower river area also offers interspersed flat alluvial canyon bottoms.
North Fork Payette River	**Recreation:** The river corridor corresponds with the Payette River Scenic Byway Corridor, a State designation that indicates outstanding scenery-viewing recreational opportunities. The river is also within the Payette River System, which is nationally known for its excellent rafting and kayaking opportunities. This river is internationally known because it has one of the longest sections of continuous Class V rapids in the country.
Payette River	**Recreation:** River corridor includes the Banks River Access Site, which is a very popular put-in and take out spot and is within the Payette River Scenic Byway corridor. The Payette River is nationally known for its excellent rafting and kayaking opportunities.
Porter Creek	**Fish:** This is a Pacfish/Infish priority watershed that supports spawning and rearing habitat for wild native chinook salmon and steelhead, cutthroat, redband, and bull trout.

River Name	ORV Description
South Fork Boise River	**Scenic:** The river area includes a steep-walled basalt canyon with talus slopes, rock formations, canyon enclosures, and isolation. The river offers large volume and flow, rapids and cascades, meandering waterways, and clear water. There are occasional alluvial benches and ponderosa pine on the gentler slopes, which create a diverse setting. **Recreation:** The river corridor offers a wide variety of recreational activities including fishing, sightseeing, wildlife viewing, swimming, hunting, hiking, biking, and non-motoried boating, and attracts visitors from throughout the United states. Portions of the river corridor are accessible year round, offering a long season recreational opportunities. **Geologic:** The river area includes a seemingly continuous sequence of volcanic, metavolcanic, metamorphic, metasedimentary, and volcanic features. This diverse set of features exhibit the turmoil and constant geologic change the area was going through over the past 850 million years. This area is of exceptional educational and scientific value because of the rare physical features being exhibited. The canyon stretch has a reputation within the boating community of some of the most scenic wter in southwestern Idaho. **Heritage:** Danskin Rockshelter is found in this river area and is one of the most important rock art sites in Idaho. It contains an usual image of a crane or heron rarely seen in the region. Boise State University excavated the site in 1989, and recovered information significant to Idaho prehistory.
South Fork Payette River	**Scenic:** Portions of the South Fork Payette River area are dominated by the presence of the river and steep canyon landforms. The river has good water clarity, variety and movement, falls, rapids, still pools, and hot springs. The river's water character is diverse. With the exception of the roadway, road cuts, and fill banks, the river offers a natural appearing setting. There is a dramatic contrast between forested and non-forested slopes on the north and south aspects of the canyon. Highly dissected mountainous canyon landforms are present. **Recreation:** This river offers a wide variety of recreation activities, including Sacajawea Hot Springs, Kirkam Hot Springs, and Pine Flats Hot Springs, dispersed camping, hiking and trail riding (both motorized and non motorized), and fishing, and, as part of the Payette River system, is known nationally for its excellent boating opportunities. Portions of this river fall within the Wildlife Canyon Scenic Byway or Ponderosa Pine Scenic Byway. Scenery viewing is a very popular recreational activity. Pine Flats and Kirkam Hot Springs are accessible year round, which makes them a popular winter activity. **Heritage:** Big Falls Portage is in this river area and has yielded significant information about the prehistory of the South Fork Payette River that has regional implications for Great Basin archaeologists. It is the only site where a specific artifact type, the use of which is debated by archaeologists, tested positive for salmon protein when submitted for blood residue analysis. **Ecological/Botanical:** The river area includes the presence of nine documented population sites for Epipactis gigantea (Giant helleborine orchid). All of these sites are in direct assocation with thermal hot springs, a rare habitat.

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Boise National Forest
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Appendix E

Appendix E.
Terrestrial Wildlife Resources

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Appendix E provides an overview of the Wildlife Conservation Strategy (WCS), including discussions pertaining to the following elements:

- The assessment supporting WCS development
- The WCS long-term goals and planning period objectives
- The assessment of current baselines, threats, and risks needed to inform WCS development
- The WCS midscale spatial priorities and type of restoration
- The implementation of WCS priorities and strategies at the fine scale, actions to be taken, and measurements of success

Wildlife Conservation Strategy Overview

Ecological sustainability is one of three interdependent components of sustainability that the Forest Plan strives to achieve (along with social and economic sustainability). In 1997, the Secretary of Agriculture convened an interdisciplinary committee of scientists to review and evaluate the Forest Service's planning process for land management planning and identify changes needed to, in part, address sustainability (Committee of Scientists 1999). Consistent with recommendations found in the Committee of Scientists report, this Forest Plan provides a management framework that integrates biological and ecological system management with their social and economic contexts, acknowledging that management should not compromise the basic functioning of these systems.

The primary purpose of the Boise National Forest's (Forest's) WCS is to provide a framework for Forest management that contributes to sustaining native ecological systems that will support diverse terrestrial wildlife species. To achieve this purpose, Appendix E must integrate and work in concert with the *Vegetation and Wildlife Restoration Strategy* (vegetation restoration strategy) described in Appendix A and Aquatic Conservation Strategy (ACS) described in Appendix B.[1] Appendix E and the WCS complement these appendices by describing what, when, and where specific habitat conditions and key habitat elements associated with terrestrial wildlife species of concern should be addressed within the context of the vegetation strategy and ACS.

A complementary and necessary secondary focus of the WCS is to provide a fine-filter conservation approach for those terrestrial wildlife species, or groups of species, whose persistence needs cannot be fully addressed through the broader vegetation restoration strategy alone or through the ACS, which specifically targets fish and other aquatic organisms. This fine-filter approach involves a small subset of the 311 terrestrial vertebrate wildlife species believed to occupy National Forest System lands within the Forest's administrative boundary. Typically, this subset consists of species determined to be of conservation concern, such as Endangered Species Act (ESA) threatened and endangered species, local endemics, and species requiring specialized components not adequately addressed through the more general vegetation strategy or the ACS.

While the long-term goal of the WCS is to maintain or restore environmental conditions needed to support persistence and sustainability of the diversity of terrestrial wildlife species found across the Forest, the short-term (i.e., this planning period) emphasis is on habitats and species believed to be of

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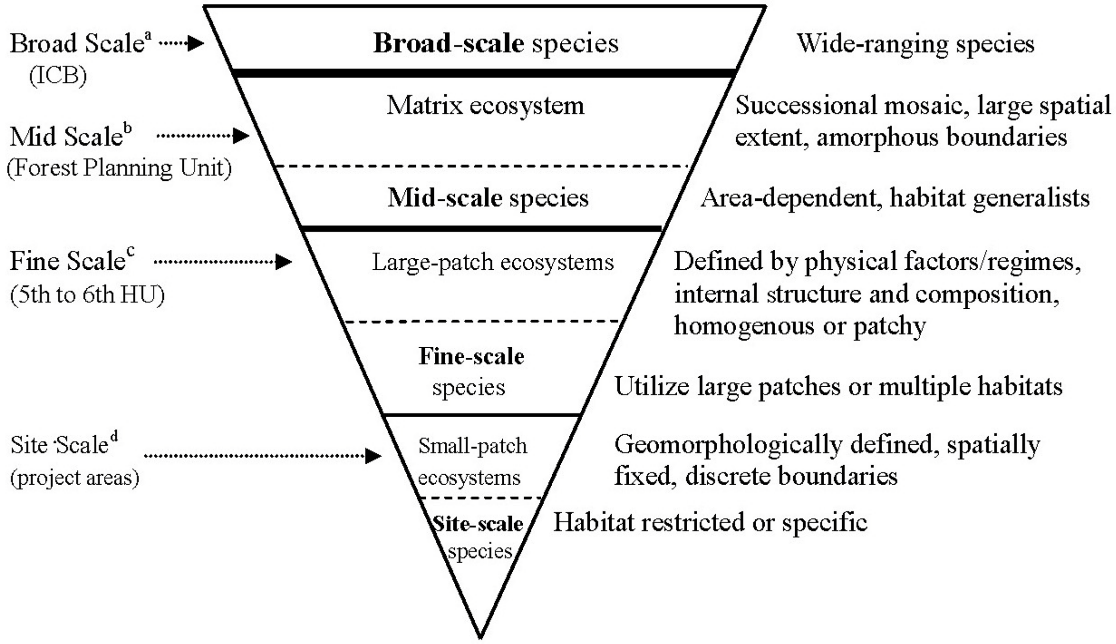
[1] Appendices A and B of this Forest Plan provide the foundational information that informs decisions concerning project design and implementation concerning desired *representative*, *redundant,* and *resilient* vegetative and aquatic resource conditions important to ecological sustainability.

conservation concern. This emphasis results in more specific threat reduction measures and spatial and temporal restoration priorities for these habitats or species, compared to species of lesser concern.

ASSESSMENT SUPPORTING WILDLIFE CONSERVATION STRATEGY DEVELOPMENT

Both the level of biological organization (species, communities, and ecosystems) and spatial scale at which biological diversity occurs (site, fine, mid, and broad scale) are important aspects of wildlife conservation planning (Figure E-1) (Poiani et al. 2000; Groves 2003). Some species occur only at site and fine scales (e.g., northern Idaho ground squirrel), while others have much larger spatial requirements (e.g., wolverines and wolves) and are best addressed at mid to broad scales. Similarly, some vegetation communities and ecosystems, such as those occurring in caves or along cliffs, are localized in their distributions, while others, such as low- to mid-elevation ponderosa pine forests of the Intermountain West, occur over vast areas.



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[a] Broad scale: A regional land area that may include all or parts of several states; typically millions of acres or greater. An example of a broad-scale assessment is the Interior Columbia Basin (ICB) Ecosystem Management Project.

[b] Mid scale: An area varying in size from a U.S. Geological Survey 4th-field hydrologic unit (HU) to groups of 4th-field HUs, approximately 500,000 to 5,000,000 acres. Subbasin review, EcoGroup, and forest planning unit analyses occur at this scale.

[c] Fine scale: This scale is used to define a landscape area varying in size from a 6th-field HU to a combination of 5th-field HUs, approximately 10,000 to 100,000 acres.

[d] Site scale: Any scale less than a broad, mid, or fine scale.

Figure E-1. Biological organization and spatial scale

Past efforts in conservation planning suggest that the biological diversity needed to support species persistence and sustainability occurs at varying spatial levels (Groves 2003). Changing a condition at one scale, without accounting for its effect at other scales, may inadvertently affect the desired outcomes at various scales. Thus, an effective conservation strategy must account for this hierarchical ordering of nature and the variety of spatial scales at which species and ecosystems occur.

The Wildlife Conservation Strategy and its Relationship to the Interior Columbia Basin Ecosystem Management Project Science Findings

The Forest falls within the Interior Columbia Basin (ICB). The Forest WCS was developed in the context of the Interior Columbia Basin Ecosystem Management Project's (ICBEMP's) broader-scale science findings, which are summarized in the *Highlighted Scientific Findings of the Interior Columbia Basin Ecosystem Management Project* (Quigley and Cole 1997). One of these findings identified three common themes that successful land management strategies, including this WCS, must address (Quigley and Cole 1997; Quigley et al. 2001):

1. Multiple risks to ecological integrity and economic well-being must be recognized and managed.
2. Risks and opportunities differ significantly across a project area and management plans must recognize this variation.
3. Individual sites are linked to ecological processes and human activities; these links must be understood and considered.

Habitat Suites, Families, and Associated Species of Mid-scale Focus Used in this Wildlife Conservation Strategy

The ICBEMP science assessment found that source habitats[2], as described by Wisdom et al. (2000) and Raphael et al. (2001), for some wildlife species within the ICB have declined substantially in geographic extent from historical conditions.

In 2003, an inter-Agency memorandum of understanding (MOU)[3], implementing *The Interior Columbia Basin Strategy* was signed and stated the following:

> Management plans shall address ways to maintain and secure terrestrial habitats that are comparable to those classified by the science findings as "source" habitats that have declined substantially in geographic extent from the historical to the current period and habitats that have old-forest characteristics. Direction should address opportunities to re-pattern these habitats when and where necessary, maintain and guide expansion of the geographic extent and connectivity of source habitats that have declined where they can be sustained. Direction needs to address restoration of the important vegetation characteristics of these habitats (such as species composition, vegetation structure, snags or coarse woody debris), which various terrestrial species need to survive and reproduce. (USDA Forest Service et al. 2003a,b)

Consistent with this MOU, one of the foundational elements of the WCS was the concept of source habitat as defined by Wisdom et al. (2000). The Forest Planning Team adopted the hierarchical system described in Wisdom et al. (2000) of grouping source habitats into suites and families (refer to Table E-1). Three of the habitat suites and 12 of the families are consistent with those used in the broad-scale assessment, *Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-scale Trends and Management Implications*, completed by Wisdom et al. (2000). The remaining

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[2] Source habitats are those characteristics of macrovegetation (cover types and structural stages) that contribute to stationary or positive population growth for a species within its distributional range (Wisdom et al. 2000; Raphael et al. 2001). Further, source habitats contribute to source environments, which represent the composite of all environmental conditions that result in stationary or positive population growth in a specified area and within a specified time range (Wisdom et al. 2000; Raphael et al. 2001).

[3] The purpose of the 2003 inter-Agency MOU was to cooperatively implement *The Interior Columbia Basin Strategy* (USDA Forest Service et al. 2003a, b) to guide the amendment and revision of Forest Service forest plans and Bureau of Land Management (BLM) resource management plans and project implementation on public lands administered by the Forest Service and BLM throughout the ICB.

suite, Suite 4, was developed by the Forest Planning Team and includes riverine and nonriverine riparian and wetland habitat. The importance of Suite 4 habitats was recognized by Wisdom et al. (2000); however, due to the broad-scale nature of the study, their analysis could not "reliably estimate their [Suite 4] habitat abundance." [4] Wisdom et al. (2000) concluded that that these habitats and related species needed to be addressed through mid- to fine-scale assessments, such as those completed as part of forest planning and subsequent plan to project fine-scale planning.

Of the 311 species of birds, mammals, or reptiles believed to occur within the Forest, 57 were identified as species of conservation concern. These species of conservation concern include ESA threatened or endangered species, Region 4 sensitive species, and/or a species of conservation concern identified in the *Idaho Comprehensive Wildlife Conservation Strategy* (IDFG 2005).

After reviewing available literature and local information, the Forest Planning Team assigned the species of conservation concern to one of the 13 habitat families based on habitat attributes. The number of species of conservation concern tied to each particular habitat family is identified in Table E-1 and described in detail in the *Boise National Forest Wildlife Conservation Strategy Report* (Nutt et al. 2010). While Wisdom et al. (2000) used a selected set of species to derive habitat families, the WCS assessment began by using those defined families to derive species of focus for each habitat family assessed. This approach is consistent with direction stated in the 2003 Interagency MOU implementing the *The Interior Columbia Basin Strategy* (USDA Forest Service et al. 2003a,b).

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[4] "Additional species (>80), most of which were deemed to be dependent on riparian or water habitats, also met the seven criteria [for selection of species of broad scale focus] (table 1); source habitats for these species, however, were identified by experts as needing mapping units smaller than 100 ha (247 acres) to reliably estimate their habitat abundance." (Wisdom et al. 2000, Volume 1, p. 9)

Table E-1. Wildlife Conservation Strategy habitat suites and families and number of associated species of conservation concern (SCC), including how many are Endangered Species Act listed, Region 4 Sensitive, and/or State of Idaho species of conservation concern (IDFG 2005). Overlap exists between each of these various SCC categories.

Suites: Source habitats restricted to:	Source habitats dominated by:	Family number	Family name	Total Number of SCC	Number of ESA listed	Number of Region 4 Sensitive	Number of Idaho SCC
Suite 1: Forests only	Old-forest stages, low elevation	1	Low-elevation old forest	3	0	1	3
	Old-forest stages, broad elevation	2	Broad-elevation old forest	7	0	6	4
	Broad range of structural stages	3	Forest mosaic	4	1	2	4
	Forest stand-initiation stage (early seral)	4	Early seral montane and lower montane	0	0	0	0
			Suite 1 totals =	**14**	**1**	**9**	**11**
Suite 2: Combination of forests and rangelands	Broad range of forest and rangeland cover types	5	Forest and range mosaic	4	0	2	4
	Forests, woodlands, and montane shrubs	6	Forests, woodlands, and montane shrubs	1	0	1	0
	Forests, woodlands, and sagebrush	7	Forests, woodlands, and sagebrush	3	0	2	3
	Unique combinations of rangeland cover types and early and late seral forests	8	Rangeland and early and late seral forests	0	0	0	0
	Woodlands	9	Woodlands	N/A	N/A	N/A	N/A
			Suite 2 totals =	**8**	**0**	**5**	**7**
Suite 3: Rangelands only	Broad range of grassland, shrublands, and other cover types	10	Range mosaic	5	0	1	5
	Sagebrush	11	Sagebrush	5	0	1	5
	Grassland and open-canopy sagebrush	12	Grassland and open-canopy sagebrush	5	1	1	5
			Suite 3 totals =	**15**	**1**	**3**	**15**
Suite 4: Riverine and nonriverine wetland/riparian	Riverine riparian and wetland streams	13	Riverine riparian and wetland	5	1	2	5
	Open water, ponds, lakes, nonriverine riparian, and wetland	14	Nonriverine riparian and wetland	15	0	1	15
			Suite 4 totals =	**20**	**1**	**3**	**20**
			Total ALL Suites =	**57**	**3**	**20**	**53**

Within each habitat family, a subset of species was selected as "focal species" and used in mid-scale analyses to help identify habitat needs for species associated with each family. These species were selected by evaluating the key ecological functions (KEFs)[5] and key environmental correlates (KECs)[6] associated with species in the family. The Forest Service selected the fewest number of species necessary to represent the full array of KECs and KEFs associated with a family and likely to be affected by management actions implementing the Forest Plan. In addition, all ESA listed species, Region 4 sensitive species, and management indicator species (MIS) were included in the subset selected. ESA listed and Region 4 sensitive species were included in part because the Forest Service must assess these species in project planning where project activities may affect habitat associated with them. MIS were included due to their role in Forest Plan monitoring. Mid-scale assessments provide the context needed to inform more refined priorities established during plan-to-project fine-scale planning and site-specific conclusions about the magnitude of effects to habitat associated with species of concern.

Detailed documentation of habitat family descriptions, source habitat definitions for species associated with each family, KECs and KEFs associated with mid-scale focal species, and assessments completed for habitat families and each focal species are in the planning record.

WILDLIFE CONSERVATION STRATEGY LONG-TERM GOAL

The long-term goal of the WCS is to maintain or effectively restore representative, resilient, and redundant networks of habitats across the planning unit:

- **Representative—**Landscapes within the planning unit should contain the full array of potential "states" (i.e., diverse conditions) of an ecosystem characteristic on the landscape (Harris 1984; Hunter 1990). The assumption of a representative approach is that providing a wide range of habitat conditions will sustain the greatest percentage of terrestrial wildlife species that utilize those characteristics. For example, the intent of the WCS is to provide a range of forest structural stages and canopy closures characteristic of the historical landscapes. How and where this is done is informed by the knowledge that source habitats for some species are tied to specific size classes, canopy covers, and tree species (e.g., species associated with Family 1), while species in other families use a broader variation of conditions (e.g., species associated with Families 2 and 3).
- **Redundant—**To avoid extinction or endangerment caused by naturally occurring stochastic events (e.g., disease, predation, floods, and fires) and human-related disturbance, representative source habitat conditions should occur multiple places within the planning unit (Forman 1995). The WCS addresses redundancy by conserving or restoring representative source habitat conditions across the planning unit where the habitat historically occurred.

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[5] Key Ecological Functions are the set of ecological roles performed by a species in its ecosystem (Marcot and Vander Heyden 2004). These ecological roles are the main ways organisms use, influence, and alter their biotic and abiotic environments. For example, beavers are primary consumers (herbivores), are prey for secondary and tertiary consumers (predators), create structures that can be used by other organisms (dams), and impound water by creating dams or diversions. This last function is unique to the beaver. The loss of beaver in a system where it is normally present, influences many other species. In Idaho, 33 wildlife species are directly and positively associated with beaver activity (e.g., dams, lodges, ponds).

[6] Key Environmental Correlates are biotic or abiotic habitat elements that species use on the landscape to survive and reproduce. For example, flammulated owls utilize natural or woodpecker-created cavities in standing dead trees in forested habitats. If those habitat elements are not present, this species cannot persist. The function (KEF) that northern flickers and pileated woodpeckers perform (cavity excavation) creates a habitat element (KEC) needed by the flammulated owl.

- **Resilient—**Landscapes within the planning unit identified as priority areas for a particular habitat family should be resilient to natural and human-caused disturbances. This criterion means that the representation and redundancy of source habitats and their associated species populations should be of sufficient quality to persist over long periods of time. For communities, ecosystems, and other surrogate measures, this criterion implies that natural ecological processes and disturbance regimes, such as fires and floods, are operating within their historical range of variability (Hunter 1990; Landres et al.1999) and the sizes of the areas are sufficient to allow source habitat features and related species populations to recover from natural disturbances. In terms of human disturbance, resilience implies that anthropogenic disturbance levels are within limits that will retain habitat features necessary to support species populations and source habitats.

The WCS addresses resilience by emphasizing the importance of restoring ecological processes and disturbance regimes, such as fires and floods, and by addressing potential effects of human disturbance on the quality of source habitats using an assessment based on conservation principles found in this appendix. The WCS used information such as published literature, regional and local expert input, and local field data regarding species habitat requirements to determine the representation and redundancy of ecosystem characteristics or specific habitat features needed to sustain a species. This range of specific habitat features becomes the context in which the current and projected status of an ecosystem characteristic can be evaluated. This is similar to the representative and redundant approach identified in Appendix A of the Forest Plan for vegetation conditions across the planning unit. However, the WCS goes a step further: the proportional amount of the vegetative characteristic to be maintained or restored has been further refined, and where it was identified as a priority to address during this planning period, specific planning period management direction has been defined to address the issue associated with the priority (e.g., restoration of dry forest pine, retention of old-forest habitat).

ASSESSING CURRENT BASELINES, THREATS, AND RISKS NEEDED TO DEVELOP THE WILDLIFE CONSERVATION STRATEGY

Nine conservation principles form the basis for assessing current baselines, threats, and risks and assigning appropriate WCS mid-scale strategies (i.e., active, passive, or conservation) and priorities (i.e., low, moderate, or high) for restoration; these principles are described below. The first six principles (1–6) relate to Suites 1, 2, and 3; the remaining three (7–9) apply to Suite 4. By using these principles to assist in project design and implementation, the desired representative, resilient, and redundant network of habitats should be realized in the long term.

Conservation Principles for Suites 1, 2, and 3

1. *Species well distributed across their range (redundant) are less susceptible to extinction (resilient) than species confined to small portions of their range.*

This principle builds upon the belief that a widely distributed population will likely persist through major disturbance perturbations or other impacts that occur throughout its entire range at once. Local population extirpation and habitat recolonization following disturbance events are natural phenomena. Well-distributed populations allow the recolonization of extirpated habitats following these events. For instance, a severe drought may dry up the breeding ponds used by a species of salamander for several years in a row across two or three habitat patches. If that salamander does not occur elsewhere, it would be extirpated. However, if that salamander is widely distributed, at least some breeding ponds within its range would not completely dry out and would still contain salamanders. From these refugia, the species can recolonize areas where it had been extirpated. As an extreme example, a plant species that has become confined to the riparian zone of a single stream could become extirpated by a single extreme flood event. Keeping species well distributed is therefore a logical conservation goal and corresponds to the well-accepted "multiplicity" principle, which states it is preferable to have many patches rather than few (Soule and Simberloff 1986; Noss 1994). The provision of the ESA that allows for listing of local populations, even when the species as a whole is not threatened, is consistent with this principle.

Maintaining occupied source habitats for multiple populations of species ensures a natural range of genetic variability and reduces the likelihood that environmental variability will result in species extirpation. As such, habitat management must consider redundancy. Focal species associated with a particular habitat must be represented in many places across the landscape so that extirpation at one location does not eliminate the species entirely from the planning area.

2. *Habitat in contiguous blocks is better than fragmented habitat (i.e., representative, resilient).* (Refer to Figure E-2.)

Fragmentation reduces patch size of habitat remaining in the planning area, increases edge effects, and isolates patches by removing connecting habitat corridors (Forman 1995; Botequilha Leitao and Ahern 2002). Although species differ in their sensitivity to these changes (Crooks 2002), the theory of island biogeography suggests that fragmentation will decrease species richness due to reduced immigration and emigration potential (in the case of isolation) and increased extinction rates (in the case of small populations size) (MacArthur and Wilson 1967). Although fragmentation can result from natural disturbance, in many landscapes, fragmentation can also result from anthropogenic activities. Small and isolated habitat patches are expected to have smaller populations and less opportunity for demographic or genetic "rescue" from surrounding populations (Brown and Kodric-Brown 1977). In metapopulation theory, an unoccupied patch of suitable habitat isolated by fragmentation is less likely to be colonized or recolonized by a species (Gilpin and Hanski 1991). If enough connections between suitable habitat patches are severed and the habitat becomes fragmented, the metapopulation is destabilized and less likely to persist.

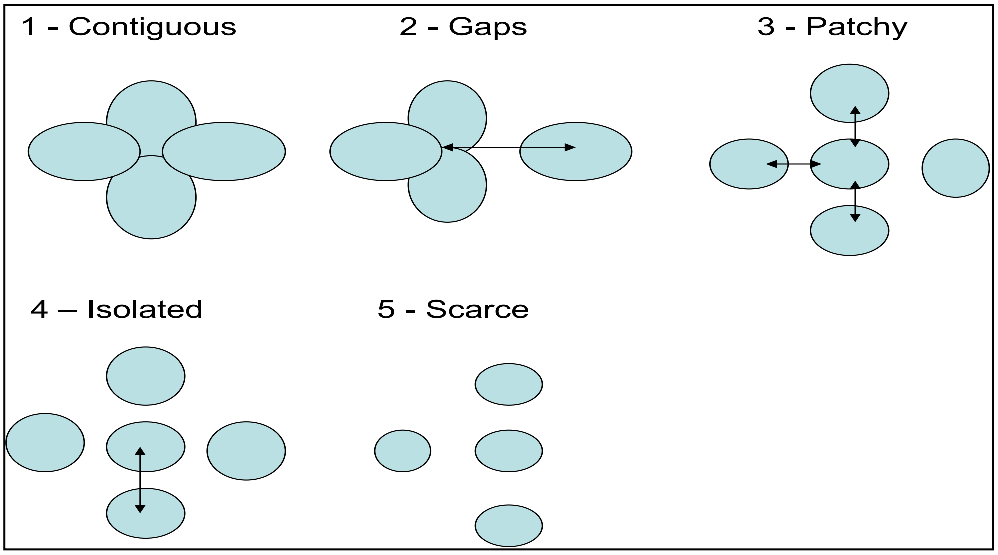

Figure E-2. Conceptual diagram of the five habitat outcome classes developed by Lehmkuhl et al. (1997) to assess effects of planning alternatives on selected plants and animals within the Interior Columbia Basin. Classes were defined as follows: outcome 1 indicated habitat was broadly distributed with the opportunity for nearly continuous distribution of the species; outcome 2 indicated habitat was broadly distributed but with gaps but patches were large and close enough to permit dispersal (indicated by arrows between patches); outcome 3 indicated habitat occurred primarily in patches, some of which are small or isolated, causing limitations in species dispersal; outcome 4 indicated habitat occurred in isolated patches with strong limitations on dispersal among patches and some likelihood of local extirpation; and outcome 5 indicated habitat was scarce with little or no opportunity for dispersal among patches and strong likelihood of extirpation.

When large habitat blocks are broken into smaller ones, not all species will be detected in the remaining patches because of sampling effects (Arrhenius 1921, 1922; Wilcox 1980). This effect is especially true for rare species and nonmobile organisms—such as small mammals, amphibians, and many invertebrates—that may already be sparsely or patchily distributed within the planning area. Additionally, connecting populations of these nonmobile populations may require multiple generations, and the persistence of these species is further dependent on suitable corridor habitat (Beier et al. 2008).

Large animals and top carnivores require large areas of habitat. These species are especially vulnerable to reduced habitat area caused by landscape fragmentation, and they may disappear entirely from forest patches because food or other resources are inadequate to support them (Newmark 1987; Carroll et al. 2001). Even smaller species are affected by the size of habitat patches; decreases in landscape connectivity via fragmentation and habitat loss can affect amphibian assemblages (Lehtinen et al. 1999). The disappearance of some species from forest fragments can profoundly affect the forest itself. For example, depletion of mammal or bird communities due to habitat fragmentation reduces seed survival or seedling establishment for certain plants (Santos and Tellería 1994; Asquith et al. 1997, 1999; Cordeiro and Howe 2001, 2003). Other species may persist, but in smaller populations with lower genetic diversity, which will increase the vulnerability of those species to other ecological changes such as disease. Rare species and those that normally occur at low population densities are especially vulnerable to these effects (Golden and Crist 1999). Smaller forest patches may also include less environmental variability and therefore fewer microhabitats than more extensive forest areas. The presence of fewer microhabitats can result in the loss of individual species and may reduce total species richness per area of forest (Collinge 1995, Laurance and Bierregaard 1996).

Fragmentation involves more than population effects for a single species. Effects at the community, ecosystem (Saunders et al. 1991), and landscape levels are also well documented (Noss and Csuti 1994). Problems at these higher levels include abiotic and biotic edge effects that reduce the area of secure interior habitat to smaller habitat patches and the proliferation of invasive species; increase disturbance of rare habitats and species; and disrupt natural disturbance regimes, hydrologic functions, and other natural processes. The end result of fragmentation is often a landscape that has lost native species and is dominated by exotics and other invasive species. Although species richness at the local or landscape scale is often higher after fragmentation than in more natural conditions, this richness is misleading because it is accompanied by a homogenization of flora and fauna at a broader scale and net loss of rare species.

3. *Large blocks of habitat containing large populations of species (representative and resilient) are superior to small blocks of habitat containing few individuals.* (Refer to Figure E-2.)

The principle of "largeness" is another universally accepted generalization of conservation biology (Soule and Simberloff 1986). A larger block of suitable habitat will usually contain a larger population of a species; large populations are less vulnerable to extirpation than small populations. Large blocks of habitat are also less likely to experience a disturbance that affects the entire area. Furthermore, refugia and recolonization sources are more likely to be present in large blocks of habitat than in small blocks, thus enhancing population persistence. Also, some species are present only in large blocks of habitat. This correlation is recognized as a species-area relationship: species richness increases as habitat area increases.

Larger patches of habitat generally contain more species, more individuals of a given species, more species with large home ranges, more species sensitive to human activity, and more intact ecosystem processes than do small areas (Robbins et al. 1989; Turner et al. 1993; Newmark 1995; Schafer 1995). Larger patches will also usually contribute to greater resilience of populations and may also increase the utility of patches that act as “stepping stones” or connectors across a landscape (Buechner 1989; Lamberson et al. 1992). However, smaller reserve patches may also supplement larger reserves by protecting rare species that occur only in certain areas. Hence, greater variability in patch sizes may increase niche diversity and, consequently, regional biodiversity (Franklin and Forman 1987; Hansen et al. 1991).

4. *Blocks of habitat close together are better than blocks far apart (i.e., representative, redundant).* (Refer to Figure E-2.)

Across a landscape, habitat patches range from being evenly distributed to “clumped.” Aggregation of habitat patches helps explain how species may be found in patches that are close together but not in more isolated patches (Ritters et al. 1996; He et al. 2000). This concept generally follows the island biogeography (MacArthur and Wilson 1967) and metapopulation theories (Levins 1969, 1970) and helps explain the function of patches within a landscape.

Many species are capable of crossing narrow patches of unsuitable habitat, such as a recreation trail or a narrow secondary road; far fewer are able to successfully move across a multilane highway or large clear-cut. Without intervening barriers, close habitat patches will experience more interchange of individuals than patches that are far apart. If enough interchange occurs between habitat patches, they are functionally united into a larger population that is less vulnerable to extirpation (Soule and Simberloff 1986).

Habitat patches that are close together may function as one larger, contiguous habitat patch for those species that are able to move among areas. However, what constitutes "close together" depends on the species of concern. Habitats close together for birds might be inaccessible for animals incapable of crossing barriers. For example, many small mammals, salamanders, and flightless invertebrates seldom or never cross roads (Mader 1984; Merriam et al. 1989; Fahrig et al. 1995; Forman and Alexander 1998).

5. *Interconnected blocks of fragmented habitat are better than isolated blocks, and dispersing individuals travel more readily through habitat resembling that preferred by the species in question (representative, redundant, and resilient).* (Refer to Figure E-2.)

Connectivity— which is the opposite of fragmentation but not synonymous with contiguousness—has become one of the most widely accepted conservation planning principles (Margules and Pressey 2000). Despite continuing arguments over benefits versus costs of particular corridor designs (Simberloff et al. 1992), conservation biologists generally agree that habitats functionally connected by natural movements of species are less subject to extirpation than habitats artificially isolated as a result of human activities. It is also probable that corridors or linkages will likely function better when habitat within them resembles that preferred by the species (Haddad 1999a,b; Ricketts 2001). For example, although we may not know exactly what habitats species associated with old-forest habitat will travel through, older forests are likely to provide better linkages than early seral forests.

Connectivity allows organisms to move between patches that contain suitable habitats. A collection of small areas individually may be too small to maintain populations of some species, if connected, these small areas may provide sufficient habitat for a species to maintain sustainable populations. In essence, connectivity refers to the pattern of interconnectedness or "networking" in a landscape. It helps determine how individuals of a species and natural processes, such as fire, move or function within a landscape (Wiens et al. 1985; Noss and Cooperrider 1994; Bascompte and Solé 1996; With 1999). A well-connected area can sustain important elements of ecosystem integrity—namely the ability of species to move and natural processes to function—and is more likely to maintain its overall integrity than a highly fragmented area.

The isolation of patches, or distance between patches, plays an important role in many ecological processes. Several studies have shown that patch isolation is the reason that fragmented habitat patches often contain fewer bird and mammal species than contiguous habitat patches (Murphy and Noon 1992; Reed et al. 1996; Beauvais 2000; Hansen and Rotella 2000). As habitat is lost or fragmented, residual habitat patches become smaller and more isolated from each other (Shinneman and Baker 2000); species movement is disrupted; and individual species and local populations become isolated and at greater risk of extinction from synchronous disturbance events. Connectivity is especially critical to the persistence of low-vagility species. Suitable habitats for these species that are connected for long periods allow multiple generations of these species to move (Beier et al. 2008). Isolated habitats can put species at higher risk for extirpation.

6. *Blocks of habitat that are in areas where direct and indirect effects of human disturbance are low are more likely to provide all elements of a species' source environment than areas where it is not (representative, resilient and redundant).*

Species disturbance caused by human activities may elicit behavioral responses and/or physiological responses that are detrimental to the species (Gabrielsen and Smith 1995; Gill et al. 2001). Behavioral responses are influenced by characteristics of the disturbance (e.g., type of activity, distance away, direction of movement, speed, predictability, frequency, and magnitude) and its location (e.g., above versus below, in open areas versus areas screened by topography or vegetation) (Knight and Cole 1995). Disturbances at critical life-history periods, such as during the winter, are those that are unanticipated (MacArthur et al. 1982; Parker et al. 1984). In circumstances where motorized use is predictable and localized (confined to routes), wildlife responses to unanticipated disturbances by people afoot, skiing, or using off-road vehicles may be even more pronounced than responses to vehicles on roads, to which species have adapted.

A continual threat to many species is increased access to habitats, primarily through roads. Increasing road density is the common thread in habitat-altering activities such as timber harvest, resource extraction, and conversion of wildlands for residential and commercial purposes. A wealth of scientific literature describes the effects that roads have on habitat and various wildlife species (Trombulak and Frissell 2000). Included among these effects are direct wildlife disturbance, increased erosion, increased air and water pollution, the spread of invasive species, and wildlife mortality.

Livestock grazing is also grouped under this principle as a human disturbance. Livestock grazing can affect the composition, function, and structure of ecosystems (Wagner 1978; Crumpacker 1984; Fleischner 1994) in the following ways: (1) altering species composition of communities, including decreasing density and biomass of individual species, reducing species richness, and changing community organization; (2) disrupting ecosystem functioning, including interfering in nutrient cycling and ecological succession; and (3) altering ecosystem structure, including changing vegetation stratification, contributing to soil erosion, and decreasing water availability to biotic communities; and (4) spreading infectious diseases between domestic and wild species.

Suite 4 Conservation Principles

To effectively address the long-term goal for habitat families in Suite 4 (riparian and wetland habitats), the Forest Planning team developed three specific principles unique to this suite. These principles were developed using the overall concepts behind the six principles above for Suites 1–3 and the ACS (Appendix B). Conservation principles for Suite 4 include the following:

1. *Representative species well-distributed across their range (redundant) are less susceptible to extinction (resilient) than species confined to small portions of their range.*

Similar to species in Suites 1, 2 and 3, Suite 4 species that are distributed in multiple populations across the variety of environmental regimes and habitats they naturally occupy will be less susceptible to the stochastic processes that can lead to extinction. In any given year, some populations may be subject to natural disturbances such as floods or fire, abnormally high levels of predation, or human-related threats such as habitat loss or degradation. However, if a sufficient number of populations exist appropriately distributed across their range, the species will be less susceptible to extinction.

2. *Continuous, nonfragmented riparian and wetland systems are better than fragmented habitat (i.e., representative, redundant and resilient).*

Many aquatic resources in need of restoration have problems that originated with harmful alteration of channel form or other physical characteristics, which in turn may have led to problems such as habitat degradation, changes in flow regimes, and siltation. Stream channelization, ditching in wetlands, disconnection from adjacent ecosystems, and shoreline modifications are examples of structural alterations that may need to be addressed in a restoration project. In such projects, restoring the original site morphology and other physical attributes is essential to the success of other aspects of the project, such as improving water quality and restoring native biota.

Perhaps the greatest impact of roads concerns alterations and fragmentation of stream and riparian habitats. Studies show that road networks constructed in forests appear to have increased the magnitude and frequency of peak flows and debris slides, thus altering the natural dynamics of stream and riparian areas (Jones et al. 2000).

3. *Riparian and wetland systems* ***representative*** *of the full array of historical natural functions are more resilient and more likely to provide the source environments needed to support species persistence in the short and long term.*

Structure and function are closely linked in river corridors, lakes, wetlands, estuaries, and other aquatic habitat. Reestablishing the appropriate natural structure can restore beneficial eco functions. For example, restoring the bottom elevation in a wetland can be critical for reestablishing the hydrological regime, natural disturbance cycles, and nutrient fluxes. To maximize the societal and ecological benefits of the restoration project, it is essential to identify what functions should be present and make missing or impaired functions priorities in the restoration.

Using the Conservation Principles to Conduct Analysis

Wildlife guideline WIGU15 states that these conservation principles should be used to assist in identification of treatment priorities within watersheds, in design treatments for wildlife habitat restoration, and to help understand the effects of proposed activities on wildlife habitat. Evaluating these principles provides a consistent and logical line of reasoning to document progression toward Forest Plan restoration goals and objectives, as well as recognize when, where and why effects may occur to source habitats and the species associated with them. Since the principles are interdependent, when Forest managers evaluate the principles, they should consider the entire set of principles likely to be affected by proposed management actions, rather than just one principle absent the context of others.

For example, natural resource use and development in the western United States over the past 200 years has resulted in extensively fragmented systems in some areas, leaving only small, isolated remnants of native vegetation (conservation principles 2–5). Domestic livestock grazing has affected both the remaining patch fragments and the surrounding matrix, and nonnative plant and animal species have affected the native biota (Hobbs 2001). Invasive plant species have the potential to significantly alter ecosystem composition and functioning. *These different influences often interact.* For instance, smaller fragments are often more prone to plant invasion and more likely to have been grazed in the past. Invasions by plant species is often linked with livestock grazing or road development. Classical fragmentation studies that concentrate on parameters such as habitat area and isolation but ignore changes in habitat condition brought about by livestock grazing, road development, and invasive species are unlikely to yield meaningful results. Similarly, management of fragmented ecosystems must account for not only the spatial characteristics of the remaining habitat but also the importance of other influences, particularly those that impinge on fragments from the surrounding matrix.

Mid-scale conservation principle indicators (CPI) were developed for each conservation principle to assist in developing the WCS. For each CPI, three relative risk ratings (high, moderate, and low) were developed to help inform mid-scale conclusions concerning how well a principle is currently met and what, if any, action may be needed to restore conditions related to a conservation principle. The Boise National Forest *Wildlife Conservation Strategy Report* (Nutt et al. 2010) provides the detailed documentation of these assessments and associated findings.

The evaluation of mid-scale CPIs provided a consistent and logical line of reasoning to inform development of the Forest Plan WCS and subsequent Forest Plan management direction. Likewise, evaluations of principles and appropriate CPIs for fine- to site-scale planning will provide a consistent and logical line of reasoning for documenting progress toward WCS restoration goals and objectives reflected in the Forest Plan; inform conclusions as to when, where, and why project effects may occur to conditions addressed by the indicator; and provide a framework for developing project-specific mitigation responding to effects. In some cases, the CPIs developed for mid-scale assessments will be appropriate in these finer scale assessments; however, in some cases more specific CPIs may be developed to take advantage of better data sources. When new CPIs are developed through fine- to project-scale planning, documentation to demonstrate the value and use of an indicator should be completed as at the mid-scale (*2009 Science Findings Contract* [Suring 2009a]).

A final caveat to consider is that in some cases, negative effects (i.e., increases in relative risk) to one principle in the temporary (≤3 years) or short (≤15 years) term may be acceptable to improve (i.e., reduce relative risk) another principle in the long term (>15 years). A decision whether to allow a negative impact within temporary or short-term time frames to provide for long-term risk reductions and/or promote restoration goals will depend on the duration of the impact, site-specific conditions, the status of species of concern in that location, and other resources of concern.

WILDLIFE CONSERVATION STRATEGY MID-SCALE SPATIAL PRIORITIES AND TYPE OF RESTORATION

Restorative actions taken almost anywhere would provide some benefit to vegetation and wildlife habitat. However, due to limited resources and funds, not all needs can be addressed in the foreseeable future. Spatially prioritizing restoration areas will help ensure source environments are expanded and functional source habitat areas are reconnected in a manner and time frame that provides the greatest benefit to species of conservation concern.

Forest managers and scientists believe the likelihood of restoration success increases as a landscape prioritization strategy is developed and implemented. A landscape prioritization strategy helps managers better understand how restoration in a given area contributes to the greatest conservation benefits for species of conservation concern and the spatial integration of restoration efforts relative to multiple habitat areas; how benefits can be maximized for a given cost; and how, through integration with other resources within and among agencies, managers can capitalize on common objectives and minimize unintended effects to accomplish various restoration objectives

(USDA Forest Service and USDI BLM 2000; Rieman et al. 2000; Mehl and Haufler 2001; Brown 2002; Crist et al. 2009).

Two types of landscape prioritization strategies were developed to address source habitat and the more inclusive source environment needs for habitat families and species of conservation concern. The first strategy addresses conservation and restoration needs for habitat families where vegetation conditions are substantially departed from those believed to have occurred historically (e.g., habitat Family 1). The second strategy addresses potential human conflicts associated with source environments linked to species of concern such as wolverine (e.g., habitat Family 3).

The spatial priorities for these strategies are displayed on the Wildlife and Vegetation Habitat Restoration Strategy map and the Source Environment Restoration Strategy Map, respectively (FEIS, Appendix 3). Both Forest-wide and Management Area direction are directly linked to these spatial strategies. While the long-term goal of these spatial priorities and associated plan direction is to maintain or restore environmental conditions needed to support persistence of terrestrial wildlife species found across the Forest, a short-term emphasis (i.e., this planning period) is provided for habitats or species of greatest conservation concern. This approach to short-term restoration will not equally address all habitats needing restoration. However, with the long-term component of the strategy in place, opportunities for restoring departed habitats of lesser concern will still be available. A brief synopsis of the long- versus short-term priorities follows.

Long-term (>15 years) Priorities: In order to provide habitat well distributed across the planning unit to support sustainability of native species, Forest vegetation communities should contain the array of desired habitat conditions described in Appendices A (i.e., macrovegetation features) and E (e.g., fine-scale elements such as old-forest habitat). The vegetative desired conditions described in Appendix A fall within the historic range of variability (HRV). Similarly, the desired conditions for wildlife habitat in the Forest Plan are to remain within, or move towards, conditions that fall within the HRV. The underlying assumption of the WCS is that the risk of losing species, processes, or genetic diversity within populations is thought to increase as departure from the HRV increases (Figure E-3) (McComb and Duncan 2007). While the level of risk likely becomes increasingly uncertain as the distance from HRV increases, the shape of the relationship and the confidence intervals depicted are not well understood (McComb and Duncan 2007) and likely vary among specific taxa.

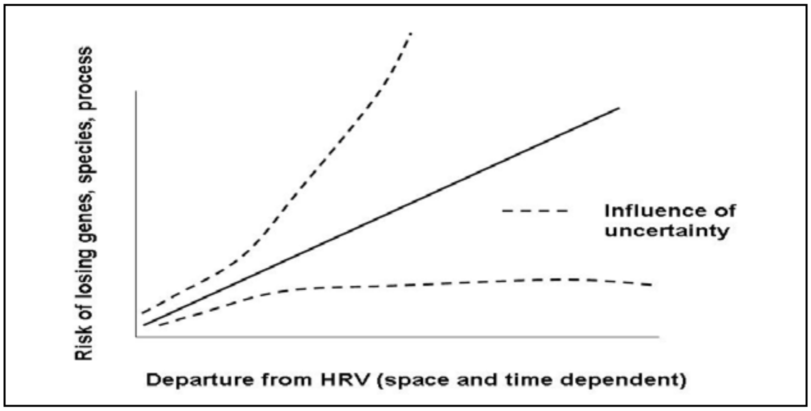

Figure E-3. Risk of species loss relative to departure from historic range of variability (HRV) (McComb and Duncan 2007)

While every acre across the Forest does not need to contribute to a desired network of source habitat and related environmental conditions, Forest managers should recognize that the greater the departure of source environments from HRV—largely depicted by the aforementioned conservation principles—the greater the risk to species sustainability.

Short-term (≤15 years) Habitat Maintenance and Restoration Priorities: Not all habitat families have experienced habitat change equally from historic to current conditions. While changes in habitat have occurred in each family, Families 1 and 3 in the forests only habitat suite have a greater need for short-term conservation and restorative action compare to Families 2 and 4 in this suite (Table E-1). Since the Forest has limited funding to support restoration, short-term restoration priorities are designed to focus efforts and funding during the next 10–15-year planning window on those habitats and species with the greatest departure from historical conditions in habitat quantity, quality, and/or distribution. Restoring short-term priority areas will provide the building blocks for locating and designing restorative management actions over the long term.

IMPLEMENTING WILDLIFE CONSERVATION STRATEGY PRIORITIES AND STRATEGIES AT THE FINE SCALE, TAKING ACTION, AND MEASURING SUCCESS

Mid-scale decisions about priority 5th Code HUs (i.e., watersheds) are supplemented at the fine and site scales with information about specific threats at these smaller scales and site-specific actions needed to reduce or eliminate these threats. Generally, the more detailed datasets typically available at fine-to-site scales should be used to assess those habitat elements (e.g., snag conditions and distribution, verification of old-forest habitat) that could not be assessed fully in mid-scale analyses due to the limitations of common, planning unit–wide datasets. Understanding threat distribution and severity within fine-scale landscapes is vital to identifying and designing specific actions to effectively eliminate or mitigate the threats.

Relationship of the Wildlife Conservation Strategy to Forest Plan Appendices A and B and the Aquatic Conservation Strategy

Forest Plan vegetative management direction and Appendix A provide the operational framework for achieving desired vegetative conditions envisioned in the Forest Plan. Appendix A contains the mapping criteria, classification descriptions, and desired condition tables for vegetation. Separate tables and/or narratives within Appendix A disclose (1) desired conditions for separate components of forested vegetation, including snags and coarse woody debris; (2) desired conditions for woodland, shrubland, and grassland; and (3) desired conditions for riparian vegetation, including vegetation in riparian conservation areas (RCAs). Appendix A also describes how to plan for and undertake management actions that result in vegetative patches and patterns typical of those believed to have existed historically.

Forest Plan soil, water, riparian, and aquatic (SWRA) resource management direction; Appendix B; and the ACS provide the operational framework for achieving the desired SWRA resource conditions envisioned in the Forest Plan. Appendix B contains (1) the Southwest Idaho Ecogroup Aquatics Matrix, which describes properly functioning conditions for SWRA resources by pathways and watershed condition indicators; (2) Guidance for Delineation and Management of RCA; (3) the Implementation Guide for Identifying and Managing Landslide and Landslide Prone Areas; and (4) an Overview of the Southwest Idaho Ecogroup ACS, including determinations of the appropriate type of subwatershed restoration and the priority for short- and long-term progression toward achieving SWRA resource desired conditions.

Wildlife resource assessments supporting the Forest Plan indicated that these vegetative and SWRA resource strategies would maintain or contribute to the long-term maintenance and restoration of landscapes to a condition similar in *representation*, *resiliency*, and *redundancy* as that believed to have occurred historically (i.e., HRV). As such, management actions that strive toward achieving the appropriately functioning or desired conditions described in Appendices A and B will result in achieving long-term landscape source habitat conditions needed to support terrestrial wildlife species.

However, while Appendices A and B provide consistent definitions of the desired macrovegetative and SWRA resource conditions that encompass source habitat definitions, in many cases these definitions need to be refined during fine- and site-scale assessments to more accurately depict the range of conditions that represent source habitat needed to support ESA listed species, Region 4 sensitive species, and other species of conservation concern in the short versus long term.

For mid-scale assessments, species source habitat was assessed using Appendix A macrovegetation elements that best aligned with definitions from Wisdom et al. (2000), as well as other locally relevant literature. This more generalized approach was sufficient to assess factors needed to develop a mid-scale WCS that (1) conserves or restores habitat representation, resiliency, and redundancy across the planning unit; (2) identifies potential threats to current habitats and options to address them; and (3) identifies principles that should be used to help assess the relative risk these threats present to maintaining or restoring desired source environments. However, in future fine- and site-scale assessments, it will be important to recognize that the vegetative communities associated with Appendix A macrovegetation elements and their successional stages have unique environmental conditions that are ecologically important as niches for wildlife species (Thomas et al. 1979). Combinations of these successional stages may be necessary for some species for foraging, reproduction, or both, while other species are associated with one stage for all their needs.

To address this variation, the WCS developed habitat definitions and modeling parameters for habitat families, ESA listed species, and Region 4 sensitive species that linked to Appendix A macrovegetation elements but also described the other habitat features that could not be captured by the macrovegetation elements alone. Description of habitat definitions and modeling parameters was also done for other species of mid-scale analysis focus (i.e., focal species), including MIS. Documents providing this information have all been combined into the *Boise National Forest Wildlife Conservation Strategy Report* (Nutt et al. 2010). Biologists should refer to this report to find more specific definitions and habitat parameters for habitat families and their associated species.

As fine- to site-scale assessments are completed in support of plan implementation, it will be important to understand that as vegetation moves from one successional stage to the next, both the vertical and horizontal structure of the vegetation changes (i.e., size and arrangement). Understanding how Appendix A macrovegetation elements relate to a successional stage is important to assessing the quality of habitat on a landscape.

The structural stages displayed in Figure E-4 were used by Wisdom et al. (2000) and Hann et al. (1997) in their analyses for the Interior Columbia Basin project and provide an illustration of the important structural stages. These structural stages do not necessarily move sequentially from one stage to the next but instead follow paths influenced by climatic factors, site and landscape characteristics, disturbance type, disturbance severity, disturbance periodicity, and anthropogenic influences. Structural stages can be altered by management practices that either advance or impede movement into another stage; these stages could fall within various Appendix A structural size classes (i.e., large, medium, small, sapling, or grass/forb/shrub/seedling [GFSS]). Understanding the pathways between stages can help identify opportunities for restoring, as well as maintaining, desired structural stages over time. By associating the tree size class and canopy cover variables described in Appendix A with these structural stages, wildlife biologists can more finely characterize source habitat needs for individual species or habitat families. A description of each structural stage follows the FigureE-4.

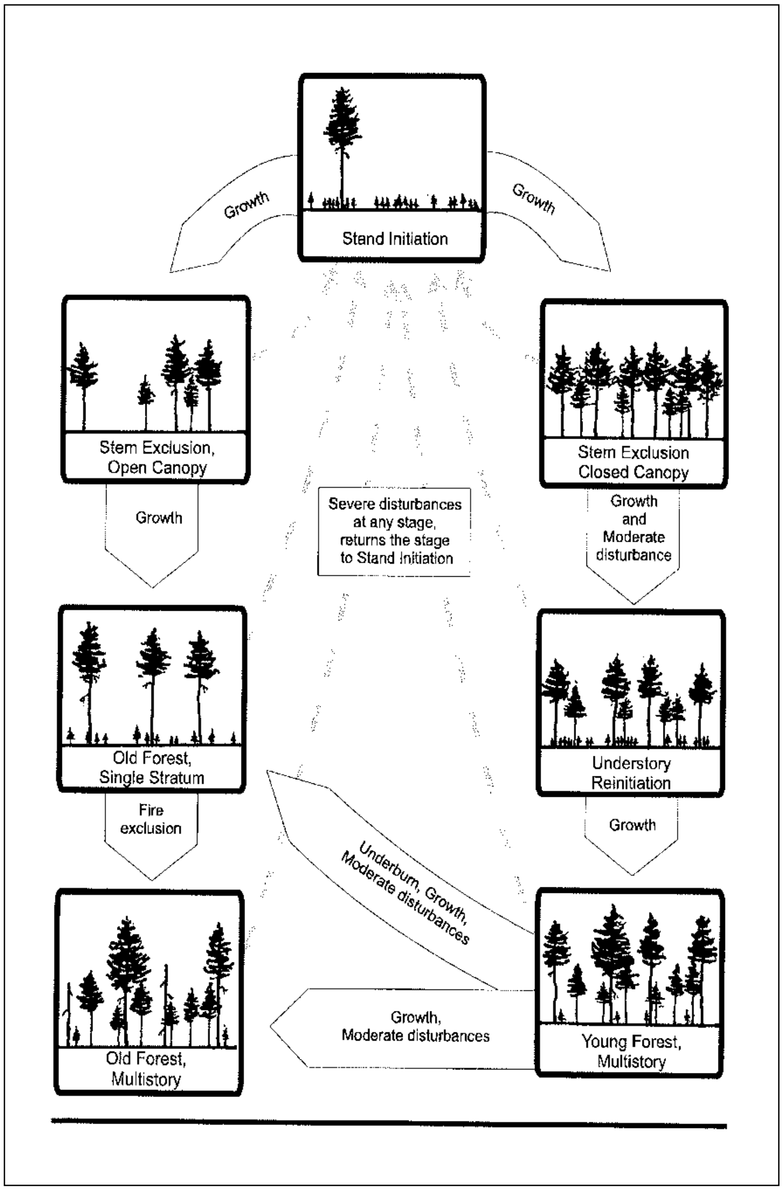

Figure E-4. Illustration of forest structural stages (Hann et al. 1997; Wisdom et al. 2000)

Stand Initiation—This stage refers to land that is reoccupied following a stand-replacing disturbance (Hann et al. 1997). Sites are occupied by GFSS in a broken or continuous layer (O'Hara et al. 1996). Legacy trees could be present but would make up <10 percent of the canopy cover. Typically this stand condition would be classified as either a GFSS or sapling tree size class per Appendix A definitions.

Stem Exclusion, Open Canopy—This stage refers to forested areas where the occurrence of new tree stems is limited by moisture (Hann et al. 1997). Sites are occupied by one broken-canopy cohort, usually of small- or medium-sized trees (O'Hara et al. 1996). Some large live legacy trees, up to 29 percent of the canopy cover, may also be present. When large trees account for 10–29 percent of the canopy cover, this stand condition would be classified as a large tree size class per Appendix A definitions. When large trees make up <10 percent of the canopy cover, this stand condition would typically be classified as a small or medium size tree stand per Appendix A definitions

Stem Exclusion, Closed Canopy—This stage refers to forested areas where the occurrence of new tree stems is predominately limited by light (Hann et al. 1997). Sites are generally occupied by one cohort of small- or medium-sized trees in a continuous closed canopy (O'Hara et al. 1996). Some large live legacy trees, up to 29 percent of the canopy cover, may also be present. When large trees account for 10–29 percent of the canopy cover, this stand condition would be classified as a large tree size class per Appendix A definitions. When large trees make up <10 percent of the canopy cover, this stand condition would typically be classified as a medium size tree stand per Appendix A definitions.

Understory Reinitiation—This stage occurs when a second generation of trees is established under an older, typically mid-seral, overstory (Hann et al. 1997). Sites are occupied by at least two, sometimes more, cohorts of younger trees under older small- or medium-sized trees (O'Hara et al. 1996). Some large live legacy trees, up to 29 percent of the canopy cover, may also be present. When large trees account for 10–29 percent of the canopy cover, this stand condition would be classified as a large tree size class per Appendix A definitions. When large trees make up <10 percent of the canopy cover, this condition could be classified as a small or medium size tree stand per Appendix A definitions.

Young Forest Multistory—This stand development stage results from frequent harvest or lethal disturbance to the overstory (Hann et al. 1997). Sites are occupied by multiple cohorts, ranging from seedlings to medium sized trees (O'Hara et al. 1996). Managed young, multistory stands have undergone some form of silvicultural treatment, salvage, or roading and contain relatively few large snags or trees (Wisdom et al. 2000). Unmanaged young, multistory stands have not undergone disturbances described for managed stands and contain higher densities of large snags and large trees. When large trees account for 10–29 percent of the canopy cover in a young multistory stand, this stand would be classified as a large tree size class per Appendix A definitions. When large trees make up <10 percent of the canopy cover, this stand condition would be classified as a medium size tree stand per Appendix A definitions.

Old Forest, Single Stratum—This stage refers to forested areas resulting from frequent nonlethal fire or other management activities (Hann et al. 1997). Sites are occupied by broken-to-continuous cover of large, single or multiaged cohorts in the same stratum (O'Hara et al. 1996). The understory is absent or consists of some inclusions of seedlings or saplings. Wisdom et al. (2000) defined old forest, single story as stands with >30 percent canopy cover in the large tree size class and <20 percent canopy cover in smaller size classes. Old-forest habitat is defined for potential vegetation groups (PVGs) in Table E-2. Forested stands within the planning unit that meet these conditions are identified as old-forest habitat. Per Appendix A definitions, these stand conditions would always be classified as a large tree size class.

Old Forest, Multistory—This stage refers to forested areas resulting from a lack of understory disturbance (Hann et al. 1997). Sites are occupied by multiaged trees in an assortment of size classes and stratums (O'Hara et al. 1996). Wisdom et al. (2000) defined old forest multistory as stands with >30 percent canopy cover in the large tree size class and at least 20 percent canopy cover in smaller size classes. Old-forest habitat is defined for PVGs in Table E-2. Forested stands within the planning unit that meet these conditions are identified as old-forest habitat. Per Appendix A definitions, these stand conditions would always be classified as a large tree size class.

Understanding Context is Key to Successful Strategy Implementation

As stated in Appendix A, and supported by findings in Appendix B, *"In many areas, current conditions deviate strongly from desired conditions…even under careful management it may take several decades for these areas to approach desired conditions. During that time, managers will have to choose among several approaches to maintain progress toward desired conditions. There may be many different paths to a common endpoint that meet different management objectives, but each path has its own trade-offs. Navigating these paths and trade-offs will be the challenge of ecosystem management in trying to achieve desired vegetative conditions"* (Appendix A, page A-1). For managers to effectively understand trade-offs between resources, priority activities identified for vegetative and SWRA resources need to be evaluated alongside those priorities identified for wildlife source habitat or species of conservation concern (Table E-1). Although in many cases these priorities are consistent, situations exist where they are not. In these situations, trade-offs will need to be balanced consistent with the multiple-use objectives associated with the applicable Forest Plan management prescription category (MPC) allocation.

In most cases, Forest managers must use broad- and mid-scale assessment findings to establish a broader context for identifying fine-scale issues/priorities. The absence of context is like having a word with no sentence; there is nothing to help explain the meaning of the word or what message is being conveyed. Information or attributes visible at one scale may disappear at another scale. Influences at broader scales generally operate over a longer time frame than at finer scales; setting limits on ecosystem, analogous to machinery operating at finer scales. Fine-scale machinery is the gears, rods, and pistons, more or less invisible at broader scales, that make the ecosystem tick. The machinery at one scale is the context or constraint at the next scale down.

As discussed in Chapter III of the Forest Plan (p. III-1), three analysis scales should be considered during plan implementation to fully understand the context of and effects (negative or beneficial) to ecosystem and species diversity likely to result from implemented actions. At each scale, consistent with WIGU15, the conservation principles discussed above should be used to assist in evaluations.

From larger to smaller, the following three scales should be addressed and/or assessed:

1. Mid scale: This scale of analysis was completed by the Forest interdisciplinary team (IDT) within the context of broader-scale findings, such as those identified in the ICBEMP and *Idaho Comprehensive Wildlife Conservation Strategy* (IDFG 2005). This analysis is maintained in the planning record and will be updated periodically as part of Forest Plan monitoring and

evaluation consistent with timelines established in Chapter IV of the Forest Plan. This analysis provides conservation and restoration priorities *among* 5th HU watersheds.

2. Fine scale: This scale of assessment results in a better understanding of spatial and temporal relationships of threats, risks, and priority actions *within* a 5th HUC watershed. Typically, outcomes from this scale of assessment support what is referred to "tactical planning" and would be reflected by the Forest Leadership Team in updates to the Forest's 5-year integrated plan for forest plan implementation (i.e., projects to be implemented to address Forest multiple-use priorities over the next 5 years). This 5-year plan integrates the various resource priorities for action along with other social and economic priorities, such as hazardous fuel reduction activities within the wildland-urban interface (WUI).
3. Site scale: Analysis at this scale supports site-specific planning and design of projects that implement priority actions identified in the Forest's 5-year integrated plan.

Evaluations across these scales lead to the following:

- An understanding of the importance of each watershed within a planning unit in providing source environments, including source habitat, for species associated with habitat families in the short and long term.
- An understanding of what threats represent the greatest risk to species and their source environments and where action is needed in the short and long term.
- The ability to trace the logic of management priorities to address the threats that represent the greatest risks in the short term (i.e. this planning period); and ultimately the long term.
- The ability to provide the context needed to support the probable effect of a specific project activity and its likelihood of changing an identified threat to habitat, and what that change means in terms of decreasing or increasing short-term risks to habitats and associated species of conservation concern across their respective ranges within the planning unit.

This hierarchical and iterative approach to evaluating ecosystem and species diversity will likely be more rigorous where risks to ecosystems and species are high or where potential management is complex. To improve planning efficiencies, the rigor of analysis should be commensurate with the degree of risk a project represents to habitats and their associated species of concern. Additional information concerning fine- and site-scale assessments is provided below.

Fine-Scale Assessments (Short-Range Tactical or Plan-to-Project Planning)

Similar to how plan-level mid-scale analyses provide context to fine-scale analyses, fine-scale analyses provide context to conclusions reached in site-specific analyses. Fine-scale assessments provide the more finite information needed to support scheduling of actions that will help achieve Forest Plan goals and objectives, as well as Forest program goals and emphasis items. These assessments rely on existing datasets unless the Responsible Official determines that additional data collection is warranted in light of the potential risk and threats to be addressed. In most cases, existing data can be used directly or as surrogate indicators of a potential threat needed to assess risk to habitat or associated species.

Results from fine-scale assessments are not only used to identify and prioritize opportunities for restoration within watersheds, but also to inform the Responsible Official of the likely magnitude (spatially and temporally) of potential project effects. Fine-scale information—in combination with the forest planning mid-scale assessment—can help inform priorities for project planning and design, resolve potential issues about the magnitude of effects to wildlife species in one area over another, and assist in understanding the effects of an action within the broader planning-unit framework. In other words, what may appear to be a concern or not a concern when looking at the project area alone may take on a different light when viewed from a higher scale. Fine-scale assessments should help answer questions such as the following:

- For proposed projects with a purpose to maintain or restore habitat related to one or more habitat families:
  - Why is a particular threat to habitat, or its associated species, the right one to address?
  - Why is it a priority to address this threat or need for restoration in this location at this time?
- For proposed projects whose purpose is to achieve other multiple-use goals and objectives in the Forest Plan (e.g., recreation facility development, mining, domestic livestock grazing, and forest products for socio-economic support):
  - Will implementing this action measurably increase the magnitude of a threat that has been identified as potentially contributing to declines in habitats associated with species of conservation concern within this watershed and/or planning unit?
  - If implementing this action is likely to measurably increase the magnitude of a threat, what project design or mitigation is needed to avoid or minimize the magnitude of the threat to the level where it will no longer result in unacceptable consequences to an ESA listed species, Region 4 sensitive species, or other species of concern?
  - If no project design or mitigation measures are available to avoid or minimize the magnitude of the effect in that location, can the effect be compensated for elsewhere within the watershed and/or planning unit in a manner that does not increase the overall risk or uncertainty concerning persistence of species within the planning unit?
  - Do opportunities for wildlife source environment restoration exist in this location, regardless of the WCS priority, that can be capitalized on through this action?

Setting priorities and scheduling work are key considerations in fine-scale assessments. Actions designed to address opportunities generated through fine-scale, plan-to-project planning will typically be included in the Forest's 5-year integrated plan when the Forest Service is reasonably confident the funding is or will be available to implement the project.

Site-Scale Assessments (Project or Site-specific Planning)

While fine-scale analyses provide context as to the importance of the beneficial or negative effects of a proposed project, they do not include the necessary detail concerning baseline conditions within a project area needed to assess and disclose site-specific direct, indirect, and cumulative effects of an action. Project design, planning, and related assessments provide this necessary detail.

In addition, the WCS identifies three important fine- to site-scale habitat elements that need greater emphasis for conservation and restoration during project design and planning this planning period: old-forest habitat, legacy trees, and large snags. These elements are discussed in detail below.

Old-Forest Habitat

As a result of commitments made by the Region 4 Regional Forester to implement the 2003 ICBEMP Memorandum of Understanding and Strategy, the term old forest habitat, instead of old growth, was adopted for the Forest Plan. Old forest habitat better represents the desired habitat condition for those species of conservation concern than of old growth. This distinction is important on the Boise National Forest since many old growth definitions exclude forests with fire influences, even where fire is a part of the historical disturbance regime. In other cases, such disturbance is incorporated in the old growth concept. Many definitions of "old growth" are based on climax or near climax communities that have successfully developed in the absence of disturbance. Across the Forest, "old" trees were historically common, but were often in vegetative communities that resulted from disturbance rather than the absence of disturbance.

Since the inception of the "old growth" concept, many scientists have come to agree that "old" forests, regardless of their successional pathways, share several traits. For example, they contain relatively mature old trees with little to no evidence of post-settlement activities. Thomas et al. (1988) emphasize that there is no single all-inclusive definition for "old growth" characteristics which vary by region, forest type, and local conditions. Hunter (1990) promotes that a universal "old growth" definition is not desirable and that forest ecologists should develop unique definitions for each forest type, taking into account forest structure, development, function, and patterns of human disturbance.

In central Idaho, "old growth" was considered historically rare, particularly in vegetative communities frequented by fire even though the large tree size class was extensive in many PVGs (Appendix A) (Morgan and Parsons 2001). Historically, forested stands in lower-elevation potential vegetation groups with nonlethal to mixed1 fire regimes likely developed stands of large ponderosa pine trees with relatively low canopy cover during mid-seral stages, and these conditions were maintained over time by frequent low-intensity fire. Denser stands composed of late seral to near climax species compositions, and decadence typically associated with "old growth" conditions were rarer on the landscape in those areas with frequent fire but did occur more extensively in potential vegetation groups with longer fire-free intervals. Therefore, rather than exclude these large tree conditions that contain old trees because they do not meet local "old growth" definitions (Hamilton 1993, Mehl et al. 1998), or develop Forest-specific definitions based on the concept of "near climax", the planning team advocated applying the broader definition of old forest habitat as defined Hann et al. 1997 and adopted by Wisdom et al. 2000. This more inclusive definition captures a greater array of large tree conditions including large old trees in stands that may or may not be defined as old growth and stands that contain large old trees of early seral species. Thus old forest habitat as defined below may include old growth, depending on the PVG, but is also broader to include the early and mid-seral, fire maintained systems.

This is important because across the Forest, this more broadly defined "old-forest habitat" is an important source habitat condition that provides essential denning, nesting, foraging, and cover habitat for many wildlife species. Old-forest habitats are distinguished by old trees and related structural attributes, which include tree size, signs of decadence, large snags and logs, canopy gaps, and understory patchiness (USDA Forest Service 2003a; Van Pelt 2007, 2008). Old-forest habitat develops when structural elements (e.g., large snags, logs, understory structure) are found in proximity to old, large trees, typically those defined as legacy trees (refer to Appendix A). Due to differences in forest/habitat types, site quality, climate, and disturbance patterns, old forests may vary extensively in tree sizes, age classes, and presence and abundance of structural elements (Helms 1998).

Old forest habitat is described using two distinct structural stages: old forest single-story (or stratum) and old forest multistory (refer to Description of Forest Structural Stages above). Structural conditions and associated characteristics for old-forest habitat vary depending on forested vegetation type (PVG) and the associated fire regime (Table E-2). The minimum criteria in Table E-2 for defining old forest habitat describe a subset of the large tree size class based on the canopy cover classes, species composition, snags, and coarse woody debris displayed in Appendix A.

Table E-2. Definitions for old-forest habitat within potential vegetation groups (PVGs) (arranged by fire regime). Components are measured at the stand level.

Fire Regime	PVG	Tree Size Class	Canopy Cover of Live Trees ≥20 inches d.b.h.[a] (Large Tree Canopy Cover)	Canopy Cover of Live Trees ≥0.1 inches d.b.h. (Stand Canopy Cover)	Species Composition of Live Trees ≥20 inches d.b.h.[e]	Number of Snags of a Particular Size in Each Acre[b]		Coarse Woody Debris Tons/Acre[c]	
						10 – 19.9 inch	≥20 inch	≥3 inch	≥15 inch
Nonlethal	1	Large	≥30%	≥30% and <70%	PP ≥60%	≥1	≥1	≥6	>75%
	2	Large	≥30%	≥30% and <70%	PP ≥60%	≥2	≥2	≥9	>75%
Nonlethal–mixed-1	5	Large	≥30%	≥30% and <70%	PP ≥60%	≥3	≥2	≥9	>75%
Mixed 1–mixed 2	3	Large	≥30%	≥50% and <70%	PP and/or DF ≥60%	≥2	≥1	≥9	>65%
	4	Large	≥30%	≥50% and <70%	DF ≥60%	≥2	≥1	≥9	>65%
	6	Large	≥30%	≥50% and <70%	PP, WL, and/or DF ≥60%	≥3	≥2	≥9	>65%
Mixed 2	7	Large	≥30%	≥50% and <70%	DF ≥60%	≥3	≥2	≥12	>50%
	11	Large	≥30%	≥50% and <70%	WB and/or ES ≥60%	≥2	≥1	≥9	>25%
Lethal	8	Large	≥30%	≥50% and ≤100%	WL, DF, and/or ES ≥60%	≥4	≥2	≥12	>25%
	9	Large	≥30%	≥50% and ≤100%	ES ≥60%	≥4	≥2	≥12	>25%

[a] d.b.h.=diameter at breast height

[b] Regardless of d.b.h., the height of all snags should be ≥30 feet in all PVGs except PVGs 1 and 11 where the minimum height is ≥15 feet. Note, while snags shorter than these heights do not contribute to determining whether a forest stand meets the old forest habitat definition, they do contribute to ecological functions and should be retained.

[c] Regardless of diameter, the length of all coarse woody debris should be ≥6 feet.

[d] PVG 10 is not included because persistent lodgepole pine does not develop old-forest conditions that are considered source habitat for WCS focal species or species of concern.

[e] PP = ponderosa pine; DF =Douglas-fir; WL = western larch; ES = Engelmann spruce; WB = whitebark pine

The historical fire regime heavily influenced the patch size, spatial distribution, and vertical/horizontal diversity of structural elements of old-forest habitat for the associated PVG. Forested stands that experience frequent low- or mixed-severity fire disturbances (e.g., dry and moist ponderosa pine [PVGs 1 and 2]) develop old-forest single-story structure, which has been described as uneven-aged stands composed of relatively small, even-aged groups or patches interspersed with herbaceous openings and canopy gaps (Figure E-5; Kaufman et al. 2007). These stands primarily occur in the lower to mid-elevations; are typically less dense, consisting of fairly open clumps of large trees; and have small to moderate accumulations of understory conifers and large coarse woody debris/logs.

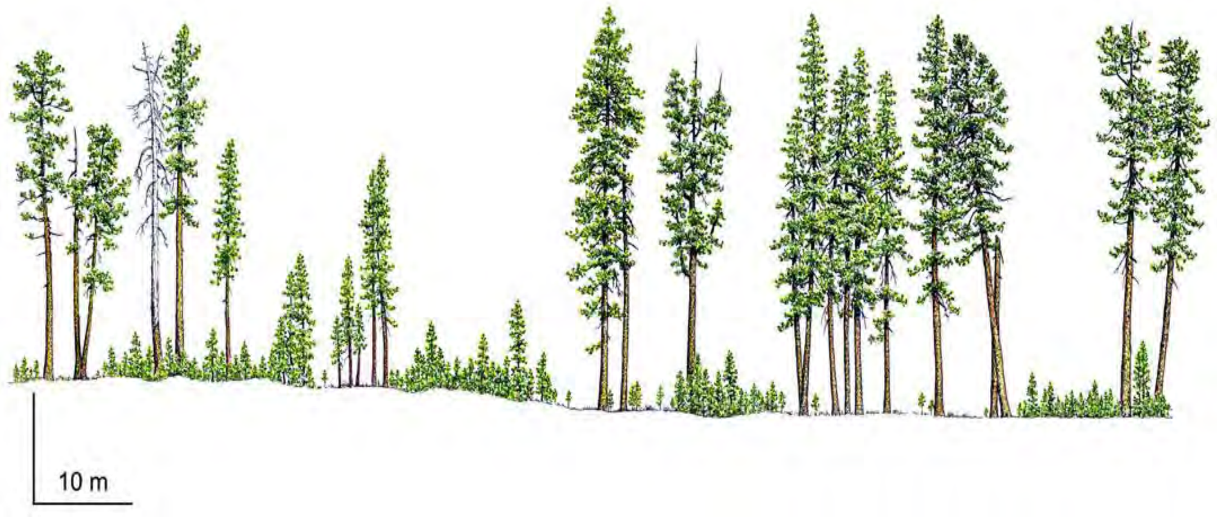

Figure E-5. Graphic of ponderosa pine old-forest habitat, single-story condition (Van Pelt 2008)

Forested stands that developed from less frequent high- or mixed-severity fire disturbances (e.g., warm, dry subalpine fir [PVG 7]) tend to develop multistory old-forest structure, which includes a variety of sizes and conditions of live trees, snags, and logs and some large, old trees (Figure E-6). In these stands, spatial heterogeneity is present vertically, in the form of a vertically continuous but variably dense total stand canopy, and horizontally, apparent in patchiness in stand density (WSDNR 2005). Structural attributes of multistory old forest typically include a developed understory, multi-aged trees, and large volumes of large coarse woody debris/logs. These stands are more typical of the upper montane and subalpine forests.

Figure E-6. Graphic of Douglas-fir in an Old-Forest Habitat, Multistory Condition (Van Pelt 2007)

Criteria found in Table E-1 should be used to determine compliance with Forest Plan standards concerning old-forest habitat—WIST08 and WIST09. To comply with these old-forest habitat standards, management actions are permitted within these stands as long as (1) the stands continue to meet the definition of old-forest habitat (WIST08) after the action is completed or (2) if the stand is currently not in an old-forest habitat condition but has the species composition needed to restore this condition, management actions do not preclude development of old-forest habitat (WIST09).

The definitions for old forest habitat include attributes that are commonly collected as part of forest inventory or stand examination. This was done because 1) attributes collected through these activities have existing, well defined protocols; 2) are already collected through on-going programs, and 3) can be assessed objectively using the same procedures as those in place to screen macrovegetation for the Appendix A desired conditions. The portion of large tree size class described in Appendix A where the large tree, nonoverlapping canopy cover ranges from 10 to 29 percent canopy is not defined as old-forest habitat (refer to Figure E-4). However, the large trees in these stands do provide important habitat for a variety of species, particularly if they are legacy trees. Therefore, where the tree species composition is consistent with that desired in old-forest habitat, these large trees can provide a starting point for restoring old-forest habitat conditions.

Legacy Trees and Old-Forest Habitat

Legacy trees are important attributes of old-forest habitat because they are often the largest and oldest specimen present. As discussed in Appendix A, legacy trees can be defined as anything handed down from a pre-disturbance ecosystem (Perry and Amaranthus 1997). These old, large trees can also be a remnant of a prior old-forest condition that exists in stands of other forest structural stages due to a previous disturbance event. In forests characterized by low- or mixed-severity fire regimes, aging stands become more diverse and complex due to low-severity disturbances that result in the establishment of multiple cohorts (Van Pelt 2008). In these forests, it is often the presence of clumps or individual legacy trees that determine opportunities for restoration of old-forest habitat and ultimately become the foundation for a restoration plan (Van Pelt 2008).

Characteristics of legacy trees include deep bark fissures, wide bark plates, altered bark color, flattened crowns, different branch characteristics, dead tops, and diversity in crown form (Kaufman et al. 2007; Van Pelt 2008). These old, large trees are often selected as nesting sites due to their larger branches that are capable of supporting large stick nests, and these trees often have dead tops or internal decay that provide nesting or denning habitat for cavity-dependent species. Older, larger trees have deep, full canopies that provide more foraging area for bark and foliage gleaners and typically produce greater quantities of seed important to a number of species. When these legacy trees die they continue to provide important habitat as a large snags or eventually as a large logs within old-forest habitat. Legacy trees also provide genetic material important for future stand establishment because it reflects local site conditions.

Ponderosa pine and western larch legacy trees are important to wildlife species on the Forest, and the Forest Plan includes specific direction (VEGU08) emphasizing the need to retain these important trees. These trees are long-lived seral species that contribute to old-forest habitat conditions important for wildlife species persistence and are typically subject to management activity due to their presence in lower and midelevations where forest management is most likely to occur. Refer to the Appendix A discussion and description of legacy trees.

Estimates of the HRV of Old Forest Habitat

The ICBEMP assessment provides an estimate of historical ranges for old forest structural stages using a process similar to that which generated the HRV for Appendix A (Hann et al. 1997). Estimates were generated for Ecological Reporting Units (ERU) including the Central Idaho ERU, which covers most of the Boise National Forest. This information was used to develop the ranges displayed in Table E-3.

Table E-3. Historical Estimates of Old Forest Habitat by PVG for the Boise National Forest

Old Forest Habitat	Percentage Within Each PVG (%)									
	Nonlethal			Mixed1		Mixed2			Lethal	
	PVG1	PVG2	PVG5	PVG3	PVG6	PVG4	PVG7	PVG11	PVG8	PVG9
Historical Range	17-49			19-35		23-34				

Mid-scale assessments supporting the WCS concluded that far fewer acres of large tree size class forests exist compared to what was believed to exist historically. While mid-scale data are not detailed enough to fully assess all elements of old-forest habitat (Table E-3), it was assumed that the greater the departure of large tree size class stands from historical conditions, the greater the departure in old-forest habitat conditions. Thus, compared to historical conditions, source habitats—including old-forest habitats—in the low- and mid-elevation ponderosa pine forests have experienced the greatest change and have become much smaller in patch size, simplified in structure, homogenized within patches, and increasingly fragmented. These declines are the result of several factors, including historic forest management, disruptions in historical fire processes (i.e., long-term fire exclusion), and uncharacteristic fire events.

In response to these findings and assumptions, the Forest Plan strategy includes standards that require retention of existing old-forest habitat (WIST08) and restoration of old-forest habitat conditions (WIST09). Management actions are permitted within forested stands defined as old-forest habitat as long as the stands will continue to meet the definition of old-forest habitat when the action is completed. To design projects that comply with these standards, the definitions in Table E-1, Figures E-5 and E-6 and the discussion on legacy trees should be used as guides.

Snag Retention

Forest Plan direction results in different levels of snag retention within the various MPCs across the planning unit, consistent with the multiple-use objectives associated with individual MPCs. This direction includes retention requirements during general vegetation management treatments and in some cases, specific retention requirements during any salvage operation. Table E-4 provides a summary of snag retention requirements by MPC.

Studies conducted in burned forests have shown that several species respond positively to postfire conditions (Hutto 1995; Saab and Dudley 1998; Smith and Hoffman 2000). Kotliar et al. (2002) identified at least nine species of birds that are consistently more abundant in burned forests, indicating that these are important wildlife habitat areas. In addition, different postfire burn severities offer unique conditions or combinations of resources for species, and in order to meet habitat needs of all species, a range of fire severities need to be provided for across the landscape (Smucker et al. 2005). Some species (e.g., black-backed woodpecker, American three-toed woodpecker) are considered burn specialists and heavily rely on high-severity, postfire forests. These species nest in snags and rely on snags for feeding sources. Wood-boring beetle larvae are known to dramatically increase following severe fire, and their short life cycle (2–3 years) results in a very narrow window of opportunity for bird species to utilize this food source.

Table E-4. Snag retention requirements by management prescription category (MPC)

MPC	MPC Acres in Planning Unit	Vegetation Treatments, Including Salvage Logging	Snag Retention Requirement per MPC Standards
1.1 and 1.2	247,000	Prohibited	All snags retained
2.2 and 2.4	15,000	Allowed	As allowed in the RNA or Experimental Forest Management Plan
3.1, 3.2, 4.1a, and 4.1c	1,005,000	Allowed	Retain all snags >20 inches d.b.h. during all vegetation management operations. In addition, retain the upper end of Appendix A desired range for total snags and snags <20 inches d.b.h.
4.2, 5.1, and 6.1	999,000	Allowed	Retain the upper end of Appendix A desired range of snags >20 inches d.b.h. during salvage operations. All other vegetation management treatments manage consistent with Appendix A

Measuring Success, Monitoring and Evaluation, and Adaptive Management

Adaptive management incorporates new information and findings into conservation actions. Specifically, it is integrating the scientific method into the design, management, and monitoring of decisions. Adaptive management is used to systematically test assumptions and measure success in order to *adapt* and *learn* from decisions.

In light of the uncertainties associated with some of the assumptions used in developing the WCS, testing and documenting the outcome of actions during Forest Plan implementation is key to adjusting the “path” that ensures the realization of WCS. Chapter 4 of this Forest Plan provides the monitoring questions, indicators, and measuring frequencies for mid-scale elements. Results from monitoring will be comprehensively evaluated every 5 years. Results from these 5-year evaluations will be used to adapt our current mid- to fine-scale assumptions, Forest Plan management direction, and WCS priorities.

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APPENDIX F
RECREATION OPPORTUNITY SPECTRUM

ROS and its Role in Forest Plan Revision

What is ROS?

The Recreation Opportunity Spectrum (ROS) consists of a classification system in which components of recreation settings and facilities—such as access, developed sites, activities, and experiences—are organized and arranged along a continuum or spectrum. The continuum ranges from very primitive settings and experiences to highly concentrated, urbanized ones. Each class is defined in terms of its specific combination of activities, setting, facilities, and experience opportunities.

The ROS provides a framework for defining the types of outdoor recreation opportunities and experiences that the public might desire, as well as the mix of the spectrum that a given National Forest might be able to provide. It also provides a context and tool for estimating and describing recreation resources as well as effects to those resources from alternative management strategies and actions.

Applications in Forest Plan Revision

ROS is utilized in the Forest Plan to provide a framework for:

a) Providing a management context that ensures the maintenance or enhancement of recreation settings and of meeting public expectations for recreation experiences.
b) Reflecting the overall resource management strategy, as expressed by MPC assignments, within each management area in a recreation opportunity context.
c) Providing a meaningful context for the expression of recreation management strategy and direction at both the Forest-wide and management area levels. The application of the adopted ROS strategy is illustrated in Figure F-1, below.
d) Analyzing trade-offs of available recreation opportunities in effects analysis.
e) Comparing alternatives relative to the mix of recreation opportunities provided.
f) Monitoring outputs in terms of providing recreation opportunities.
g) Estimating recreation supply.

ROS Class Descriptions

The following descriptions of ROS classes were developed as a supplement to the ROS Users Guide, which contains more detailed information for most of these classes. The *ROS Users Guide* (USDA Forest Service, undated), contains a detailed description of the classes, overall concepts, and describes an inventory methodology. Specific ROS-related guidance for structure and improvement design can also be found in *The Built Environment Image Guide for the National Forests and Grasslands* (USDA Forest Service, 2001). This guide should be consulted when designing any type of structure or improvement on National Forest System lands.

Primitive

These areas provide for primitive recreation opportunities in unroaded and non-motorized settings. Unmodified natural and natural-appearing settings dominate the physical environment. In that these areas are generally larger than 5,000 acres, they offer opportunities for solitude, remoteness, and risk, with no onsite controls or restrictions evident after entry. Encounters with other users, and signs of other users, are minimal. Prescribed fire could be used to attain a variety of resource objectives. Generally, snowmobile, ATV, and other OHV uses are inconsistent with this ROS class.

In relatively rare cases, a motorized use may be present within areas classified as Primitive. This may occur as a result of uses authorized by legislation, administrative or emergency use of motorized vehicles, a setting inconsistency, or as an anomaly whose effects are extremely limited.

Semi-Primitive Non-Motorized

These areas provide for non-motorized recreation opportunities in unroaded and non-motorized settings. A natural-appearing setting dominates the physical environment, with only subtle or minor evidence of human-caused modifications. In that these areas are generally larger than 2,500 acres, they offer opportunities for solitude, remoteness, and risk, with a minimum of on-site controls and restrictions. Other user encounters should be generally low, with low levels of the sights and sounds of other users.

Management to control undesirable effects of insects, disease, and other pests, as well as management actions designed to maintain or improve the long-term health of the ecosystem, could occur. Prescribed fire could be used to attain a variety of resource objectives. Generally, snowmobile, ATV, and other OHV uses are inconsistent with this ROS class.

In relatively rare cases, a motorized use may be present within areas classified as semi-primitive non-motorized. This may occur as a result of administrative or emergency use of motorized vehicles, a setting inconsistency, or as an anomaly whose effects are extremely limited.

A number of setting inconsistencies may be present during winter periods in this classification. These inconsistencies consist mainly of roads or road prisms, minor structures and developed recreation features, and intermediate timber harvests whose presence becomes far less obvious during winter snow cover. Access during these periods usually shifts dramatically to skis and snowshoes, contributing to more primitive experiences.

Summer/winter shifts between this class and Semi-Primitive Motorized can also occur as a result of different travel management regulations. For example, areas where cross-country motorized travel is prohibited during the summer may be open to snowmobile use during winter periods.

Semi-Primitive Motorized

These areas provide for motorized recreation opportunities in semi-primitive settings. In areas seen from travelways, a natural-appearing setting dominates the outdoor physical environment, with only subtle or minor evidence of human-caused modifications. Other areas could have moderately dominant alterations. In that these areas are generally larger than 2,500 acres, they offer opportunities for solitude, remoteness, and risk, with little on-site controls and restrictions. Other user encounters should be generally low; however, the sounds of other users may be evident due to motorized uses.

A range of management activities that are consistent with semi-primitive settings may occur in these areas that support a wide range of other resource objectives. Prescribed fire could be used to attain a variety of resource objectives.

Motorized and non-motorized trails are the primary means of recreational user access within the area. Generally, existing roads within this class would be either inappropriate for or closed to passenger type vehicles. Non-motorized recreation opportunities may be present but these experiences are likely to be influenced by motorized uses in the area. Cross-country snowmobile use may occur on adequate snow depth in accordance with the current travel management plan or map and travel amendments. There may be areas or trails, within this ROS class, where motorized use is prohibited or restricted to enhance recreation experiences or to protect public safety or resources.

In some locations during winter, there may be considerable shifts to the Semi-Primitive Motorized class as the snow cover results in the road network being inaccessible to general automobile use. Where these areas are of sufficient size and are open to over-snow vehicles and/or have groomed snowmobile routes, they may function more closely like a Semi-Primitive Motorized area.

Some of the areas that shift from roaded natural or roaded modified during summer to a semi-primitive setting during winter may have a number of setting inconsistencies. These inconsistencies consist mainly of roads or road prisms, minor structures and developed recreation features, and intermediate timber harvests whose presence becomes far less obvious during winter snow cover. Access during these periods usually shifts dramatically to only over-snow vehicles and/or skis and snowshoes, contributing to more semi-primitive experiences.

Summer/winter shifts between this class and Semi-Primitive Non-Motorized can also occur as a result of different travel management regulations. For example, areas where cross-country motorized travel is prohibited during the summer may be open to snowmobile use during winter periods.

Roaded Natural

These areas provide for a wide range of recreation activities that are generally focused along the primary and secondary travel routes in a natural–appearing, roaded, motorized setting. Recreation facilities are provided to facilitate recreation use. There may be a moderate to high degree of user interaction, as well as the sights and sounds of other users, depending upon the facilities provided. Seasonal or year-round recreation facilities are provided for user comfort and convenience. Although structures may be designed to accommodate numerous users, they generally convey a rustic theme and blend with the natural landscape. There may be considerable on-site user controls or restrictions. Opportunities for isolation, challenge, or risk are generally not very important, although opportunities for practicing outdoor skills may be important.

Scenic values are often emphasized. Recreation is often only one of many management objectives applied to these areas. A wide range of management activities and objectives may occur, generally being guided by the adopted visual quality objectives. Landscape modifications due to resource management activities, where evident, harmonize with the natural setting. Prescribed fire could be used to attain a variety of resource objectives.

A wide range of recreation facilities may be provided for user convenience and comfort. Developed campgrounds of varying size, complexity, and development scale could occur. There may also be a wide range of facilities and structures to support other Forest uses such as telecommunication facilities, power lines, and administrative sites.

A wide range of transportation routes can occur, from State Highways to native-surfaced, timber access roads. Cross-country snowmobile use may occur on adequate snow depth in accordance with the current travel management plan or map and travel amendments. There may be areas, trails, or roads within this ROS class where motorized use is prohibited or restricted to enhance recreation experiences or to protect public safety or resources.

Roaded Modified

These areas provide for a range of recreation experiences that are consistent with substantially modified, motorized settings in which the sights and sounds of humans are readily evident and the interaction between users can be from low to high. Recreation experiences and opportunities in these areas often depend on vehicular access off the primary routes via secondary roads. Camping experiences are relatively primitive, with few on-site facilities provided, requiring some self-reliance and use of primitive outdoor skills.

Recreation is often only one of many management objectives applied to these areas. Recreation management may be secondary to other resource needs and commodity production, or vegetation restoration may be the dominant emphasis. A wide range of management activities and uses, such as providing commercial wood products, may often take priority, and may result in substantially altered settings over much of the area. Prescribed fire could be used to attain a variety of resource objectives.

There may also be a wide range of facilities and structures to support other Forest uses, such as telecommunication facilities, power lines, and administrative sites. There generally should be few recreation developments in these areas. Basic facilities may be provided in some areas for resource protection. Camping occurs at user defined or dispersed camping locations.

The transportation network primarily consists of unpaved, gravel, or native-surface local or secondary roads. Cross-country snowmobile use may occur on adequate snow depth in accordance with the current travel management plan or map and travel amendments. There may be areas, trails, or roads within this ROS class where motorized use is prohibited or restricted to enhance recreation experiences or to protect public safety or resources.

In some locations during winter, there may be considerable shifts to the Semi-Primitive Motorized class as the snow cover results in the road network being inaccessible to general automobile use. Where these areas are of sufficient size and are open to over-snow vehicles and/or have groomed snowmobile routes, they may function more closely like a Semi-Primitive Motorized area.

Rural

Typically, these areas are characterized by recreation sites that can be utilized by large numbers of people at one time. High quality and quantity recreation use characterize these areas. While natural conditions usually do not dominate the activity centers, scenic values are often a critical element of the landscape seen as middleground and background from such areas. Surrounding scenic values are often a valued resource in the adjacent Forest landscape. The recreation opportunities offered are usually managed, regulated, and numerous but also in harmony with nature.

Numerous recreation facilities may be clustered in these areas. Facilities are designed for user comfort to accommodate large groups and are surrounded by highly intensified motorized use and organized parking. Forms of mass transit are often available to carry people throughout the site. The on-site vegetation is often in a manicured or managed state.

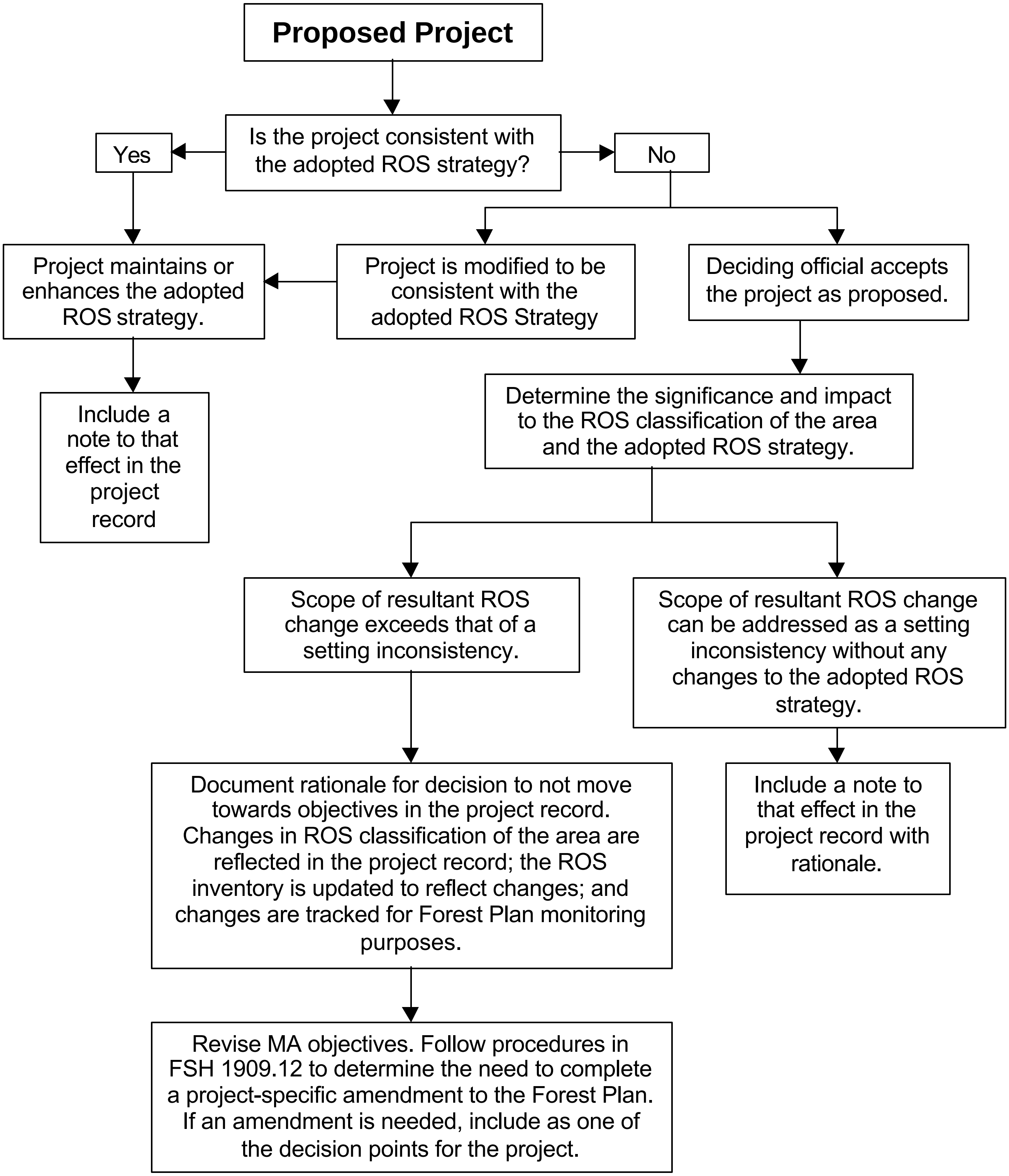
Generally, transportation routes consisting of State and Forest Service paved roadways are the primary means of recreational user access within the area. Trails may also be paved or surfaced in areas of concentrated use. There may be areas, trails, or roads within this ROS class where motorized use is prohibited or restricted to enhance recreation experiences or to protect public safety or resources.

REFERENCES

USDA Forest Service, Undated, *ROS Users Guide*

USDA Forest Service, 2001, *The Built Environment Image Guide for the National Forests and Grasslands,* FS-710

Figure F-1. ROS Management Direction Implementation Pathway



LAND CAPABILITY GROUPS AND SUSCEPTIBILITY TO EROSION

This appendix was derived and based on the methodology and information contained in the publication "Land Systems Inventory, Boise National Forest, Idaho" authored by Wendt et al. (1975). The approach outlined in Wendt's publication aggregates certain landtype associations together into what are termed land capability groups. These groups are typically defined as areas that have similar characteristics, suitabilities, potentials, and responses to use. Once aggregated, the landtype capability groups are used to make meaningful resource decisions. They reflect management opportunities and constraints that can be the basis for land use planning decisions. For example, lands that have an inherently high productivity potential for timber and low susceptibility to erosion can be identified as areas with the best opportunity for coordinated timber activities with a maximum return for dollars invested. Conversely, lands that have a high susceptibility to erosion may not be the best place to build new roads or intensively harvest timber.

Figure G-1 is to be used as a starting point for making more definitive decisions about determining or "firming up" individual allotment grazing capacities. For this generally purpose, all the Forest's land capability groups were aggregated into two categories:

1) Those with a high susceptibility to erosion, and
2) Those with low to moderate susceptibility to erosion.

High susceptibility to erosion is defined as the land capability groups (landtype capability groups 6 through 9) that:

- Have moderately high-to-high erosion potential,
- Have low to moderate forage productivity,
- Require a high level of effort to maintain an intensive land use, and
- Are ranked as having the greatest erosion hazard in conjunction with intensive management.

The remaining groups (landtype capability groups 1 through 5, and 10) were placed in the low to moderate category.

Rangeland Resources Guideline 1 of this plan can be applied when ground verification of an allotment's grazing capacity occurs. By using the following appendix map and determining whether the conditions outlined in the guideline (i.e., ground cover, slope, soil depth) exist, a decision can then be made as to whether a specific piece of the allotment is included as part of the grazing capacity determination. This process can be documented as part of the allotment's 2210 Analysis and Plans records, and then be used as a basis for term grazing permit adjustment decisions.

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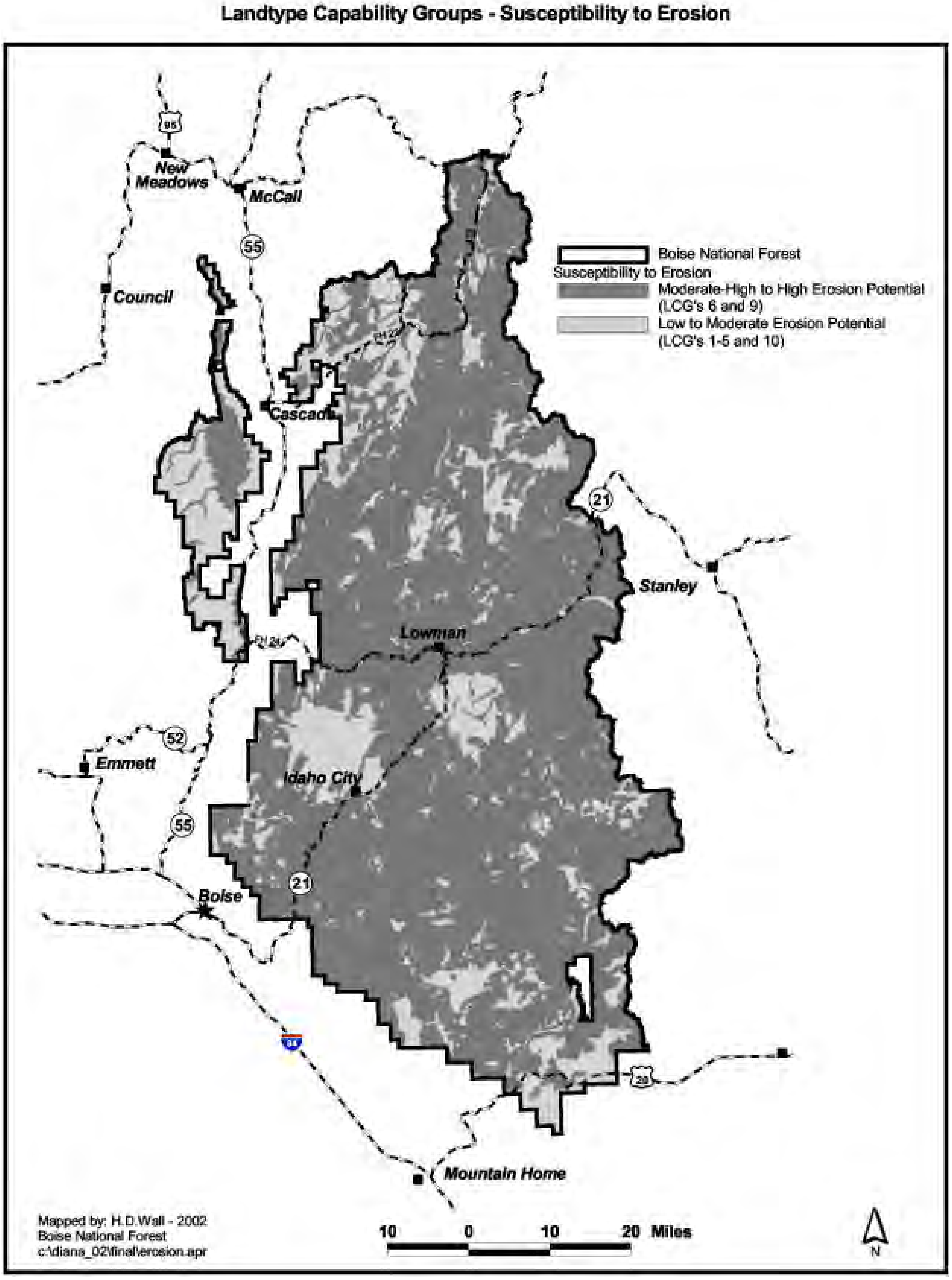
Figure G-1. Land Capability Groups for the Boise National Forest



INTRODUCTION

This appendix briefly describes some of the major laws, regulations, and policies that govern Forest Planning and resource management on the Boise National Forest, and how this framework provides protection to Forest Resources. Appendix H contains a definition of Forest Plans and information on the following requirements: legal requirements of Forest Plans; National Forest Management Act; Code of Federal Regulations; Forest Service Manual; Statutory, Regulatory, and Policy Authorities on Selected Topics; and Sensitive Species – Key Policies and Requirements. Forest Resources and their addition legal requirements are listed in the same order as they appeared in Chapter 3 of the Forest Plan EIS and Chapter III of the Forest Plan.

FOREST PLAN DEFINITION

A Forest Plan is a document required by Sec. 6 (a) of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA), as amended by the National Forest Management Act of 1976 (NFMA). Forest Plans guide all natural resource management activities and establish management standards and guidelines for the National Forest System. They determine resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management. [36 CFR §219.1(b)] The six decisions made in a Forest Plan are outlined in Chapter I, Introduction, of this Forest Plan.

LEGAL REQUIREMENTS OF FOREST PLANS

The NFMA and its accompanying regulations (36 CFR §219), along with Forest Service Manual (FSM) 1920, define the legal requirements of Forest Plans. Additional information on planning can be found in the National Environmental Policy Act (NEPA), Case Law, Appeal Decisions, Forest Service Handbook 1909.15, Internal Memos, Informal WO and RO direction, preferences of local managers and planners, and chapters in the Regional Desk Guide.

National Forest Management Act Requirements

The following are requirements for forest plans from the NFMA.

1. Determine forest management systems, harvesting levels, and procedures [16U.S.C. 1604 §6 (e)(2)].

2. Describe proposed and possible actions, including the planned timber sale program and the proportion of probable methods of timber harvest. [16 U.S.C.
    a. 1604 §6 (f)(2)]

3. [The regulations shall] require the identification of the suitability of lands for resource management. [16 U.S.C. 1604 §6 (g)(2)(A)]

4. Even-aged harvest methods will be used only where...there are established according to geographic areas, forest types, or other suitable classifications the maximum size limits for areas to be cut in one harvest operation. [16 U.S.C. 1604 §6 (g)(3)(F)(iv)]

5. Identify lands within the management area, which are not suited for timber production. [16 U.S.C. 1604 §6 (k)]

Code of Federal Regulations Requirements

Planning regulations set forth a process for developing, adopting, and revising Forest Plans. These regulations prescribe how land and resource management is to be conducted on National Forest system lands. Following is a summary of these regulations.

Scope And Applicability

Additional planning for special areas (wilderness, wild and scenic rivers, national recreation areas, and national trails) shall be met through forest plans. [36 CFR §219.2 (a)]

Public Participation

Public participation activities shall be used early and often throughout the development of plans. [36 CFR §219.6 (c)]

Monitoring And Evaluation

A program of monitoring and evaluation shall be conducted. [36 CFR §219.7(f)]

Forest Plan General Procedures

Revisions are not effective until considered and approved in accordance with the requirements for the development and approval of a forest plan. [36 CFR §219.10(g)]

Draft and Final Environmental Impact Statement

A draft and final environmental impact statement shall be prepared for the proposed plan according to NEPA procedures. [36 CFR §219.10 (b)]

- The draft environmental impact statement shall identify a preferred alternative. [36 CFR §219.10 (b)]
- The interdisciplinary team shall formulate a broad range of reasonable alternatives according to NEPA procedures. [36 CFR §219.12 (f)]
- The physical, biological, economic, and social effects of implementing each alternative considered in detail shall be estimated and compared according to NEPA procedures. [36 CFR §219.12 (g)]
- The interdisciplinary team shall evaluate the significant physical, biological, economic, and social effects of each management alternative that is considered in detail. [36 CFR §219.12 (h)]
- The Forest Supervisor shall recommend to the Regional Forester a preferred alternative to be identified in the draft environmental impact statement and displayed as the proposed plan. [36 CFR §219.12 (i)]

Record of Decision

The Regional Forester shall prepare a concise public Record of Decision, which documents approval and accompanies the plan and final environmental impact statement. [36 CFR §219.10 (c)(1)]

The Record of Decision shall include a summarized comparison of the selected alternative with any other alternative considered that is environmentally preferable to the selected alternative, and any other alternative considered that comes nearer to maximizing present net value. [36 CFR §219.12 (j)]

Forest Plan Content

A forest plan must contain the following items:

1. A brief summary of the Analysis of the Management Situation. [36 CFR§219.11 (a)]
2. Forest multiple-use goals and objectives [36 CFR §219.11 (b)]
3. A description of the desired future condition of the forest or grassland [36CFR §219.11 (b)]
4. An identification of the quantities of goods and services that are expected to be produced [36 CFR §219.11 (b)]
5. Multiple-use prescriptions and associated standards and guidelines for each management area [36 CFR §219.11 (c)]
6. Proposed and probable management practices such as the planned timber sale program [36 CFR §219.11 (c)].
7. Monitoring and evaluation requirements [36 CFR §219.11 (d)]

Analysis of the Management Situation

The analysis of the management situation shall include the following:

- Benchmark analyses to define the range within which alternatives can be constructed [36 CFR §219.12 (e)(1)]
- [Estimates of] the current level of goods and services provided by the unit and the most likely amount of goods and services expected to be provided in the future if current management direction continues [36 CFR §219.12(e)(2)]
- Projections of demand using best available techniques with both price and non-price information [36 CFR §219.12 (e)(3)]
- A determination of the potential to resolve public issues and management concerns [36 CFR §219.12 (e)(4)]
- A determination of the need to establish or change management direction [36 CFR §219.12 (e)(5)]

Timber Resource Land Suitability

Lands that are not suited for timber production shall be identified. [36 CFR§219.14]

Vegetation Management Practices

The vegetation management practices chosen for each vegetation type and circumstance shall be defined in the forest plan with applicable standards and guidelines. [36 CFR 219.15]

Timber Resource Sale Schedule

The selected forest management alternative includes a sale schedule that provides the allowable sale quantity. [36 CFR §219.16]

Evaluation of Roadless Areas

Unless otherwise provided by law, roadless areas within the National Forest System shall be evaluated and considered for recommendation as potential wilderness areas during the forest planning process. [36 CFR §219.17 (a)]

Wilderness Management

Forest planning shall provide direction for the management of designated wilderness and primitive areas. [36 CFR §219.18]

Fish and Wildlife Resources

Each alternative shall establish objectives for the maintenance and improvement of habitat for management indicator species [of fish and wildlife]. [36 CFR§219.19 (a)]

Certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species, and the reasons for their selection will be stated. [36 CFR §219.19 (a)(1)]

Habitat determined to be critical for threatened and endangered species shall be identified, and measures shall be prescribed to prevent the destruction or adverse modification of such habitat. [36 CFR §219.19 (a)(7)]

Grazing Resource

The suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for management indicator species shall be determined. [36 CFR §219.20]

- Lands suitable for grazing and browsing shall be identified, and their condition and trend shall be determined. [36 CFR §219.20 (a)]
- The present and potential supply of forage for livestock, wild and free-roaming horses and burros, and the capability of these lands to produce suitable food and cover for selected wildlife species shall be estimated. [36CFR §219.20 (a)]
- The use of forage by grazing and browsing animals will be estimated. [36CFR §219.20 (a)]
- Lands in less than satisfactory condition shall be identified and appropriate action planned for their restoration. [36 CFR §219.20 (a)]

Recreation Resources

Forest planning shall identify:

- The physical and biological characteristics that make land suitable for recreation opportunities [36 CFR §219.21 (a)(1)],
- The recreational preferences of user groups and the settings needed to provide quality recreation opportunities [36 CFR §219.21 (a)(2)],
- Recreation opportunities on the National Forest System lands [36 CFR§219.21 (a)(3)].

The visual resource shall be inventoried and evaluated as an integrated part of evaluating alternatives in the forest planning process. [36 CFR §219.21(f)]

Forest planning shall evaluate the potential effects of vehicle use off roads, and classify areas and trails of National Forest System lands as to whether or not off-road vehicle use may be permitted. [36 CFR §219.21(g)]

Diversity

Inventories shall include quantitative data making possible the evaluation of diversity [of plant and animal communities and tree species] in terms of its prior and present condition. [36 CFR §219.26]

Research

Research needs for management of the National Forest System shall be identified during planning. [36 CFR §219.28]

Cultural and Historic Resources

Forest planning shall:

- Provide an overview of known data relevant to history, ethnography, and prehistory of the area under consideration, including known cultural resource sites,
- Identify areas requiring more intensive inventory,
- Identify the need for maintenance of historic sites on, or eligible for inclusion in, the National Register of Historic Places,
- Identify opportunities for interpretation of cultural resources for the education and enjoyment of the American public. [36 CFR §219.24].

Research Natural Areas

Planning shall make provision for the identification of examples of important forest, shrubland, grassland, alpine, aquatic, and geologic types that have special or unique characteristics of scientific interest and importance and that are needed to complete the national network of RNAs. [36 CFR §219.25]

Forest Service Manual Requirements

1. The forest plan consists of both forest-wide and area specific standards and guidelines that provide for land uses with anticipated resource outputs under the given set of management constraints. (FSM 1922)

2. Minimum results required of forest planning are:

    a) Identification of resource management issues and concerns and management opportunities [FSM 1922.11 (1)]

    b) Development of a set of criteria to guide the formulation and evaluation of alternatives [FSM 1922.11 (2)]

    c) Analysis of the management situation including all items required in 36 CFR219.12 (e) [FSM 1922.11 (3)]

    d) Formulation of a set of alternatives in accordance with 36 CFR 219.12 (f) [FSM 1922.11 (4)]

  e) Evaluation of alternatives, and identification of a preferred alternative in accordance with NEPA, CEQ regulations, and Forest Service environmental policies and procedures [FSM 1922.11 (5)]

  f) A forest plan that achieves the 14 principles described in 36 CFR 219.1[FSM 1922.11 (6)]

  g) A monitoring program to evaluate progress toward achieving the goals, objectives, and standards of the plan and the validity of assumptions and coefficients used to estimate outputs and effects [FSM 1922.11 (7)]

3. In addition, the forest planning process must:

   a) Provide management direction for wilderness, wild and scenic rivers, national recreation areas, national trails, national monuments, national scenic areas, research natural areas, national management emphasis areas, and other identified special interest areas [FSM 1922.15 (1)]

   b) Determine the silvicultural systems and practices to be applied to suitable land [FSM 1922.15 (3)]

   c) Determine output levels for fuelwood and other non-industrial wood products where sustained demand is anticipated [FSM 1922.15 (5)]

   d) Determine the annual net growth on lands suitable for timber production for the fifth decade of the forest plan for at least the preferred alternative [FSM 1922.15 (8)]

   e) Identify the desired landownership pattern and develop guidelines for landownership adjustments [FSM 1922.15 (15)]

   f) Identify the specific access requirements and travel management options available to meet the objectives for each management prescription [FSM 1922.15 (17)].

   g) Determine watershed condition class and include objectives or prescriptions for improving watershed conditions when necessary [FSM 1922.15 (20)]

   h) Identify groundwater aquifers and provide management direction for their protection [FSM 1922.15 (22)]

4. 36 CFR §219.11 establishes minimum requirements for content of the forest plan. (FSM 1922.2)

5. To revise a forest plan, follow procedures set forth in 36 CFR §219.12 after obtaining approval of the Chief to schedule a revision. (FSM 1922.6)

6. Consideration of wilderness suitability is inherent in land and resource management planning. Planning for potential wilderness designation may occur in development of a forest plan or may require a separate study. (FSM 1923)

7. Consideration of potential wild and scenic rivers is an inherent part of the ongoing land and resource management planning process. (FSM 1924)

Statutory, Regulatory and Policy Authorities on Selected Topics

Specific direction concerning diversity is given in both the 1976 NFMA statute and implementing regulations of 1982. The NFMA provides statutory direction for managing the National Forest System to provide for diversity of plant and animal communities. Section 6(g)(3)(B) of the NFMA states:

> The [planning] regulations shall include, but not be limited to . . . (3) specifying guidelines for land management plans developed to achieve the goals of the [RPA] Program which . . . (B) provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives, and within the multiple-use objectives of a land management plan adopted pursuant to this section, provide, where appropriate, to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the plan.

To ensure an adequate consideration of diversity, the NFMA planning regulations (36 CFR 219) address diversity at several points. First, the regulations provide a definition of diversity to guide land and resource management planning:

> 36 CFR 219.3 Definitions and Terminology. “Diversity: The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.”

Other sections of the NFMA regulations that specifically use the term “diversity” are:

> 36 CFR 219.26 Diversity. “Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area. Such diversity shall be considered throughout the planning process. Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition. For each planning alternative, the interdisciplinary team shall consider how diversity will be affected by various mixes of resource outputs and uses, including proposed management practices.”
>
> 36 CFR 219.27 Management Requirements. “(a) Resource Protection. All management prescriptions shall-- . . . (5) Provide for and maintain diversity of plant and animal communities to meet overall multiple use objectives, as provided in paragraph (g) of this section; . . .(g) Diversity. Management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which would be expected in a natural forest and the diversity of tree species similar to that existing in the planning area. Reduction in diversity of plant and animal communities and tree species from that which would be expected in a natural forest, or from that similar to the existing diversity in the planning area, may be prescribed only where needed to meet overall multiple use objectives . . .”

FSM 2620 includes direction regarding habitat planning and evaluation, including specific forest planning direction for meeting biological diversity requirements:

> "A forest plan must address biological diversity through consideration of the distribution and abundance of plant and animal species, and communities to meet overall multiple-use objectives.” (FSM 2622.01)

Specific direction concerning viability is provided in the 1982 NFMA implementing regulations at 36 CFR 219.19:

> "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area." (36 CFR 219.19)

The 1983 USDA Departmental Regulation 9500-4 provides further direction to the Forest Service, expanding the viability requirements to include plant species:

> "Habitats for all existing native and desired non-native plants, fish, and wildlife species will be managed to maintain at least viable populations of such species. In achieving this objective, habitat must be provided for the number and distribution of reproductive individuals to ensure the continued existence of a species throughout its geographic range . . . Monitoring activities will be conducted to determine results in meeting population and habitat goals."

Specific FSM direction, from 1986, concerning viability of plant and animal species includes:

> "Management of habitat provides for the maintenance of viable populations of existing native and desired non-native wildlife, fish, and plant species, generally well-distributed throughout their current geographic range" [FSM 2622.01(2)]
>
> "Maintain viable populations of all native and desired non-native wildlife, fish and plant species in habitats distributed throughout their geographic range on National Forest System lands." [FSM 2670.22(2)]

Specific management requirements and direction concerning management indicator species is provided in the 1982 NMFA implementing regulations at 36 CFR 219.19, and in the Forest Service Manual 2600:

> "In order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species and the reasons for their selection will be stated. These species shall be selected because their population changes are believed to indicate the effects of management activities. In the selection of management indicator species, the following categories shall be represented where appropriate: Endangered and threatened plant and animal species identified on State and Federal lists for the planning area; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; non-game species of special interest; and additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality . . ." [36CFR 219.19(a)(1)]
>
> "Planning alternatives shall be stated and evaluated in terms of both amount and quality of habitat and of animal population trends of the management indicator species." [36 CFR 219.19(a)(2)]
>
> "Population trends of the management indicator species will be monitored and relationships to habitat changes determined . . ." [36 CFR 219.19(a)(6)]

> "Habitat determined to be critical for threatened and endangered species shall be identified, and measures shall be prescribed to prevent the destruction or adverse modification of such habitat. Objectives shall be determined for threatened and endangered species that shall provide for, where possible, their removal from listing as threatened and endangered species through appropriate conservation measures, including the designation of special areas to meet the protection and management needs of such species." [36 CFR 219.19(a)(7)]

Forest Service Manual direction concerning habitat planning is contained in 2620.

> "Management Indicators: Plant and animal species, communities, or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent." (FSM 2620.5)
>
> "Select management indicators for a forest plan or project that best represent the issues, concerns, and opportunities to support recovery of Federally-listed species, provide continued viability of sensitive species, and enhance management of wildlife and fish for commercial, recreational, scientific, subsistence, or aesthetic values or uses. Management indicators representing overall objectives for wildlife, fish, and plants may include species, groups of species with similar habitat relationships, or habitats that are of high concern." (FSM 2621.1)
>
> "Select ecological indicators (species or groups) only if scientific evidence exists confirming that measurable changes in these species or groups would indicate trends in the abundance of other species or conditions of biological communities they are selected to represent." [FSM 2621.1(3)].
>
> "Document, in the permanent planning records for a forest plan, the rationale, assumptions, and procedures used in selecting management indicators." [FSM 2621.1(4)]
>
> "Document, within the forest or project plan, how management indicators collectively address issues, concerns, and opportunities for meeting overall wildlife and fish, including endangered, threatened, and sensitive species goals for the plan or project area." [FSM 2621.1(5)]
>
> "To preclude trends toward endangerment that would result in the need for Federal listing, units must develop conservation strategies for those sensitive species whose continued existence may be negatively affected by the forest plan or a proposed project. To devise conservation strategies, first conduct biological assessments of identified sensitive species. In each assessment, meet these requirements:
>
> 1. Base the assessment on the current geographic range of the species and the area affected by the plan or project. If the entire range of the species is contained within the plan or project area, limit the area of analysis to the immediate plan or project area. If the geographic range of the species is beyond the plan or project area, expand the area of analysis accordingly.
>
> 2. Identify and consider, as appropriate for the species and area, factors that may affect the continued downward trend of the population, including such factors as: distribution of habitats, genetics, demographics, habitat fragmentation, and risk associated with catastrophic events."
>
> 3. Display findings under the various management alternatives considered in he plan or project (including the no-action alternative).

"Biological assessments may also be needed for endangered or threatened species for which recovery plans are not available. See FSM 2670 for direction on biological assessments for endangered and threatened species." (FSM 2621.2)

> "In analyzing the effects of proposed actions, conduct habitat analyses to determine the cumulative effects of each alternative on management indicators selected in the plan or project area . . ." (FSM 2621.3)
>
> "The forest plan must identify habitat components required by management indicators; determine goals and objectives for management indicators; specify standards, guidelines, and prescriptions needed to meet management requirements, goals, and objectives for management indicators; prescribe mitigation measures, as appropriate, to ensure that requirements, goals, and objectives for each management indicator will be sufficiently met during plan implementation at the project level." (FSM 2621.4)
>
> "Conduct monitoring of plans and projects to determine whether standards, guidelines, and management prescriptions for management indicators are being met and are effective in achieving expected results. Use monitoring and evaluation to guide adjustments in management and to revise or refine habitat relationships information and analysis tools used in planning." (FSM2621.5)

Specific direction concerning use of best available data is provided in the 1982 NFMA implementing regulations at 36 CFR 219.12(d):

> "Each Forest Supervisor shall obtain and keep current inventory data appropriate for planning and managing the resources under his or her administrative jurisdiction. The Supervisor will assure that the interdisciplinary team has access to the best available data. This may require that special inventories or studies be prepared. The interdisciplinary team shall collect, assemble, and use data, maps, graphic material, and explanatory aids, of a kind, character, and quality, and to the detail appropriate for the management decisions to be made."

Specific direction concerning use of information and scientific data is also provided in the NEPA implementing regulations at 40 CFR 1502.24:

> "Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement. An agency may place discussion of methodology in an appendix."

LEGAL AND ADMINISTRATIVE FRAMEWORK BY RESOURCE

Air Quality and Smoke Management

The *Clean Air Act and Amendments* were established to protect public health and welfare. This Act has been strengthened by several amendments, the latest coming in 1990. The Clean Air Act requires that the federal agencies comply with all federal, state, tribal, interstate, and local air quality standards and requirements, including the following:

- Air Quality Related Values for Class I airsheds,
- Ambient Air Quality Standards for six pollutants known to harm human health,

- Visibility Protection and Regional Haze standards related to fine particulate matter,
- Conformity provisions related to federal activities occurring within non-attainment areas.

Additionally, EPA's Interim Air Quality Policy on Wildland Fire and Prescribed Fires was developed to integrate the goals of allowing fire to function in its ecological role while protecting public health and welfare by mitigating the impacts of smoke. Federal agencies are expected to incorporate the requirements of the interim policy into their planning and operations.

The *Forest and Rangeland Renewable Resources Act* (1974), *Federal Land Management Policy Act* (1976), and *National Forest Management Act* (1976) and subsequent rules provide a mandate to:

- Protect and improve the quality of the air resource on National Forests,
- Manage public lands in a manner that protects air quality and atmospheric values,
- Comply with requirements imposed by federal, state, interstate or local authorities or courts.

The *Wilderness Act* (1964) and subsequent Acts designating individual Wilderness Areas were enacted to preserve wilderness resources and character. Although air quality and its effects are not directly mentioned in the Wilderness Act, the Act requires the Forest Service to minimize the effects of human use or influence on natural ecological processes, and preserve natural conditions.

Individual State Rules for Smoke Management Programs, Open Burning and Emergency Air Pollution Episodes. *Idaho Administrative Code IDAPA58.01.01: Rules for the Control of Air Pollution in Idaho* and *Utah Administrative Code Rule R307-202, 204 and 105.* These state laws described rules for fire use, and processes (permits, reporting and other requirements) for the coordinated burning operations of the smoke management programs (MT/ID Airshed Group and the Utah Interagency Smoke Management Program). The state rules for emergency air pollution episodes describe levels for stages and actions required to abate pollution levels such as delaying fire use operations.

Soil, Water, Riparian, and Aquatic Resources

The *Organic Act of 1897* recognizes watersheds as systems that need to be managed to sustain their hydrologic function. One of the primary reasons for establishing the National Forests was to provide for "favorable conditions of water flow".

The *Clean Water Act* (1948-->1987) includes a series of acts designed to restore and maintain the chemical, physical, and biological integrity of the nation's water by complying with state and federal pollution controls.

National Forest Management Act of 1976 includes direction to prevent watershed conditions from being irreversibly damaged and to protect streams and wetlands from detrimental impacts.

The *Endangered Species Act of 1973* requires federal agencies to conserve threatened and endangered species and the ecosystems they depend upon, including riparian and aquatic ecosystems, and to contribute to recovery of listed species.

The *Safe Drinking Water Amendments of 1977* necessitate federal agencies with jurisdiction over federally owned or maintained public water systems to comply with all authorities respecting the provision of safe drinking water.

Pacfish (1995) is the Interim strategy for USFS and BLM management of anadromous fish-producing watersheds within eastern Washington and Oregon, Idaho, and portions of California. Designed to offset impacts of all proposed or new projects, and those ongoing activities that pose unacceptable risks to anadromous fish habitat. Amended the 1990 Forest Plan and is being replaced by the revised Forest Plan.

Infish (1995) is the Interim strategy for USFS management of all stream systems not covered by Pacfish that support inland native fish species within eastern Washington and Oregon, Idaho, western Montana, and portions of Nevada. Designed to offset impacts of all proposed or new projects, and those ongoing activities that pose unacceptable risks to inland native fish habitat. Amended the 1990 Forest Plan and is being replaced by the revised Forest Plan.

Executive Orders 11988 and 11990 direct federal agencies to avoid, where possible, impacts associated with the destruction or modification of floodplains and wetlands.

Governor's Bull Trout Conservation Plan (1996) requires strengthening water quality protection within Idaho and improving compliance with the Federal Clean Water Act in order to protect bull trout habitat within State of Idaho.

Forest Service Manuals 2500 and 2600 pertain to the protection of watershed and fish and wildlife resources from natural resource management activities on Forest Service administered lands.

The *Regional Forester's Sensitive Species Program* is an internal listing process with direction, designed as an attempt to prevent additional imperiled fish, wildlife, and plants from being listed under the Endangered Species Act (ESA).

The *Forest Service Chief's Properly Functioning Condition Memo* (1997) directs USFS to adopt the BLM policy to use the Wetland and Riparian Initiative for the 1990s to evaluate and pursue achieving properly functioning condition of riparian resources.

The *Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters* (1999) provides a consistent mechanism for the Forest Service to collaborate with the State of Idaho in the assessment and where appropriate, development of a TMDL and water quality restoration plan for impaired water bodies.

The *Clean Water Action Plan* resulted from the recent listings of the salmon, steelhead, and bull trout and their associated Biological Opinions, and more recently, the *Unified Federal Policy for Ensuring a Watershed Approach to Federal Land and Resource Management*, which strongly direct the need to prioritize and restore degraded watersheds and improve the aquatic habitat for these species.

Wildlife Resources

National Environmental Policy Act– Requires analysis and public disclosure of effects to wildlife species and habitats from proposed federal actions.

The *Endangered Species Act* requires the Forest Service to maintain or improve habitat conditions for threatened, endangered, and proposed wildlife species.

National Forest Management Act - Provides direction for managing terrestrial wildlife species and habitats on National Forest System lands. Includes direction for Management Indicator Species and biological diversity.

Forest Service Manuals 2500 and 2600 pertain to the protection of watershed and fish and wildlife resources from natural resource management activities on Forest Service administered lands.

Regional Forester's Sensitive Species Program - Provides administrative direction to maintain or improve conditions for species on the Regional Forester's Sensitive Species List.

Forest Service Policy - Recognizes the Idaho State wildlife and fish agencies as responsible for the management of animals and National Forests as responsible for the management of habitat.

Vegetation

The *Organic Act of 1897* (16 U.S.C. 473 - 475) authorizes the Secretary of Agriculture to establish regulations governing the occupancy and use of National Forests and to protect the forests from destruction.

The *Multiple-Use, Sustained Yield Act of 1960* (U.S.C 528-531) recognizes timber and range as major resources for which the National Forests are to be managed. It further directs the Secretary to develop and administer the renewable surface resources of the National Forests for multiple-use and sustained yield of the many products and services obtained from these resources.

The *Forest and Rangeland Renewable Resources Planning Act of 1974* (RPA) (16 U.S.C. 1600-1614, as amended by the *National Forest Management Act of 1976*) directs the Secretary to periodically assess the forest and rangeland resources of the nation, and to submit to Congress at regular intervals, recommendations for long-range Forest Service programs essential to met future resource needs.

The *National Forest Management Act (NFMA) of 1976* (16 U.S.C. 472a) provides for balanced consideration of all resources in land management planning and establishes requirements for Land and Resource Management Plans, particularly for forested lands. It specifically addresses most aspects of timber management and how it is related to other resources. It also stresses the maintenance of productivity and the need to protect and improve the quality of biological and physical resources.

The *Endangered Species Act 1973 as amended 1978, 1979, 1982 and 1988* (16 U.S.C. 1531 et seq.) sets forth the requirements for all agencies to conserve endangered and threatened species. Section 7 directs agencies to ensure that actions do not result in destruction or adverse modification of critical habitats for endangered and threatened species.

36 CFR 219.15 Vegetation Management Practices set forth a requirement where multiple management practices are used in a vegetation type, conditions for use and evaluation need to be based upon technical and scientific literature and practical experience. *Section 219.26 Diversity* states that forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple use objectives of the planning area. *Section 219.27 Management Requirements* sets minimum requirements for resource protection, vegetative manipulation, silvicultural practices, even-aged management, riparian areas, and diversity.

Botanical Resources (TEPCS Plants)

The National Forest Management Act (NFMA) of 1976 (16 U.S.C. 472a) provides for balanced consideration of all resources in land management planning and establishes requirements for Land and Resource Management Plans, particularly for forested lands. The accompanying regulations (36 CFR 219.27 (g) require that "…management prescriptions …shall preserve and enhance the diversity of plant and animal communities, including endemic, and desirable naturalized plant species…Reductions in diversity of plant and animal communities and tree species…may be prescribed only where needed to meet overall multiple use objectives." The regulations state that habitat is to be "managed to maintain viable populations of existing and desired vertebrate species in the planning area."

The *Endangered Species Act 1973 as amended 1978, 1979, 1982 and 1988* (16 U.S.C. 1531 et seq.) sets forth the requirements for all agencies to conserve endangered and threatened species. Section 5 directs the Secretary of Agriculture to establish and implement a program to conserve fish wildlife and plants, including federally listed species. Section 7 directs agencies to "ensure that actions…do not result in destruction or adverse modification of their critical habitats". The act also requires conferencing whenever an action is likely to jeopardize the continued existence or when adverse modification of critical habitat may occur for any proposed for listing as threatened or endangered.

USDA, Departmental Regulation 9500-4 provides direction that expands viability requirements to include plant species. The Secretary of Agriculture's policy on wildlife, fish, and plant habitat directs the Forest Service to "manage habitats for all existing native and desired non-native plants in order to maintain at least viable populations of such species". It requires that habitat goals for threatened or endangered plants, or species with special habitat needs, be established in the forest planning process. It also states that monitoring activities will be conducted to determine results in meeting population and habitat goals, and directs "activities and programs to assist in the identification and recovery of threatened and endangered plant species, and to avoid actions which may cause a species to become threatened or endangered."

Non-native Plants

The *Federal Noxious Weed Act of 1974* delegates authority to the Secretary of Agriculture for noxious weed management. It also addresses eradication and control of certain foreign weeds within the United States, as does current Forest Service policy. Direction is to "...control the establishment, spread, or invasion of non-indigenous plant species in otherwise healthy native vegetative ecosystems." The 1990 Forest Plan for the Boise National Forest addressed noxious weeds minimally and broadly. Recent direction that is in accordance with the 1990 Farm Bill amendment of the 1974 Noxious Weed Act requires the use of Integrated Weed Management (IWM), the determination of factors favoring the establishment and spread of noxious weeds, and the design of prescriptions that reduce the risks. The first priority of IWM is to prevent the introduction of new invaders or noxious weed species. The amendment also provides direction for cooperation and cost sharing with State and local governments.

On February 3, 1999, the President issued an Executive Order (EO) (Clinton 1999) "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause". The EO further states that, "Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law...use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded.

In Idaho, it is unlawful for any individual to allow noxious weeds to propagate or go to seed on their land, unless they are complying with an approved weed management plan. This law directs the counties to develop weed control districts to plan and implement weed control efforts. The law also directs district (county) weed boards to "make all reasonable efforts to develop and implement a noxious weed program covering all land within the district owned or administered by a federal agency". Accordingly, the Forest Service now requires that all hay, straw, or other feeds brought upon Forest System lands be certified weed seed free.

The State of Idaho has finalized a *Strategic Plan* for managing noxious weeds. The purpose of the strategic plan is two-fold: (1) to heighten the awareness among all citizens of the degradation brought to Idaho lands and waters by the explosive spread of non-native weeds and, (2) to bring about greater statewide coordination, cooperation, prioritization, and action that will successfully halt the spread of such weeds and restore infested lands and waters to a healthy and productive condition. The Strategic Plan recommends the statewide formation of "Cooperative Weed Management Areas" and application of "Integrated Weed Management" prevention and control measures. Such a coordinated effort is operating within the Payette River Weed Management Area, established with a Memorandum of Understanding in 1998. Similar opportunities for coordination exist within the three Forests, particularly within the large river corridors and basins.

Fire Management

The *Organic Administration Act* (1897) authorizes the Secretary of Agriculture to provide for protection of national forest lands from destruction by fire.

The *Bankhead-Jones Farm Tenant Act* (1937) authorizes and directs the Secretary of Agriculture to develop a program of land conservation and utilization that protects public lands.

The *Reciprocal Fire Protection Act* (1955) authorizes reciprocal agreements with federal, state, and other wildland fire protection organizations.

The *Wilderness Act* (1964) authorizes the Secretary of Agriculture to take such measures as may be necessary to control fire within designated wilderness.

The *National Forest Management Act* (1976) directs the Secretary of Agriculture to specify guidelines for land management plans to ensure protection of forest resources.

The *Clean Air Act* (as amended 1977 and 1990) provides for the protection and enhancement of the nation's air resources.

The *Federal Wildland Fire Management Policy,* adopted December 18, 1995 by the Secretaries of Agriculture and Interior, directs agencies to implement the principles, policies, and recommendations found in the Final Report of the Federal Wildland Fire Management Policy and Program Review.

Rangeland Resources

The *Forest and Rangeland Renewable Resources Planning Act of 1974* specifies that the Secretary of Agriculture is to promulgate regulations that set out the process for the development and revision of land management plans. This process requires the identification of the suitability of lands for resource management. As result, the Secretary's regulation *36 CFR 219.20 "Grazing Resource"* specifies that, "In forest planning, suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for indicator species shall be determined as provided in paragraphs (a) and (b) of this section. Lands so identified shall be managed in accordance with direction established in forest plans."

To comply with regulations in planning and to be consistent with recent court decisions, the Chief of the Forest Service gave general guidance in 4/97 (Forest Service, 1997), regarding the evaluation of capable and suitable grazing lands during forest plan revision. The guidance removes inconsistent direction in Forest Service Manual and Handbook, and defines the difference between rangeland capability and suitability. Grazing capacity determination, which is different from capability/suitability assessments, is conducted during project level analysis. *Forest Service Handbook 2209.21* provides guidance for this type of determination (Range Technical Report #2, 1999).

Pursuant to regulations issued by the Secretary of Agriculture, the Chief of the Forest Service is authorized to develop, administer, and protect range resources. He is to permit and regulate grazing use of all kinds and classes of livestock on all National Forest System lands and/or other lands under Forest Service control. This authority originates from many acts (10), from the *Organic Administration Act of 1897* through the *Public Rangelands Improvement Act of 1978* (FSM 2201.1, 1990).

Forest Service policy authorizes all livestock grazing and other livestock use on lands under Forest Service administration or control by written grazing permit or agreement. On the Boise National Forest, a term grazing permit is the document used to authorize individuals, partnerships, or corporations to graze livestock. The permit may be issued up to a period of ten years. Forest plan standards and guidelines relating to grazing are incorporated into the term grazing permits as terms and conditions.

Timberland Resources

The *Organic Act of 1897* (16 U.S.C. 473 - 475) authorizes the Secretary of Agriculture to establish regulations governing the occupancy and use of National Forests and to protect the forests from destruction.

The *Knutson-Vandenberg Act of 1930* (16(U.S.C. 576-576b), as amended by the *National Forest Management Act of 1976* (16 U.S.C. 528-531) directs the Secretary to provide for improvement of the productivity of the renewable resources within the National Forest timber sales areas. It authorizes the collection and use of timber receipts for these purposes.

The *Multiple-Use, Sustained Yield Act of 1960* (U.S.C 528-531) recognizes timber as one of the five major resources for which the National Forests are to be managed. It further directs the Secretary to develop and administer the renewable surface resources of the National Forests for multiple-use and sustained yield of the many products and services obtained from these resources.

The *Small Business Act* (15 U.S.C. 644, as amended 1958) provides for federal agencies to participate in programs with the Small Business Administration. This is the authority for the Small Business Timber Sale Set-aside Program.

The *National Environmental Policy Act (NEPA) of 1969* (16 U.S.C. 4321) requires federal agencies to analyze the physical, social, and economic effects associated with proposed plans and decisions, to consider alternatives to the proposed actions, and to document the results of the analysis.

The *Forest and Rangeland Renewable Resources Planning Act of 1974* (RPA) (16 U.S.C. 1600-1614, as amended by the *National Forest Management Act of 1976*) directs the Secretary to periodically assess the forest and rangeland resources of the nation, and to submit to Congress at regular intervals, recommendations for long-range Forest Service programs essential to meet future resource needs.

The *National Forest Management Act (NFMA) of 1976* (16 U.S.C. 472a) sets forth requirements for Land and Resource Management Plans for the National Forest System. It also amends several acts applicable to timber management. It specifically addresses most aspects of timber management and how it is related to other resources. NFMA is the primary authority governing the management and use of timber resources on the national forests.

The *Forest Resources Conservation and Shortage Relief Act of 1990* (16 U.S.C. 620) sets forth restrictions on export of unprocessed timber originating from federal lands. It addresses certain exceptions to export restrictions and establishes reporting requirements.

The following regulations also apply: The rules governing the sale and disposal of timber are set forth at *36 CFR 223, Subparts A and B*. Subpart C governs suspension and debarment of timber purchasers, and Subpart D covers timber export and substitutions restrictions. The Chief's authority to manage and dispose of timber is delegated from the Secretary at *7 CFR 2.42* and described at *36 CFR 223.1*. The text of these rules is set forth in *Forest Service Manual 1010.*

Mineral Resources

Federal laws and regulations chiefly guide the management of mineral resources on National Forest System lands. Mineral resources are separated into three categories, whose exploration and development is guided by different statutes:

- **Locatable Minerals** are those valuable deposits subject to exploration and development under the *General Mining Law of 1872* and its amendments. Commonly, these minerals are referred to as "hard rock" minerals, and include gold, silver, molybdenum, iron, copper, and lead. The mining law as amended, gives citizens the right to enter public lands to locate and claim valuable minerals. Valuable mineral discovery conveys a property right to the mineral and, through the patent process, also to the surface. The 1872 *Surface Use Act* regulations provide for federal land management that minimizes mining-related adverse environmental impacts to surface resources. The *Organic Act of 1897* specifies that these mining regulations apply to National Forests. These laws authorize the present surface management program for mining claims, which requires written operating plans, reasonable environmental protection measures, reclamation plans, and bonds.

- **Leasable Minerals.** Federally owned leasable minerals may include such minerals as fossil fuels (oil, gas, coal, oil shale, etc.), geothermal resources, phosphates, and sulfur. The *Mineral Leasing Act of 1920* and its amendments authorize the Secretary of the Interior to lease land for these minerals. The Bureau of Land Management has considerable discretion whether or not to lease, and whether to attach special stipulations that are recommended by the Forest Service to ensure resource protection. On a federal mineral lease, the lessee has a vested right to develop the mineral resource after the lease and associated stipulations have been issued. The Forest Service reviews, approves, and administers the surface activities on the Forest, and the BLM manages the exploration and development program.

- **Mineral Materials or Saleables.** Salable mineral materials, or common varieties, are generally deposits of sand, clay, gravel, and stone that are used for road surfacing and building materials. The *Minerals Materials Act of 1947* states that common variety minerals on National Forest are subject to disposal by the Secretary of Agriculture, and are not subject to mining and leasing laws. The Forests have the discretion of whether and how common variety mineral materials should be developed. Use of these materials is by special use authorization.

For those acquired National Forest System lands in which the mineral rights are under federal ownership, mineral rights can be leased but mining claims cannot be staked. For those acquired lands in which the mineral rights are not under federal ownership, mineral rights can be exercised with the consent of the subsurface owner. Leasing on acquired lands is generally subject to Secretary of Agriculture rules and regulations. The *Acquired Lands Leasing Act* authorizes the Secretary of Interior to issue leases and prospecting permits for hard rock minerals on acquired lands with consent of the surface managing agency. The BLM issues leases and permits with attached special stipulations following a joint agency review and analysis of a proposal. The Forest Service makes recommendations on issuance of leases and permits subject to sufficient bonding by the proposed operator to ensure proper protection of other natural resources, and reclamation of disturbed areas.

Public Law 167, The Surface Resources Act (July 23, 1955), recognizes vested surface rights. In these cases, the claimant manages the surface under an approved Plan of Operations.

Special legislation has determined some areas to be unsuitable for mineral production. The Salmon River and the Middle Fork and its tributaries have been closed to dredge and placer mining. Under provisions of the Mining Claim Rights Restoration Act (PL 84-359), the Forest Service may, on a case- by-case basis, request a hearing before any mining activity is permitted on a placer mining claim in a power site withdrawal.

Several State laws are specific to mining, and apply to all lands in Idaho, including National Forests. For example, The *Idaho Dredge and Placer Mining Protection Act of 1955* requires reclamation of disturbed areas and adherence to water quality standards. The *Idaho Surface Mining Act of 1971* provides measures to reclaim the lands disturbed by surface mining operations. The State of Idaho Department of Lands administers these laws with State Land Board direction. The Idaho State Department of Health and Welfare administers state water quality laws.

Recreation Resources

The *Organic Administration Act* of 1897 authorized annual permits for land occupied by ski runs as well as undeveloped portions of ski areas.

The *Occupancy Permits Act* of 1915, as amended in 1956, authorized the issuance of term permits for structures or facilities on Nation Forest System lands on up to 80 acres for up to 30 years.

The *Multiple-Use Sustained Yield Act* of 1960 supplements the purposes for which national forests were established and administered including outdoor recreation.

The *Land and Water Conservation Fund Act* of 1964 "assists in preserving, developing, and assuring accessibility to all citizens of the United States of America ... such quality and quantity of outdoor recreation resources as may be available and are necessary and desirable ... by ... providing funds for the federal acquisition and development of certain lands and other areas." The law also provides for the collection of daily recreation use fees for each federal agency developing, administering, providing or furnishing, at federal expense, specialized outdoor recreation sites, facilities, equipment, or services.

The *Architectural Barriers Act* of 1968 states "Standards for design, construction, and alteration of buildings ... will be prescribed to insure whenever possible that physically handicapped persons will have ready access to, and use of, such buildings."

The *National Trails System Act* of 1968 establishes a National Trail System containing national recreation, scenic, historic, and connecting or side trails for the purpose of providing trail recreation opportunities. It prescribes administrative and development matters and encourages the use of volunteers in the trail program. It also established provisions for agreements to carry out the purpose of the Act.

The *National Forest Ski Area Permit Act* of 1986 allows the Forest Service to issue special use permits to the private sector to construct and operate ski areas on an unlimited number of acres of National Forest System lands for a period of up to 40 years.

The *Federal Cave Resources Protection Act* of 1988 provides specific authority to protect cave resources on federal lands. The policy of this Act establishes that "... Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves."

The *Americans with Disabilities Act* of 1990 establishes additional requirements to ensure that buildings, facilities, rail passenger cars, and vehicles are accessible, in terms of architecture and design, transportation, and communication, to individuals with disabilities.

Executive Order 11644 and *CFR 295.2 – 295.6* provide direction on the management of off-highway vehicles to protect resources, promote safety, and minimize conflict among users.

Executive Order 11989 requires land managing agencies to close areas to use when they determine that use causes, or will cause, considerable adverse effects on the soil, vegetation, wildlife, habitat, or cultural or historic resources.

Scenic Environment

A number of federal laws require all federal land management agencies to consider scenic and aesthetic resources in land and resource management planning, project design, project implementation, and monitoring. The more important authorities for management of the National Forest System's scenic resources lie in the following statutes:

- *The Multiple-Use Sustained Yield Act of June 12, 1960*
- *The Wilderness Act of 1964*
- *The Wild and Scenic Rivers Act of 1968*
- *The Nation Trail System Act of 1969*
- *The National Environmental Policy Act of 1969*
- *The Environmental Quality Act of 1970*
- *The Forest and Rangeland Renewable Resources Planning Act of 1974*
- *The National Forest Management Act of 1976*
- *The Surface Mining Control and Reclamation Act of 1977*

Forest Service policy and regulations are defined in the Forest Service Manual (FSM) Chapter 2300 - Recreation, Wilderness, and Related Resource Management; and Chapter 2380 - Landscape Management. The Forest Service has responded to the above legislation by developing a Landscape Management program with the objective to "manage all National Forest System lands so as to attain the highest possible visual quality commensurate with other appropriate public uses and benefits" (FSM 2380.3).

Each Regional Forester is delegated the responsibility of establishing a management system for this resource and producing visual quality objectives (FSM 2380.4). These objectives are to be determined from consideration of the physical characteristics and scenic quality of the land, as well as the principles of design and the desires and preferences of the public.

The Heritage Program and Cultural Resources

The *Antiquities Act* of 1906 protects historic or prehistoric remains or any object of antiquity on federal lands and applies to both cultural and paleontological resources.

The *National Historic Preservation Act* of 1966 *(NHPA),* as amended, protects historic and archeological properties during the planning and implementation of federal projects. The law requires the location and identification of cultural resources during the planning phase of a project, a determination of "significance" (based on scientific archaeological value) for potentially affected resources, and provisions for mitigation of any significant sites that may be affected for any federally funded, permitted, or licensed activities on National Forests. This law also fosters the development of agency Heritage Programs that emphasize a balance between protection of historic properties and public outreach, education, and involvement for the enjoyment of American history.

The *Federal Land Policy and Management Act* of 1976 requires that public lands be managed in a manner that will protect the quality of scientific, historical, archeological, and other values. It also requires federal agencies to preserve and protect lands in their natural condition, where appropriate.

The *Archaeological Resources Protection Act* of 1979 requires each federal agency to develop a plan for inventory, survey, and site protection. It also imposes civil penalties for the unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources.

The *Native American Graves Protection and Repatriation Act* of 1990 and its 1995 implementing regulations protect American Indian burials and sacred items. It requires each federal agency to survey and inventory heritage collections for material related to ceremonial usage. Each act requires public and other agency consultations regarding potential impacts to significant sites.

The *1996 Executive Order 13007* requires federal agencies to protect and make accessible Indian sacred sites on public lands for Indian religious practitioners. This includes consultation with Indian tribes for the identification of sacred sites, and for when federal actions or policies may restrict access to or use of a ceremonial site, or may adversely affect the physical integrity of the site.

The *Uniform Rules and Regulations (16 U.S.C.G. 432-433)* coincide with the *Antiquities Act of 1906.* They give the Secretary of Agriculture jurisdiction over ruins, archaeological sites, historic and prehistoric monuments and structures, objects of antiquity, historic landmarks, and other objects of historic or scientific interests on National Forest System lands.

36 CFR 261.9 prohibits "excavating, damaging, or removing any vertebrate fossil or removing any paleontological resource for commercial purposes without a special use permit.

Tribal Rights and Interests

The basis of a tribe's unique status stems from the tribe's inherent sovereignty. This sovereignty is expressly recognized within the context of U.S. Constitutional provisions for federal government's powers for treaty making with other sovereign nations, including tribes. The treaty-making period between the U.S. Government and American Indian tribes ended in 1871. The federal government thereafter relied upon Agreements (signed by both houses) to legally acquire Indian lands, allow tribes to cede lands, establish reservations, provide federal recognition of tribes, and remove Indian peoples to reservations or rancherias.

A tribe's sovereign status is also recognized and affirmed by treaties and agreements with the U.S. government; Congressional and Executive Branch recognition of the tribe; and federal court affirmation of tribal sovereignty. Tribes also have constitutions and by-laws, which formalize their governmental organization and state their relationship with the U.S. Government.

Additional sources of legal status may be found in federal statutes and Congressional Acts, which often do not distinguish between federally and non-federally recognized tribes and bands. Examples of these acts and statutes are provided below.

Laws, Executive Orders, and Policies Pertinent to Tribal Interests and Rights

The various laws, treaties, executive orders, and Forest Service policies that have established Reservations/Tribal Sovereignty and reserved on- and off-reservation rights are listed below.

FSM 1563: Tribal Governments - This Forest Service Manual outlines Forest Service responsibities to American Indian tribes.

National Historic Preservation Act of 1966 (NHPA) (P.L. 89-665, as amended, P.L. 91-423, P.L. 94-422, P.L. 94-458 and P.L. 96-515) - This act pertains only to tangible properties (buildings, structures, sites, or objects) that are important in history and prehistory. It requires agencies to consider the effects of undertakings on properties eligible to or listed in the National Register of Historic Places by following the regulatory process specified in 36CFR800.

The portions of that act that relate specifically to coordination with Indian tribes were added in the 1992 amendments. These additions reflect the increased importance placed on tribal relations. A section of the act directs state and federal governments to assist in the establishment of preservation programs on Indian lands. These sections include:

> Section *2 It shall be the policy of the Federal Government, in cooperation with other nations and in partnership with the State, local governments, Indian tribes, and private organizations and individuals to-*
>
> > *(2) provide leadership in the preservation of the prehistoric and historic resources of the United States and of the international community of nations and in the administration of the national preservation program.*
> >
> > *(6) assist State and local governments, Indian tribes and Native Hawaiian organizations and the National Trust for Historic Preservation in the United States to expand and accelerate their historic preservation programs and activities.*

National Environmental Policy Act (NEPA) of 1969 (P.L. 91-190) - Federal agencies must invite Indian tribes to participate in Forest management projects and activities that may affect them.

National Forest Management Act (NFMA) of 1976 (P.L. 4-588) - Directs consultation and coordination of National Forest System planning with Indian tribes.

American Indian Religious Freedom Act of 1978 (AIRFA) (P.L.95-341 as amended, P.L. 103-344) - AIRFA states that *"...it shall be the policy of the United States to protect and preserve for American Indians their inherent right for freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to site, use and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites".*

Agencies must make a good faith effort to understand how Indian religious practices may come into conflict with other Forest uses and consider any adverse impacts on these practices in their decision-making practices. The consideration of intangible, religious, ceremonial, or traditional cultural values and concerns that cannot be tied to specific cultural sites/properties could be considered under AIRFA.

Archaeological Resources Protection Act of 1979 (ARPA) P.L. 96-95) - The purpose of this act is to protect irreplaceable archaeological resources on federal and Indian lands. The act and its regulations defer to American Indian tribal self-government and recognize the preservation and importance of traditional native cultures. ARPA recognizes the appropriateness of allowing tribal members a voice in the permitting of lawful archaeological excavations that might have an impact on areas of tribal religious significance outside of formal Indian lands. It also establishes a permit process for the management of cultural sites on federal lands that provides for consultation with affected tribal governments.

Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (P.L. 101-601, 25 U.S.C. 3001-3013) - NAGPRA specifies that an agency must take reasonable steps to determine whether a planned activity may result in the excavation of Native American human remains, funerary objects, and items of cultural patrimony from federal lands. It also provides for repatriation of human remains and various cultural items to Native American individuals or Tribes. NAGPRA has specific requirements for notification of and consultation with Tribes.

Interior Secretarial Order 3175 of 1992 - Establishes responsibility of all agencies to carry out trust responsibilities of the federal government and assess the impacts of their actions on Indian trust resources. Requires consultation with tribes when impacts are identified.

Religious Freedom Restoration Act of 1993 - Establishes a higher standard for justifying government actions that my impact religious liberties.

Executive Order 12866 of 1993, Regulatory Planning and Review - Enhances planning and coordination with respect to both new and existing regulations. Makes process more accessible and open to the public. Agencies shall seek views of tribal officials before imposing regulatory requirements that might effect them.

President Clinton's Memorandum to Department Heads, 1994 - Directs federal agencies to honor trust responsibilities and to consult with tribal governments on decisions and policies that may affect tribal interests

Executive Order 13007 of 1996, Indian Sacred Sites - Acknowledges the role of federal agencies to protect and preserve the religious practices and places of federally recognized tribes and enrolled tribal members. Requires federal agencies to consult with federally recognized tribes to learn of tribal concerns for sacred sites on public lands. Ensures access to religious places and avoidance of adverse effects to sacred sites in accordance with existing legislation.

Executive Order 13084 of 1998, Consultation and Coordination with Indian Tribal Governments - Provides direction regarding consultation and coordination with Indian tribes relative to fee waivers. Calls upon agencies to use a flexible policy with tribes in cases where proposed waivers are consistent with applicable federal policy objectives. It directs agencies to grant waivers in areas where the agency has the discretion to do so, when a tribal government makes a request. When a request is denied, the agency must respond to the tribe in writing with the rationale for denial.

Forest Service Natural Resource Book on American Indian and Alaska Native Relations (April 1997) provides information on government-to-government relations with the tribes, including research opportunities.

American Indian Treaties

Shoshone–Paiute Tribes - The un-ratified Bruneau and Boise Treaties, and Treaty of Ruby Valley establish various rights (or fail to extinguish various rights) pertaining to the Shoshone-Paiute Tribes.

Shoshone–Bannock Tribes - Under the Fort Bridger Treaty of 1868, the Shoshone–Bannock Tribes retain off-reservation hunting and fishing rights.

Nez Perce Tribe - Under the Nez Perce of 1855, Article 3, the Nez Perce Tribal members retain "the right of taking fish at all usual and accustomed places in common with citizens of the Territory; and of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed (federal) lands."

Roads

36 CFR 219.11 (14-26) provides resource management requirements that cannot be met without putting a viable transportation system in place.

36 CFR 212 provides the principal regulations for administration of the forest development transportation system.

FSM 7700 (Transportation System Manual) directs the Forest Service to plan, develop, operate, and maintain forest development transportation facilities as a system that is integrated with other public and private transportation facilities while carrying out the objectives and direction established in the Forest Plan. It provides guidance in the form of objectives, policies, responsibilities, and requirements for transportation planning and for documenting system roads.

The *National Forest Roads and Trails Act* of 1964 recognizes that construction and maintenance of an adequate system of roads and trails within and near the National Forest is essential to meeting the increasing demands for timber, recreation, and other uses. It authorizes and establishes procedures related to rights-of-way, easements, construction, and agreements.

The *Surface Transportation Assistance Act* of 1978 establishes criteria for Forest highways and defines Forest roads and Forest development roads and trails.

Wilderness

Public laws that provide wilderness management direction include:

- The *Wilderness Act* of 1964 established a National Wilderness Preservation System to be administered in such a manner as to leave these areas unimpaired for future use and enjoyment as wilderness.

- The *Central Idaho Wilderness Act* of 1980 provides provided more specific management direction for a number of Idaho Wildernesses, including the Frank Church – River of No Return Wilderness on the Boise National Forest.

Forest Service policy and regulations are defined in the *Forest Service Manual (FSM)* that provide wilderness management direction include:

- *Chapter 2320 - Recreation, Wilderness, and Related Resource Management* describes wilderness management policies.

- *Chapter 2580 – Air Resource Management* describes the authority and objectives for protecting Air Quality Related Values in Class I wilderness areas.

- *FSM 2700, Special Uses Management and Forest Service Handbook 2709.11, Special Uses Handbook* provides direction related to special use permit administration, fee determination, and outfitter and guide permits.

The *Frank Church-River of No Return Wilderness Management Plan* was approved in December of 1984 and includes management direction for the entire FC-RONR Wilderness. This plan was incorporated into the Forest Plans for the six national forests administering the FC-RONR Wilderness. The management plan and forest plans were amended in July of 1994 to include terms and conditions regarding outfitter and guide operations. This plan was recently updated to reflect changes in conditions or public demand. The updated plan was approved in December 2002.

Wild and Scenic Rivers

The *National Wild and Scenic Rivers Act of 1968* provides a national policy and program to preserve and protect selected rivers, or segments of rivers, in their free-flowing condition in the National System.

The *Wild and Scenic Rivers Act, as amended December 31, 1992,* and *Forest Service Handbook 1909.12, Chapter 8*, require that rivers identified as potential Wild and Scenic Rivers be evaluated as to their eligibility, with the findings documented in the Forest Plan. Additionally, it is recommended, but not required, to complete the wild and scenic river suitability study during the Forest Plan revision process. If recommendation is deferred on those rivers identified as eligible where the Forest Service has primary responsibility, the Forest Plan must also provide interim management direction for protection of the outstanding features.

Any recommendation in the Forest Plan for a Wild and Scenic River designation is a preliminary administrative recommendation only, which will receive further review and possible modification by the Chief of the Forest Service, the Secretary of Agriculture, and the President of the United States. The Congress has reserved any final decisions to designate rivers to the National Wild and Scenic Rivers System.

Research Natural Areas

The identification and establishment of a national network or Research Natural Areas (RNAs) are Congressionally mandated in the National Forest Management Act (36 CFR Sec. 219.25; 36 CFR 251.23) and states, “Forest planning shall provide for the establishment of RNAs. Planning shall make provision for the identification of examples of important forest, shrubland, grassland, alpine, aquatic, and geologic types that have special and unique characteristics of scientific interest and importance...and that are needed to complete the National network of RNAs.”

Social and Economic

The *National Forest Management Act (NFMA)* and its implementing regulations *(36 CFR 219.11[a], 36 CFR 219.12 [e] and 36 CFR 219.12[h])*, the *National Environmental Policy Act (NEPA)* and its implementing regulations *(40 CFR 1502.14 through 40 CFR 1502.16)*, *Forest Service Manual 1970*, and *Forest Service Handbook 1909.17* require the evaluation of social and economic effects of alternatives during the Forest Planning process.

In addition to the laws and regulations listed above, the Forest Plan revision socio-economic overview is shaped by evolving thinking about the role of socio-economic assessment in ecosystem management and forest planning. The socio-economic overview is particularly framed by two recent works:

- *Guidelines for Conducting Social Assessments Within a Human Dimensions Framework*, developed by National Forest social scientists and researchers, and university social scientists (Bright et al, 1998). The Guidelines report was developed to improve social science information and applications in forest planning and assessments.

- *Sustaining the People's Land: Recommendations for Stewardship of the National Forests and Grasslands into the Next Century*, released by an interdisciplinary Committee of Scientists in March, 1999 (Committee of Scientists 1999). Secretary of Agriculture Dan Glickman convened the Committee in 1997 to review and evaluate the Forest Service planning process and to identify changes that might be needed to planning regulations.

The Committee's report included several recommendations about social assessments. The report noted that a good assessment will examine quantitative demographic, economic, and social information, and it will include a participatory process that engages communities in a learning process about themselves (Committee of Scientists 1999, p. 47).

The Southwest Idaho Ecogroup's socio-economic overview addresses the Human Dimensions Framework and many of the recommendations included in the Committee of Scientists report. The overview includes important demographic, economic, and social information, both quantitative and qualitative, in the Boise National Forest Zone of Influence. This information was gathered from a variety of sources, including but not limited to Interior Columbia Basin Ecosystem Management Project (ICBEMP) reports, Idaho Department of Commerce data, University of Idaho and Boise State University studies, and the 1999 "Affected Economic Environment and Baseline for the No-Action Alternative," developed by Economic Modeling Specialists, Inc. for the Ecogroup's Forest Plan Revision process. Personal interviews, community self-assessment surveys, and public comments on the Forest Plan revision were also critical tools, since they provided key insights from those potentially most interested in and affected by this planning process.

LITERATURE CITED

Bright, Alan, Ken Cordell, and Anne Hoover, 1998*, Guidelines for Conducting Social Assessments within a Human Dimensions Framework* (working draft), USDA Forest Service, Southern Research Station, Athens, Georgia

Clinton, William, 1999, *Executive Order – Invasive Species,* The White House, Office of the Press Secretary

Committee of Scientists, 1999, *Sustaining the People's Lands – Recommendations for Stewardship of the National Forests and Grasslands into the Next Century,* U.S. Department of Agriculture, Washington, D.C.

INTRODUCTION

This appendix contains a map of the designated utility corridors on the Boise National Forest. These designated utility corridors relate to Forest-wide Standard LSST09, and are described in Management Areas 1, 4, 16, 17, 19, 20, and 21. They are presented here so that Forest personnel can see where these corridors occur on the Forest and adjust their management activities as needed. Larger-scale maps of the corridors are available in the Forest Plan Revision Project Record.

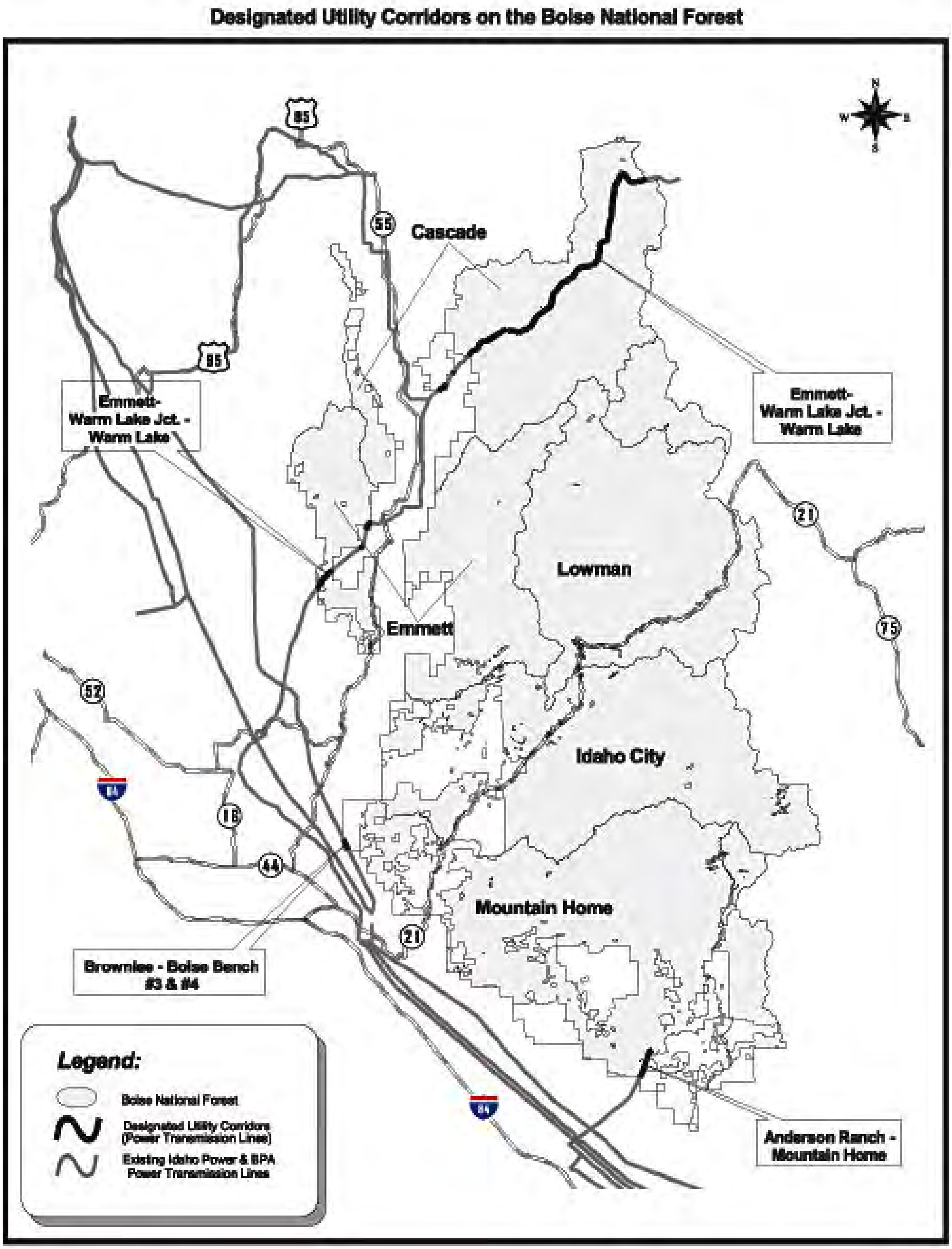


Figure I-1. Designated Utility Corridors on the Boise National Forest

Glossary, Acronyms, and Scientific Names

GLOSSARY

This glossary replaces the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans, Environmental Impact Statement, Chapter 4, Glossary/Acronyms. It adds terms in Errata #4 dated July 2005, and adds new terms used in the 2010 Wildlife Conservation Strategy, Boise National Forest Plan amendment.

abiotic
Non-living (refers to air, rocks, soil particles, and etcetera).

access management
See travel management.

activity area
The smallest logical land area where the effect that is being analyzed or monitored is expected to occur. The area may vary in size depending on the effect that is being analyzed or monitored, because some effects are quite localized and some occur across landscapes. Activity areas are to be specifically described when used in planning and project implementation documents.

- snags – The activity area for snags is the specific site affected by actions listed below, whether effects are positive or negative. Actions affecting activity areas that need to be assessed include timber harvest, site-preparation reforestation, timber stand improvement, and prescribed fire. The activity area reflects the scale at which to plan projects that provide for maintaining or improving trends in snag amounts.
- coarse woody debris – The activity area is the same as for snags above. However, this may also parallel the activity area for detrimental disturbance. See below.
- detrimental disturbance – The activity area is the specific area where proposed actions may have detrimental soil impacts, such as harvest units within a timber sale area, an individual pasture unit within a grazing allotment, or a burn block within a prescribed burn project area. Existing designated uses such as classified roads and trails, developed campgrounds, and buildings, are not considered detrimental disturbance within an activity area. See the definition for detrimental disturbance for more information.
- total soil resource commitment – Effects are generally measured across an all-inclusive activity area, like a timber sale area, a prescribed burn area, or a grazing allotment, where effects to soil commitment could occur or are occurring. Effects include both proposed actions and existing uses, such as roads (classified and non-classified), dedicated trails and landings, administrative sites, parking lots, and mine excavations. See the definition for total soil resource commitment for more information.

adaptive management
A type of natural resource management in which decisions are made as part of an ongoing process. Adaptive management involves testing, monitoring, evaluation, and incorporating new knowledge into management approaches based on scientific findings and the needs of society.

adfluvial fish
Fish that migrate between lake and river systems; such as land-locked kokanee salmon or some bull trout.

adverse effect
For Forest Plan revision, "adverse effect" is used in the context of the Endangered Species Act relative to effects on TEPC species. Definitions are from Final Endangered Species Consultation Handbook; NMFS/USFWS, 1998. They include both "likely to adversely effect" and "not likely to adversely effect". Both of these definitions are needed to clearly understand the intent of the phrase "adverse effect" when applied to Forest-wide and Management Area direction involving TEPC species. The definition of "take" is also included below to help clarify intent.

- Likely to adversely affect – the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action is "likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. A "likely to adversely affect" determination requires the initiation of formal Section 7 consultation.
- Not likely to adversely affect – the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully detect, measure, or evaluate insignificant effects; or (2) expect discountable effects to occur.
- Take – to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct [ESA §3(19)]. Harm is further defined by FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by FWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR § 17.3).

air pollutant
Any substance in air that could, if in high enough concentration, harm humans, animals, vegetation, or material. Air pollutants may include almost any natural or artificial matter capable of being airborne in the form of solid particles, liquid droplets, gases, or a combination of these.

air quality
The composition of air with respect to quantities of pollution therein; used most frequently in connection with “standards” of maximum acceptable pollutant concentrations.

allelopathic
Growth inhibiting. Usually refers to chemicals produced by one species of plant to inhibit the growth of surrounding species, thus giving the chemical-producing plant a competitive edge.

allotment (grazing)
Area designated for the use of a certain number and kind of livestock for a prescribed period of time.

Allowable Sale Quantity (ASQ)
On a National Forest, the quantity of timber that may be sold from a designated area covered by the forest plan for a specified time period.

All Terrain Vehicle (ATV)
Any motorized, off-highway vehicle 50 inches or less in width, having a dry weight of 600 pounds or less that travels on three or more low-pressure tires with a seat designed to be straddled by the operator. Low-pressure tires are generally 6 inches or more in width and designed for use on wheel rim diameters of 12 inches or less, utilizing an operating pressure of 10 pounds per square inch (psi) or less.

alternative
In an Environmental Impact Statement (EIS), one of a number of possible options for responding to the purpose and need for action.

amenity
Resource use, object, feature, quality, or experience that is pleasing to the mind or senses; typically refers to resources for which monetary values are not or cannot be established, such as scenery or wilderness.

anadromous fish
Fish that hatch and rear in fresh water, migrate to the ocean, mature there, and return to fresh water to reproduce; for example, salmon and steelhead.

ancillary facilities
Auxiliary facilities or structures that do not serve the main purpose of the facility but rather provide for support needs. For example, for a hydroelectric dam, the dam, powerhouse, penstock, and spillway would not be considered ancillary facilities, but a tool storage shed would.

Animal Unit Month (AUM)
The amount of forage required by a 1,000-pound cow and its calf, or the equivalent, for 1 month.

Appropriate Management Response (AMR)
Actions taken in response to a wildland fire to implement protection and fire use objectives.

aquatic ecosystem
40 CFR 230.3 - Waters of the United States that serve as habitat for interrelated and interacting communities and populations of plants and animals. FSM 2526.05 - The stream channel, lake or estuary bed, water, biotic communities and the habitat features that occur therein.

aquatic integrity
Aquatic integrity is an assessment and comparison of existing fish habitat conditions with historical conditions that existed before Euro-American settlement. Habitat conditions are assessed to determine how their integrity and resilience may have changed due to effects from past or current human-caused (road construction, timber harvest, livestock grazing, etc.) or natural (wildfire, floods, etc.) disturbance. Conditions or values assessed include numerous habitat parameters found in Appendix B of the Forest Plan. Relative integrity ratings are assigned at the subwatershed scale and are based on the quality of habitat conditions and the presence, abundance, and distribution of key native fish species.

arterial road
A road serving a large land area and usually connecting with public highways or other Forest Service arterial roads to form an integrated network of primary travel routes. The location and standards are often determined by a demand for maximum mobility and travel efficiency rather than specific resource management service. Arterial roads are usually developed and operated for long-term land and resource management purposes and constant service.

attitudes, beliefs, and values
FSH 1909.17. Preferences, expectations, and opinions people have for forests and the management and use of particular areas. Differing values and expectations have resulted in polarized perceptions that a healthy environment requires protection of lands from human influence, or increased attention to environmental quality presents a threat to employment, economy, or life-style.

background (bg)
The visual distance zone relating to the distant part of a landscape, generally located from 3 to 5 miles to infinity from the viewer.

background wildfire
Average amount of wildfire that occurs annually from small-sized (a through d) fires.

bankfull stage
The bankfull stage corresponds to the discharge at which channel maintenance is the most effective, that is, the discharge at which moving sediment forms or changes bends and meanders, and generally results in the average morphologic characteristics of channels. This term generally describes the elevation on the stream bank where the stream begins to flow onto a flood plain; however, not all stream channels have distinct flood plains.

beneficial effect
Beneficial effects are contemporaneous positive effects to resource, social, or economic conditions.

Specific to ESA and TEPC species, beneficial effects are contemporaneous positive effects without any adverse effects to the species. The appropriate conclusion when effects on listed species are expected to be beneficial would be: "Is not likely to adversely affect".

beneficial use
Any of the various uses that may be made of the water of an area, including, but not limited to: (1) agricultural water supply; (2) industrial water supply; (3) domestic water supply; (4) cold water biota; (5) primary contact recreational use; (6) secondary contact recreational use; (7) salmonid spawning, overwintering, emergence, and rearing; and (8) warm water biota.

Best Management Practices (BMPs)
Practices determined by the State of Idaho Division of Environmental Quality to be the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources.

big game
Large wild animals that are hunted for sport and food. This hunting is controlled by state wildlife agencies. Big game animals found on this Forest include deer, elk, and moose.

bighorn sheep emphasis areas
Areas identified by state wildlife agencies as being important to bighorn sheep (winter and summer habitat).

biological diversity (or biodiversity)
The variety and abundance of life and its processes. Biological diversity includes all living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. Biological diversity also refers to the compositions, structures, and functions of species and habitats and their interactions.

biophysical components
Refers to biological and/or physical components in an ecosystem.

biota
Living material. The flora and fauna of an area.

board foot
A measurement of wood equivalent to a board 1 foot square and 1 inch thick. Usually expressed in terms of thousand board feet (MBF) or million board feet (MMBF).

broad-scale
A regional land area that may include all or parts of several states; typically millions of acres or greater. An example of a broad-scale assessment is the Interior Columbia Basin (ICB) Ecosystem Management Project.

broadcast burning
Burning forest fuels as they are, with no piling or windrowing.

browse
Twigs, leaves, and shoots of trees and shrubs that animals eat.

Burned Area Emergency Response (BAER)
A procedure used by the federal government to restore watershed conditions following large wildfires. The objective of BAER is to provide for immediate rehabilitation by stabilizing soils, and controlling water, sediment, and debris movement.

candidate species
Plant and animal species being considered for listing as endangered or threatened, in the opinion of the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS). Category 1 candidate species are groups for which the FWS or NMFS has sufficient information to support listing proposals; category 2 candidate species are those for which available information indicates a possible problem, but that need further study to determine the need for listing.

canopy cover
Total non-overlapping cover of all trees in a vegetative unit excluding the seedling size class. Trees in the seedling size class are used to estimate canopy cover only when they represent the only structural layer on the site.

classified road
Roads wholly or partially within or adjacent to national Forest System lands that are determined to be needed for long-term motor vehicle access. Classified roads can include state roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service.

Clean Air Act
An Act of Congress established to protect and enhance the quality of the Nation's air through air pollution prevention and control.

Clean Water Act
An Act of Congress which establishes policy to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

coarse filter (conservation) approach
Used to assess the conservation value of ecosystems and landscapes. The intent of this approach is to maintain and where needed restore representative ecosystems and their inherent disturbance processes in order to conserve the majority of species without the necessity of considering them individually.

coarse woody debris (CWD)
Pieces of woody material having a diameter of at least 3 inches. Logs are a subset of coarse woody debris.

Cohesive Strategy (Current) Condition Classes
The Cohesive Strategy for the National Fire Plan defines three current condition classes as follows:

> *Condition Class 1* - Fire regimes are within an historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range.
>
> *Condition Class 2* - Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from their historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.
>
> *Condition Class 3* - Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

Cohesive Strategy (Historical Natural) Fire Regimes
The Cohesive Strategy for the National Fire Plan defines historical natural fire regimes as follows:

▪ Fire regime I	0-35-year frequency, nonlethal
▪ Fire regime II	0-35-year frequency, lethal
▪ Fire regime III	35-100+ year frequency, mixed
▪ Fire regime IV	35-100+ year frequency, lethal
▪ Fire regime V	200+ frequency, lethal

collaborative stewardship
Caring for the land and serving people by listening to all constituents and by living within the limits of the land. A commitment to healthy ecosystems and working with people on the land.

collector road
A road serving smaller land areas than an arterial road and usually connected to a Forest arterial road or public highway. These roads collect traffic from Forest local roads and/or terminal facilities. The location and standard are influenced by both long-term multi-resource service needs, as well as travel efficiency. These roads may be operated for either constant or intermittent service, depending on land use and resource management objectives for the area served by the facility.

common variety minerals
Minerals of sand, clay, cinders, roadside slough, fill dirt, etc., which have been specifically designated as common variety and are saleable under the discretion of the authorized officer.

communication sites
Areas designated for the operation of equipment, which reflect, transmit, and/or receive radio, microwave, and cellular telephone signals, for long-distance transmission or local pickup of programming.

components of ecosystem management
Biological diversity, physical diversity, social diversity, and economic diversity are the four components of the Southwest Idaho Ecosystem Management Framework.

composition (species)
The species that make up a plant or animal community, and their relative abundance.

connectivity
The arrangement of habitat that allows organisms and ecological processes to move across the landscape. Patches of similar habitats are either close together or connected by corridors of appropriate vegetation (or live stream channels). Opposite of fragmentation.

Sites in a landscape are "connected" if there are patterns or processes to link them in some way. These links arise either from static patterns (e.g., landforms, soil distributions, contiguous forest cover) or from dynamic processes (e.g., dispersal, fire). A particular landscape may have radically different degrees of connectivity with respect to different processes. Connectivity usually involves corridors and networks and describes how patches are connected in the landscape.

conservation strategy or conservation agreement
1. An active, affirmative process that (a) identifies issues and seeks input from appropriate American Indian governments, community groups, and individuals; and (b) considers their interests as a necessary an integral part of the BLM's and Forest Service's decision-making process.

2. Plans to remove or reduce threats to Candidate or Sensitive species of plants and animals so that a federal listing as Threatened or Endangered is unnecessary.

controlled burns
Are fires ignited by government agencies under less dangerous weather conditions.

controlled hunt area
An area designated by the Idaho Department of Fish and Game to manage species, usually big game such as elk or deer.

core area
A geographic area of land or water that is managed to promote and conserve specific features of biodiversity (target species, communities, or ecosystems) within the context of a broader landscape and network of core areas.

core area (for SWRA resources)
The combination of core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) constitutes the basic unit for which to gauge recovery within a recovery unit. Core areas require both habitat and bull trout to function biologically, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. Core area boundaries are typically: (1) 4th field hydrologic units (HUs), unless evidence of natural isolation (e.g., a natural barrier or presence of a lake supporting adfluvial bull trout) supports designation of a smaller core area; (2) conservative, i.e., the largest areas likely constituting a core area are considered a single core area when doubt exists about the extent of bull trout movement and use of habitats; and (3) non-overlapping (USDI FWS 2002).

corridor (landscape)
Landscape element that connect similar patches of habitat through an area with different characteristics. For example, streamside vegetation may create a corridor of willows and hardwoods between meadows or through a conifer forest.

cover type
The current or existing vegetation of an area, described by the dominant vegetation.

critical habitat
Endangered Species Act - Designated by the FWS or NMFS, specific areas, within a geographical area occupied by a threatened or endangered species, on which are found physical or biological features essential to conservation of the species. These areas may require special management consideration or protection, and can also include specific areas outside the occupied area that are deemed essential for conservation.

critical life stages
Animal life stages associated with the time of the year when reproduction, rearing young, and over-wintering occur.

crown, canopy, or aerial fires
Devour suspended material at the canopy level, such as tall trees, vines, and mosses. The ignition of a crown fire is dependent on the density of the suspended material, canopy height, canopy continuity, and sufficient surface and ladder fires in order to reach the tree crowns.

cultural resources
Cultural resources include sites, structures, or objects used by prehistoric and historic residents or travelers. They are non-renewable resources that tell of life-styles of prehistoric and historic people. Cultural resources within the Forests are diverse and include properties such as archaeological ruins, pictographs, early tools, burial sites, log cabins, mining structures, guard stations, and fire lookouts.

cumulative effects
Impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

decay classes[1] (for snags and coarse woody debris)

DECAY CLASS 1[2]	Snags	Snags that have recently died, typically have little decay, and retain their bark, branches, and top.
	Logs	Logs created by trees that have recently fallen over, and still have intact or loose bark, large branches present, a round shape, little to some wood decay, and are resting above or are in contact with the ground.
DECAY CLASS 2	Snags	Snags that show some evidence of decay and have lost some of their bark and branches and often a portion of the top.
	Logs	Logs with bark partially intact to sloughing, no fine branches, large branches present, wood largely hard to soft, may be round, log may be sagging.
DECAY CLASS 3	Snags	Snags that have extensive decay, are missing the bark and most of the branches, and have a broken top.
	Logs	Bark is absent, few branches present, wood is soft and powdery (when dry), shape is round, oval, or hard to see.

[1] From Bull et al. 1997

[2] Grand fir and Douglas-fir tend to retain their bark and therefore snags and coarse wood of these species may not meet the appropriate decay class bark description.

debris flow
A spatially continuous movement of mixed soil or rock in which surfaces of shear are short-lived, closely spaced, and usually not preserved. The distribution of velocities in the displacing mass resembles that in a viscous liquid. Debris slides may become extremely rapid as the material loses cohesion, gains water, or encounters steeper slopes.

defensible space
An area around a structure where fuels and vegetation are treated, cleared, or reduced to slow the spread of wildfire towards the structure. This space also reduces the chance of a structure fire moving from the building to the surrounding forest.

degradation
To degrade, or the act of degrading. Refer to the definition of "degrade" in this glossary.

degrade
To degrade is to measurably change a resource condition for the worse within an identified scale and time frame. Where existing conditions are within the range of desired conditions, "degrade" means to move the existing condition outside of the desired range. Where existing conditions are already outside the range of desired conditions, "degrade" means to change the existing condition to anything measurably worse. The term "degrade" can apply to any condition or condition indicator at any scale of size or time, but those scales need to be identified. This definition of "degrade" is not intended to define degradation for the State of Idaho as it applies to their Antidegradation Policy (IDAPA 16.01.02.051).

demographic
Related to the vital statistics of human populations (size, density, growth, distribution, etcetera).

denning habitat or sites
Habitat and locations used by mammals during reproduction and rearing of their young, when the young are highly dependent on adults for survival.

designated communication site
An area of National Forest System land, designated through the land and resource management planning process, for use as a communication site. These designations constitute a long-term allocation of National Forest System land. A communications site may be limited to a single communications facility, but often encompasses more than one.

designated utility corridor
A linear strip of National Forest System land, designated through the land and resource management planning process, for use as a utility corridor. These designations constitute a long-term allocation of National Forest System land. A utility corridor may be used to accommodate more than one utility use.

designee
Related to fire suppression, a designee is a person with delegated line officer authority.

Desired Condition (DC)
Also called Desired Future Condition, a portrayal of the land, resource, or social and economic conditions that are expected in 50-100 years if management goals and objectives are achieved. A vision of the long-term conditions of the land.

Desired Future Condition (DFC)
Also called desired condition, a portrayal of the land, resource, or social and economic conditions that are expected in 50-100 years if management goals and objectives are achieved. A vision of the long-term conditions of the land.

detrimental soil disturbance
Detrimental soil disturbance (DD) is the alteration of natural soil characteristics that results in immediate or prolonged loss of soil productivity and soil-hydrologic conditions. At least 85 percent of an activity area should be in a non-detrimentally disturbed condition. Stated another way, no more than 15 percent of an activity area should have detrimentally disturbed soil after the management activity is completed. DD can occur from soil that has been displaced, compacted, puddled or severely burned. Determination of DD excludes existing or planned classified transportation facilities, dedicated trails, and landings, mining dumps or excavations, parking areas, developed campgrounds, and other dedicated facilities. However, the impacts of these actions are considered total soil resource commitment (TSRC - see definition in this glossary). DD is represented by any or all of the four characteristics described below.

1. *Detrimental Soil Displacement.* Areas of 1 meter by 1 meter or larger that exhibit detrimentally displaced soil as described below:

   (a) The loss of either 5 cm or half of humus-enriched top soil (A horizon), whichever is less, or
   (b) The exceeding of the soil loss tolerance value for the specific soil type.

2. *Detrimental Soil Compaction.* Soil compaction is generally evaluated from 5 to 30 centimeters below the mineral soil surface. Specific depths for measurement are dependent upon soil type and management activities. Detrimental soil compaction is increased soil density (weight per unit volume) and strength that hampers root growth, reduces soil aeration, and inhibits water movement. Measurements of potential detrimental soil compaction may be qualitative or quantitative. Refer to the Region 4 Soil Quality Handbook for methods related to measuring/determining soil compaction.

3. *Detrimental Soil Puddling.* Puddling is generally evaluated at the mineral soil surface. Visual indicators of detrimental puddling include clearly identifiable ruts with berms in mineral soil, or in an Oa horizon of an organic soil. Detrimental puddling may occur in conjunction with detrimental compaction. The guidelines for soil compaction are to be used when this occurs. Detrimentally puddled soils are not always detrimentally compacted. Infiltration and permeability are affected by detrimental soil puddling. Puddling can also alter local groundwater hydrology and wetland function, and provide conduits for runoff.

4. *Severely Burned Soil.* Severely burned soil applies to prescribed fire and natural fires that are managed for resource benefits. Severely burned soils are identified by ratings of fire severity and the effects to the soil. A severely burned soil is generally soil that is within a High Fire Severity burn as defined by the Forest Service Burned Area Emergency Rehabilitation Program (FSH 2509.13) and Debano et al. (1998). An example of a High Fire Severity rating is provided below. Soil humus losses, structural changes, hydrophobic characteristics and sterilization are potential effects of severely burned soil.

> Example of High Fire Severity Rating – High soil heating, or deep ground char occurs where the duff is completely consumed and the top of the mineral soil is visibly reddish or orange on severely burned sites. Color of the soil below 1 cm is darker or charred from organic material that has heated or burned. The char layer can extend to a depth of 10 cm or more. Logs can be consumed or deeply charred, and deep ground char can occur under slash concentrations or under burned logs. Soil textures in the surface layers are changed and fusion evidenced by clinkers that can be observed locally. All shrub stems are consumed and only the charred remains or large stubs may be visible. Soil temperatures at 1 cm are greater than 250 C. Lethal temperatures for soil organisms occur down to depths of 9 to 16 cm.

Standards for detrimentally disturbed soils are to be applied to existing or planned activities that are available for multiple uses. These standards do not apply to areas with dedicated uses such as mines, ski areas, campgrounds, and administrative sites.

developed recreation
Recreation that requires facilities that in turn result in concentrated use of an area; for example, a campground or ski resort.

discountable effect
A discountable effect is one that is highly unlikely to occur. Therefore, no change to a resource, social, or economic condition would be expected from a discountable effect. Determination of a discountable effect may be based on scientific analysis, professional judgment, experience, or logic. Specific to the ESA and effects on Threatened, Endangered, Proposed or Candidate species, the appropriate determination for discountable effects on these species would be: "Is not likely to adversely affect". Refer to the "adverse effect" definition in this glossary.

dispersed recreation
Recreation that does not occur in a developed recreation setting, such as hunting, scenic driving, or backpacking.

disturbance
Any event, such as wildfire or a timber, sale that alters the structure, composition, or function of an ecosystem.

disturbance regime
Any recurring event that influences succession, such as fire, insects, ice storms, blow down, drought, etc.

down log
A portion of a tree that has fallen or been cut and left on the forest floor.

easement
A special-use authorization for a right-of-way that conveys a conditioned interest in National Forest System land, and is compensable according to its terms.

ecological integrity
In general, ecological integrity refers to the degree to which the elements of biodiversity and the processes that link them together and sustain the entire system are complete and capable of performing desired functions. Exact definitions of integrity are somewhat relative and may differ depending on the type of ecosystem being described.

ecological function
The activity or role performed by an organism or element in relation to other organisms, elements, or the environment.

ecological health
The state of an ecosystem in which ecological processes, functions and structure are adequate to maintain diversity of biotic communities commensurate with those initially found there.

ecological processes
The actions or events that link organisms (including humans) and their environment such as disturbance, successional development, nutrient cycling, productivity, and decay.

Ecological Reporting Unit (ERU)
In the Upper Columbia River Basin DEIS, a geographic mapping unit developed by the Science Integration Team to report information on the description of biophysical environments, the characterization of ecological processes, the discussion of past management activities and their effects, and the identification of landscape management opportunities.

economic efficiency
Producing goods and services in areas best suited for that production based on natural biophysical advantage or an area’s ability to best serve regional demands of people.

economic dependency
The degree to which a community is dependent upon National Forest resources for employment and income.

economic region
A group of communities and their surrounding rural areas that are linked together through trade.

ecosystem
A naturally occurring, self-maintained system of living and non-living interacting parts that are organized into biophysical and human dimension components that are linked by similar ecological processes, environmental features, environmental gradients and that form a cohesive and distinguishable unit.

ecosystem health
A condition where the components and functions of an ecosystem are sustained over time and where the system’s capacity for self-repair is maintained, such that goals for ecosystem uses, values, and services are met.

ecosystem management
Scientifically based land and resource management that integrates ecological capabilities with social values and economic relationships, to produce, restore, or sustain ecosystem integrity and desired conditions, uses, products, values, and services over the long term.

effective ground cover
Effective ground cover consists of vegetation, litter, and rock fragments larger than three-fourths inch in diameter. It is expressed as the percentage of material, other than bare ground, covering the land surface. It may include live vegetation, standing dead vegetation, litter, cobble, gravel, stones, and bedrock. The minimum effective ground cover, following the cessation of disturbance in an activity area, should be sufficient to prevent detrimental erosion. Minimum amounts of ground cover necessary to protect the soil from erosion are a function of soil properties, slope gradient and length, and erosivity (precipitation factor), and must be determined locally. Rock fragments, litter, and canopy might be treated independently, depending on the model used to estimate erosion hazard ratings.

electronic sites
See communication sites.

elements of ecosystem management
Essential building blocks of the biophysical (i.e., historical range of variability) and human dimension (i.e., demographics; tribal) components for Southwest Idaho Ecosystem Management Framework.

eligibility
For Wild and Scenic Rivers, an evaluation of river features to determine which rivers qualify to be studied for possible addition to the WSR System. Two screening criteria are used for a river segment to be eligible for inclusion in the WSR system. The river must be free-flowing, and it must possess one or more outstandingly remarkable scenic, recreational, geological, fish and wildlife, historical, cultural, ecological, or other value.

elk site distance
Distance at which vegetation hides 90 percent of an elk from view.

encroachments
Improvements occupied or used on National Forest System lands without authorization.

encumbrance
A claim, lien, right to, liability, or interest attached to and binding real property.

endangered species
Designated by the FWS or NMFS, an animal or plant species that has been given federal protection status because it is in danger of extinction throughout all or a significant portion of its natural range.

Endangered Species Act (ESA)
An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of "aesthetic, ecological, educational, historical, recreational, and scientific value". It may also protect the listed species' critical habitat, the geographic area occupied by or essential to the species. The FWS (USFWS) and NMFS share authority to list endangered species, determine critical habitat, and develop species' recovery plans.

enhance
In a Recreation Opportunity Spectrum context, enhance means to address or resolve setting inconsistencies in the adopted ROS strategy classifications.

entrainment
The drawing in and transport by the flow of a fluid. For example, fish can be entrained into a canal as water is diverted into the canal, if the diversion is not screened.

entrapment
To catch in, as in a trap. For example, the entrainment of fish into a diversion canal may result in fish entrapment in the canal should they not be able to return to the stream they were diverted from.

ephemeral stream
A stream or portion of a stream that flows only in direct response to precipitation or run-off events, and that receives little or no continuous water from springs, snow, or other sources. Unlike intermittent streams, an ephemeral usually does not have a defined stream channel or banks, and its channel is at all times above the water table.

eradicate (noxious weeds)
To eliminate a noxious weed from a given area, including all viable seeds and vegetative propagules.

Essential Fish Habitat (EFH)
EFH is broadly defined by the Magnuson-Stevens Act as, "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". This language is interpreted or described in the 1997 Interim Final Rule [62 Fed. Reg. 66551, Section 600.10 Definitions] -- Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include historic areas if appropriate. Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities. Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. "Spawning, breeding, feeding, or growth to maturity" covers a species" full life cycle. Federal agencies are required, under '305(b)(2) of the MSA and its implementing regulations (50 CFR 600 Subpart K), to consult with NMFS regarding actions that are authorized, funded, or undertaken by that agency that may adversely affect EFH).

essential habitat
Used to describe habitat of listed species under ESA, but not designated as "critical habitat". Essential habitat has all the important elements of habitat necessary to sustain a species.

exotic species
Animals or plants that have been introduced from a distant place and are non-native to the area of introduction.

facility
Structures needed to support the management, protection, and utilization of the National Forests, including buildings, utility systems, bridges, dams, communication system components, and other constructed features. There are three categories of facilities: recreation, administrative, and permitted.

family
A collection of focal species that share similarities in source habitats, with the similarities arranged along major vegetative themes

fg (foreground)
The visual distance zone relating to the detailed landscape found within 0 to 0.25 to 0.5 mile from the viewer.

fine filter (conservation) approach
Focuses on individual species that are assumed to be inadequately protected under the coarse-filter or meso-filter conservation approach. Typcially this includes threatened or endangered species under the Endangered Species Act (ESA) or those considered Regionally sensitive by the Intermountain Regional Forester.

fine-scale
Used to define a landscape area varying in size from a 6th-field HU to a combination of 5th-field HUs, approximately 10,000 to 100,000 acres.

fire-adapted ecosystem
An ecosystem with the ability to survive and regenerate in a fire-prone environment.

Fire Management Plans
A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program described in the approved Forest Plan.

fire regimes
The characteristics of fire in a given ecosystem, including factors such as frequency, intensity, severity, and patch size. The terms used for the different fire regimes are: Nonlethal, Mixed1, Mixed2, and Lethal. Nonlethal fires are generally of lowest intensity and severity with the smallest patches of mortality, while lethal fires are generally of highest intensity and severity with the largest patches of mortality. The others fall in between.

fire intensity
The effects of fire on the above-ground vegetation generally described in terms of mortality.

fire severity
Fire effects at and below the ground surface. Describes the impacts to organic material on the ground surface, changes to soils, and mortality of below-ground vegetative buds, roots, rhizomes, and other organisms.

fire suppression tactics
The tactical approaches regarding suppression of a wildland fire. These range from Control, Confine, Contain, and Monitor. Control is the most aggressive tactic, while Monitor is the least.

fire use
The combination of wildland fire use and prescribed fire application to meet resource objectives.

FIREWISE
A public education program developed by the National Wildland Fire Coordinating Center that assists communities located in proximity to fire-prone lands.

floodprone area width
The area that would be expected to be covered by water if the wetted stream depth were twice bank full height, determined at the deepest part on a given transect. This width is then extrapolated over the length of the stream reach by averaging several random transects taken within the project area.

fluvial fish
Fish that migrate, but only within a river system. Bull trout that migrate into larger river systems.

focal species
Species that represent the varying characteristics of a landscape's attributes that must be represented in the landscape (Lambeck 1997)

forage
Plant material (usually grasses, forbs, and brush) that is available for animal consumption.

forbs
Broadleaf ground vegetation with little or no woody material.

forest development road
See National Forest System road.

forest development trail
As defined in 36 CFR 212.1 and 261.2 (FSM 1013.4), a trail wholly or partly within or adjacent to and serving National Forests and other areas administered by the Forest Service that has been included in the forest development transportation plan.

forest development transportation plan
The plan for the system of access roads, trails, and airfields needed for the protection, administration, and use of National Forests and other lands administered by the Forest Service, or the development and use of resources upon which communities within or adjacent to National Forests are dependent (36 CFR 212.1).

forest highway
A designated forest road under the jurisdiction of, and maintained by, a public authority that is subject to the Highway Safety Act. The planning process is a cooperative effort involving the State(s), Forest Service, and the Federal Highway Administration. The location and need for improvements for these highways depend on the relative transportation needs of the various element of the National Forest System (23 CFR 660.107). The determination of relative needs involves the analysis of access alternatives associated with Forest Service programs and general public use. The basis for access needs is established in the Forest Plan. (FSM 7740.5 and 7741.)

forest stand
A contiguous group of trees sufficiently uniform in age class distribution, composition and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged, and uneven-aged stands. A stand is the functional unit of silviculture reporting and record-keeping. Stand may be analogous to Activity Area. In the Intermountain Region, contiguous groups of trees smaller than 5 acres are not recorded or tracked. (Definitions, FSH 2470, 08-13-2004.)

forested stringers
Stands of forested vegetation that are long and narrow and surrounded by non-forested vegetation. Stringers often provide high value habitat for big game and other wildlife species because they are the only hiding or thermal cover in the immediate area.

forested vegetation
Refers to lands that contain at least 10 percent canopy cover by forest trees of any size, or land that formerly had forest tree cover and is presently at an early seral cover type.

forest system trail
See forest development trail.

forest telecommunications system
All equipment and related facilities used for the purpose of Forest communication. This includes but is not limited to radio, voice, data, and video communications.

forest transportation atlas
An inventory, description, display, and other associated information for those roads, trails, and airfields that are important to the management and use of National Forest System lands, or the development and use of resources upon which communities within or adjacent to the National Forests depend.

forest transportation facility
A classified road, designated trail, or designated airfield—including bridges, culverts, parking lots, log transfer facilities, safety devices, and other transportation network appurtenances—under Forest service jurisdiction that is wholly or partially within or adjacent to National Forest System lands.

forest transportation system management
The planning, inventory, analysis, classification, recordkeeping, scheduling, construction, reconstruction, maintenance, decommissioning, and other operations taken to achieve environmentally sound, safe, cost-effective, access for use, protection, administration, and management of National Forest System lands.

fragmentation
The splitting or isolation of habitat into smaller patches because of human actions. Habitat can be fragmented by management activities such as timber harvest and road construction, and changes such as agricultural development, major road systems, and reservoir impoundments.

fragmented population
The splitting or isolation of populations into smaller patches because of anthropogenic or natural causes.

free flowing
Existing or flowing in a natural condition without impoundment, diversion, straightening, riprapping, or other modification in the waterway.

function
The flow and interaction of abiotic and biotic nutrients, water, energy, or species.

geoclimatic setting
The geology, climate (precipitation and temperature), vegetation, and geologic processes (such as landslides or debris flows) that are characteristic of a place; places with these similar characteristics are said to have the same geoclimatic setting.

Geographic Information System (GIS)
A GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

Geomorphic Integrity (GI)
Geomorphic integrity is an assessment and comparison of existing soil-hydrologic conditions with historical conditions that existed before Euro-American settlement. Upland, riparian, and stream conditions are assessed to determine how their integrity and resilience may have changed due to effects from past or current human-caused (road construction, timber harvest, livestock grazing, etc.) or natural (wildfire, floods, etc.) disturbance. Relative integrity ratings are assessed at the subwatershed scale and based on the geomorphic resilience of streams and wetland/riparian areas, and the ability of the system to absorb and store water.

geomorphology
The study of land forms. Also, a natural physical process that is responsible for the movement and deposition of organic and inorganic materials through a watershed under the influence of gravity or water (either on a hillslope or in a stream channel).

goal
As Forest Plan management direction, a goal is a concise statement that helps describe a desired condition, or how to achieve that condition. Goals are typically expressed in broad, general terms that are timeless, in that there are no specific dates by which the goals are to be achieved. Goal statements form the basis from which objectives are developed.

goods and services
The various outputs produced by forest and rangeland renewable resources. The tangible and intangible values of which are expressed in market and non-market terms. (36 CFR 219)

guideline
As Forest Plan management direction, a guideline is a preferred or advisable course of action generally expected to be carried out. Deviation from compliance does not require a Forest Plan amendment (as with a standard), but rationale for deviation must be documented in the project decision document.

habitat
A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

habitat family
See family.

habitat security
The protection inherent in any situation that allows big game to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activity. The components of security may include, but are not limited to: vegetation, topography, road density, general accessibility, hunting season timing and duration, and land ownership. Habitat security is area specific, while hiding cover (see definition below) is site specific.

habitat type
An aggregation of all land areas potentially capable of producing similar plant communities at climax (the end of secondary succession).

hardening
Used in the context of facility management, hardening refers to improvements, usually to the surfacing of roads, trails, campsite areas, and facility access areas, to reduce soil erosion and/or sedimentation in nearby watercourses. These improvements can include paving, gravel surfacing, or a number of other soil stabilization products and techniques.

head month
One head month is equal to 1 month's use and occupancy of the range by one animal. For grazing fee purposes, it is a month's use and occupancy of range by one weaned or adult cow with or without calf, one bull, one steer, one heifer, one horse, one burro, or one mule; or five sheep or five goats.

heritage program
The Forest Service program that encompasses all aspects of cultural resource management, including both project and non-project resource inventory, evaluation, mitigation, curation, interpretation, public participation and education, protection and monitoring, and support to other resources.

hibernaculum
Winter residence, or any natural covering for protecting organisms during the winter. This term is often used for bat wintering and roosting areas, which may include caves, mine adits, or loose tree bark.

hiding cover
Vegetation capable of hiding 90 percent of an adult elk or deer from a human's view at a distance equal to or less than 200 feet.

hierarchy
A general integrated system comprising two or more levels, the higher controlling to some extent the activities of the lower levels; a series of consecutively subordinate categories forming a system of classification.

historical emissions
The amount of smoke assumed to be produced annually or decadally, based on the number of acres burned in each historical fire regime. Used to provide a reference for current conditions.

Historical Range of Variability (HRV)
The natural fluctuation of healthy ecosystem components over time. In this document, HRV refers to the range of conditions and processes that likely occurred prior to settlement of the area by people of European descent (around the mid 1800s), and that would have varied within certain limits over time.

historic property
Any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on the National Register, including artifacts, records, and material remains related to such a property or resource.

human dimensions
Refers to social and economic components of an ecosystem.

hydrologic
Refers to the properties, distribution, and effects of water. "Hydrology" is the study of water; its

occurrence, circulation, distribution, properties, and reactions with the environment.

Hydrologic Unit Code (HUC)
A hierarchal coding system developed by the U.S. Geological Service to map geographic boundaries of watersheds of various sizes.

hydric
Wet or moist conditions. Can refer to a habitat characterized by, or a species adapted to wet or moist conditions, rather than mesic (moderate) or xeric (dry) conditions.

Idaho Department of Water Resources Comprehensive Water Plan
State legislation provides for the development of a comprehensive state water plan that may include protected rivers designated either as natural or recreational rivers. The legislative purpose states that selected rivers possessing outstanding fish and wildlife, recreational, aesthetic, historic, cultural, natural, or geologic values should be protected for the public benefit and enjoyment. The legislation provides that a waterway may be designated as an interim protected river prior to the preparation of the comprehensive plan for the waterway.

impinge
To strike or dash, especially with a sharp collision. For fish, impingement, or physical contact with screen material, can cause some level of injury and/or mortality. Fish impingement onto a screen face can usually be avoided with proper consideration of diversion design hydraulics. Fish screen criteria used in the Northwest specifies that approach velocity must be less than 0.4 feet per second to adequately protect salmonid fry.

indicator
In effects analysis, a way or device for measuring effects from management alternatives on a particular resource or issue.

Infish
Interim Inland Native Fish Strategy for Intermountain, Northern, and Pacific Northwest Regions (USDA Forest Service).

infrastructure
The facilities, utilities, and transportation systems needed to meet public and administrative needs.

in lieu lots (*Sawtooth only*)
Lots that are permitted to recreation residence tract permittees in lieu of existing lot permits that cannot be renewed due to a change in land use or allocation, etc. See FSH 2709.11, Chapter 2721.23f.

inner gorge
Steep valley walls that bound a stream reach. Common in areas of stream downcutting or geologic uplift. More commonly found on the costal and cascade ranges.

insignificant effect
An insignificant effect is one that cannot by detected, measured, or evaluated in any meaningful way. Therefore, no change to a resource, social, or economic condition would be expected from an insignificant effect. Determination of an insignificant effect may be based on scientific analysis, professional judgment, experience, or logic.

Specific to the ESA and effects on Threatened, Endangered, Proposed or Candidate species, an insignificant effect can never reach the scale or magnitude where a species take occurs. The appropriate effects determination for insignificant effects on these species would be: "Is not likely to adversely affect". Refer to the "adverse effect" definition in this glossary.

integrated weed management
A multi-disciplinary, ecological approach to managing weed infestations involving the deliberate selection, integration, and implementation of effective weed control measures with due consideration of economic, ecological, and sociological consequences.

interior exclusion
A parcel of non-National Forest System land within the Forest boundary that can be acquired without having Congress change the exterior Forest boundary.

interim management direction
For Wild and Scenic Rivers, the identified outstandingly remarkable values are afforded adequate protection, subject to valid existing rights. Affording adequate protection requires sound resource management decisions based on NEPA analysis. Protective management may be initiated by the administering agency as soon as eligibility is determined. Specific management prescriptions for eligible river segments provide protection to free-flowing values, river-related values, and classification impacts.

intermittent stream
A stream or portion of a stream that flows only in direct response to precipitation or seasonal run-off, and that receives little or no water from springs or other permanent sources. Unlike ephemeral streams, an intermittent has well-defined channel and banks, and it may seasonally be below the water table.

Inventoried Roadless Area (IRA)
An area that:

- is larger than 5,000 acres or, if smaller, contiguous to a designated wilderness or primitive area;
- contains no improved roads maintained for travel by standard passenger-type vehicles;
- is characterized by a substantially undeveloped character; and
- has been inventoried by the Forest Service for possible inclusion in the Wilderness Preservation System.

These areas include those identified in a set of IRA maps—contained in the Forest Service Roadless Area Conservation Final EIS, Volume 2 (November 2000), and held at the National headquarters of the Forest Service—or any update, correction, or revision of those maps. Refer to Table C-5 in Appendix C to the Forest Plan Revision Final EIS for a listing of IRAs, their location, and acreage.

isolated cabin
Cabins on sites not planned or designated for recreational cabin purposes. These cabins are authorized by special-use permit.

isolated population
A population that is not connected as a result of barriers from anthropogenic or natural causes. For fish species, the migratory form is absent and the population is isolated to local streams or a small watershed.

Key Ecological Functions (KEF)
(KEF) are the set of ecological roles performed by a species in its ecosystem (Marcot and Vander Heyden 2004). These ecological roles are the main ways organisms use, influence, and alter their biotic and abiotic environments.

Key Environmental Correlates (KEC)
(KEC) are biotic or abiotic habitat elements that species use on the landscape to survive and reproduce.

key watershed
Governor's Bull Trout Conservation Plan (7/96) - A watershed that has been designated as critical to long-term persistence of regionally important bull trout populations. Designation is based on existing bull trout population biology and not land ownership. Land management actions emphasize maintenance or recovery of bull trout. Key watersheds must:

- be selected to provide all critical habitat elements;
- be selected from best available habitat, with best opportunity to be restored to high quality;
- provide for replication of strong subpopulations within their boundaries;
- be large enough to incorporate genetic and phenotypic diversity, and small enough that subpopulations interconnect;
- be distributed throughout bull trout historic range.

ladder fires
Consume material between low-level vegetation and tree canopies, such as small trees, downed logs, and vines.

ladder fuels (or a fuel ladder)
A firefighting term for live or dead vegetation that allows a fire to climb up from the forest floor into the tree canopy.

landscape
Heterogenous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout. When defined for landscape scale assessment, the spatial extent should

be large enough to allow natural disturbance processes to operate.

landscape scale assessment
An assessment done for a landscape area varying in size from a 6th-field HU to a combination of 5th-field HUs, or approximately 10,000 to 100,000 acres. This scale is synonymous with "fine-scale analysis." Ecosystem Analysis at the Watershed Scale (EAWS) occurs at this scale.

landslide
Any downslope mass movement of soil, rock, or debris.

landslide hazard
The calculated probability of slope failure (Prellwitz 1994). In practical field use, it is a relative (e.g., low, moderate, or high) estimate of the potential susceptibility for landslide occurrence.

landslide prone area
An area with a tendency for rapid soil mass movements typified by shallow, non-cohesive soils on slopes where shallow translational planar landsliding phenomena is controlled by shallow groundwater flow convergence. The initiation is often associated with extremely wet periods, such as rain-on-snow events. It does not include slow soil mass movements that include deep earth-flows and rotational slumps, nor snow avalanche or rock fall areas. Translational slides have been documented as the dominant form of landslides for the majority of the Forest.

landtype
A portion of the landscape resulting from geomorphic and climatic processes with defined characteristics having predictable soil, hydrologic, engineering, productivity, and other behavior patterns.

landtype associations
A grouping of landtypes similar in general surface configuration and origin.

leasable minerals
Leasable minerals are normally those "soft rock minerals" related to energy resources, such as oil, gas, coal, oil shale, tar sands, etc. Some "hard rock" minerals can become leasable because of land status, i.e., acquired mineral estate.

legacy trees
Defined as older trees that survived recent disturbances and are a relic of historical communities. These trees are important because they exhibit definitive characteristics and contribute to ecosystem function in a different manner than younger trees.

lifestyle
The way people live.

local population
For bull trout, this is a group that spawns within a particular stream or portion of a stream system. Multiple local populations may exist within a core area. The smallest group of fish that

is known to represent an interactive reproductive unit will be considered a local population. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (e.g., those within a core population), but is assumed to be infrequent compared to that among individuals within a local population (USDI FWS 2002).

local road
Roads that connect terminal facilities with Forest collector or arterial roads, or public highways. The location and standard are usually controlled by topography and specific resource activities rather than travel efficiency. Forest local roads may be developed and operated for long-term, intermittent, short-term, or temporary service.

locatable minerals
Locatable minerals are normally those “hard rock minerals” that are either base or precious metals, and that are open and available for appropriation under the General Mining Laws. In Idaho, locatable minerals often include gold, silver, lead, zinc, copper, antimony, cadmium, cobalt, molybdenum, etc.

log
Coarse woody debris with diameters ≥15 inches (≥12 inches for PVG 10) and lengths ≥6 feet.

long-term effects
Effects that last 15 years or longer.

macrovegetation
A unit of vegetation for analysis above the site-scale.

Magnuson-Stevens Act
Public Law 94-265, as amended through October 11, 1996. Ocean fisheries are managed under the Magnuson Fishery Conservation and Management Act of 1976 (also called the Magnuson-Stevens Act [MSA]). The Act provided NMFS legislative authority for fisheries regulation in the United States, in the area between three-miles to 200 miles offshore and established eight Regional Fishery Management Councils (Councils) that manage the harvest of the fish and shellfish resources in these waters. In 1996, the MSA was re-authorized and changed by amendments to emphasize the sustainability of the nation’s fisheries and establish a new standard by requiring that fisheries be managed at maximum sustainable levels and that new approaches be taken in Essential Fish Habitat conservation.

maintain
When used in a management goal or objective for biological and physical resources, “maintain” means to stay within the range of desired conditions. The context is that resource conditions are already within their desired range, and the expectation is that management actions to achieve goals or objectives maintain resource conditions within their desired range in the planning period.

When used in a standard or guideline for biological and physical resources, "maintain" means that current conditions are neither restored or degraded, but remain essentially the same. The context is that resource conditions may or may not be in their desired range, and the expectation is that maintenance management actions do not degrade or restore current conditions.

This is an important distinction because most goal or objective management actions cannot be designed to achieve desired conditions for all resources. Specific actions are designed to achieve desired conditions for specific resources, but may simultaneously have effects on those or other resources. The intent behind "maintain" when used in a standard or guideline is to keep those effects from *degrading* resource conditions; i.e., moving conditions from functioning properly to functioning at risk, or making conditions measurably worse when they are currently functioning at risk or not functioning properly. See definitions for "degrade" and "restore" in this Glossary.

For Recreation, Scenic Environment, Heritage, Lands, Special Uses, and Wilderness resources, "maintain" means to continue a current or existing practice, activity, management strategy, resource condition, or level of use.

For physical improvements managed under the Roads and Facilities programs, "maintain" means to keep the road or facility in a usable condition.

For resource inventories, databases, plans, maps, or other documents related to all resources, "maintain" means to periodically update these items to reflect current conditions and/or status.

management action or activity
As identified in FSM 2527.05 - Any Federal activity including (1) acquiring, managing, and disposing of Federal lands and facilities, (2) providing federally undertaken, financed, or assisted construction or improvements, and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

An exception to this definition is fire suppression, which is considered an emergency response action rather than a management action. FSM 2671.45f, part 2(a) states, "Human safety is the highest priority for every emergency response action (see FSM 5130.3 for related direction on the wildland fire suppression policy and the priority for the safety of firefighters, other personnel, and the public)."

management area
A land area with similar management goals and a common prescription, as described in the Forest Plan.

Management Indicator Species (MIS)
Representative species whose habitat conditions or population changes are used to assess the impacts of management activities on similar species in a particular area. MIS are generally presumed to be sensitive to habitat changes.

Management Prescription Category (MPC)
Management prescriptions are defined as, "Management practices and intensity selected and scheduled for application on a specific area to attain multiple use and other goals and objectives" (36 CFR 219.3). MPCs are broad categories of management prescriptions that indicate the general management emphasis prescribed for a given area. They are based on Forest Service definitions developed at the national level, and represent management emphasis themes, ranging from Wilderness (1.0) to Concentrated Development (8.0). The national MPCs have been customized during Forest Plan revision to better fit the needs and issues of the Southwest Idaho Ecogroup Forests.

management strategies
For Forest Plan revision, this term is used to encompass both management direction and management emphasis (especially MPCs) that set the stage and sideboards for future actions or activities that may occur during the planning period. The strategies do not include any specific actions or activities, but rather focus on the general types and intensities of activities that could occur, given the management direction and prescriptions proposed under the Forest Plan alternatives.

mass stability
The susceptibility of soil masses to stress. Gravitational stresses, on slopes, changes of state (solution), and soil particles cohesion are the main factors involved (USDA Forest Service 1973).

matrix
In landscape ecology, a matrix is usually the most extensive and connected element present in a landscape. Patches and corridors are often imbedded in the matrix. The matrix may play a dominant role in the functioning of the landscape without being the most extensive landscape element. Determining the matrix in a landscape depends either on connectivity, dominance, or function. Each landscape should be evaluated individually.

matrix management
A concept that asserts biodiversity and ecological function can be sustained in working landscapes as long as attention is given to maintaining habitat across the full range of spatial scales.

Maximum Modification (MM)
Category of Visual Quality Objective (VQO) where human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

meaningful measures
A recreation, wilderness, and heritage resources management process that:

- Establishes quality standards, based on validated visitor preferences and expectations, that are used to produce desired services and facilities;
- Accounts for the costs to manage resources;
- Establishes priorities for current budgets; and
- Links recreation resources to other management responsibilities of the agency

measurable change
A measurable change is one that can be meaningfully detected, measured, or evaluated using accepted analysis or monitoring methods. A measurable change would not result from an insignificant or discountable effect.

mesic
Moderate moisture conditions. Can refer to a habitat characterized by, or a species adapted to moderate moisture conditions rather than hydric (wet) or xeric (dry) conditions.

mesofilter (conservation) approach
Used to assess the conservation value of ecosystems and landscapes that lie conceptually between the coarse-filter and fine-filter. The core idea of this approach is that by conserving representation of key habitat elements important to species but too fine to address through the coarse-filter, many species will protected without the necessity of considering them individually. Examples of mesofilter approaches include providing direction to conserve elements such as logs or snags.

metapopulation
A group or collection of semi-isolated subpopulations of organisms that are interconnected and interact both physically and genetically. A population comprising local populations that are linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events. For anadromous fish species, “metapopulation” is the population within a 3rd field HU, i.e., Snake River Evolutionarily Significant Unit.

mid-scale
An area varying in size from a U.S. Geological Survey 4th-field hydrologic unit (HU) to groups of 4th-field HUs, approximately 500,000 to 5,000,000 acres. Subbasin Review and Land Management Planning unit analyses occur at this scale.

middleground (mg)
The visual distance zone between the foreground and the background in a landscape, located from 0.25 – 0.5 mile to 3-5 miles from the viewer.

mitigate
To avoid, minimize, reduce, eliminate, rectify, or compensate for impacts or degradation that might otherwise result from management actions.

mitigation measures
Modifications of actions that: (1) avoid impacts by not taking a certain action or parts of an action in a given area of concern; (2) minimize impacts by limiting the degree or magnitude of the actions and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments.

Modification (M)
Category of Visual Quality Objective (VQO) where human activity may dominate the characteristic landscape but must, at the same time, follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

monitoring
The process of collecting information to evaluate if objectives and anticipated results of a management plan are being realized, or if implementation is proceeding as planned.

National Environmental Policy Act (NEPA)
The National Environmental Policy Act of 1969 requires environmental analysis and public disclosure of federal actions.

National Fire Plan
Strategic and implementation goals, budget requests and appropriations, and agency action plans to address severe wildland fires, reduce fire impacts on rural communities, and ensure effective firefighting capability in the future.

National Fire Plan communities
Those communities identified in the January and August 2001 Federal Register as "Urban Wildland Interface Communities" for each state as part of the National Fire Plan.

National Forest Scenic Byway
A road on National Forest System land that has been designated by the Chief of the Forest Service for its exceptional scenic, historic, cultural, recreational, or natural resources.

National Forest System road
A classified Forest road under the jurisdiction of the Forest Service. The term "National Forest System road" is synonymous with the term "forest development road" as used in 23 U.S.C. 205.

National Historic Preservation Act (NHPA)
A Federal Act, passed in 1966, which established a program for the preservation of additional historic properties throughout the nation and for other purposes, including the establishment of the National Register of Historic Places, the National Historic Landmarks designation, regulations for supervision of antiquities, designation of the State Historic Preservation Offices (SHPO), guidelines for federal agency responsibilities, technical advice, and the establishment of the Advisory Council on Historic Preservation.

National Register of Historic Places (NRHP)
A list of cultural resources that have local, state, or national significance maintained by the Secretary of the Interior.

National Wilderness Preservation System
All lands managed under the Wilderness Act and subsequent wilderness designations, irrespective of the department or agency having jurisdiction.

Nationwide Rivers Inventory (NRI)
The NRI provides a database for potential additions to the National Wild and Scenic River System. The NRI is maintained and updated by the National Park Service. Just because a segment is listed on the NRI or is on other source lists does not necessarily indicate eligibility, and conversely, absence from any such list or document does not indicate a river's ineligibility.

native species
Animals or plants that originated in the area in which they live. Species that normally live and thrive in a particular ecosystem.

natural disturbance
Any relatively discrete event in time that is not a management action or activity, that disrupts ecosystems, vegetative communities, or species populations. Natural disturbances may or may not be functioning within their historical range of variability.

natural-appearing landscape character
"Natural-appearing" refers to a visual landscape character that has resulted from a combination of geological processes, climate, disturbance events, and ecological succession.

networks
Highly interconnected features within landscapes. Network properties of connectivity are important for ensuring species dispersal, habitat colonization and hence persistence. Habitat networks are relevant when considering the movement of species and have been particularly useful for understand riparian systems.

new facilities
Facilities resulting from new construction in locations where no facilities previously existed.

new road construction
Activity that results in the addition of forest classified or temporary road miles (36 CFR 212.1).

no action (alternative)
The most likely condition expected to exist if current management practices continue unchanged. The analysis of this alternative is required for federal actions under NEPA.

non-discretionary actions
Land management activities initiated from outside the National Forest Service—such as mining proposals, special-use permitted activities, or suppression tactics for life-threatening situations.

non-forested vegetation
Lands that are not capable of supporting at least 10 percent canopy cover of forest trees of any size. Land that formerly had at least 10 percent tree canopy cover and is presently in an early seral cover type is still considered forested vegetation.

Northwest Power Planning Council Protected Rivers
The Council has designated certain river reaches in the Columbia River Basin as "protected areas". These are areas where the Council believes hydroelectric development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat. Protected rivers are those reaches or portions of reaches listed on the “Protected Areas List”.

noxious weed
A state-designated plant species that causes negative ecological and economic impacts to both agricultural and other lands within the state.

nutrient cycling
Circulation or exchange of elements such as nitrogen and carbon between non-living and living portions of the environment. Includes all mineral and nutrient cycles involving mammals and vegetation.

objective
As Forest Plan management direction, an objective is a concise time-specific statement of actions or results designed to help achieve goals. Objectives form the basis for project-level actions or proposals to help achieve Forest goals. The time frame for accomplishing objectives, unless otherwise stated, is generally considered to be the planning period, or the next 10 to 15 years. More specific dates are not typically used because achievement can be delayed by funding, litigation, environmental changes, and other influences beyond the Forest’s control.

Off Highway Vehicle (OHV)
Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland, or other natural terrain. These include common vehicles such as motorcycles, ATVs, snowmobiles, 4-wheel drive vehicles, and trail bikes.

old forest
Old forest is a component of the Large Tree Size Class, with the following general characteristics: variability in tree size that includes old, large trees with signs of decadence, increasing numbers of snags and coarse woody debris, canopy gaps, and understory patchiness. There are two broad types of old forest—single-storied and multi-storied. Single-storied old forest is characterized by a single canopy layer of large or old trees. These stands generally consist of widely spaced, shade-intolerant species, such as ponderosa pine and western larch, that are adapted to a nonlethal, high frequency fire regime. Multi-storied old forest is characterized by two or more canopy layers, with large or old trees in the upper canopy. These stands can include both shade-tolerant and shade-intolerant species, and are typically adapted to a mixed regime of both lethal and nonlethal fires. Because old forest characteristics have been aggregated into two basic categories, it is generally easier to identify, monitor, and compare the characteristics of these old forest types with desired vegetative conditions than it is with “old growth” (see old growth definition, below).

old-forest habitat
See old forest.

old growth
Old growth is a defined set of forested vegetation conditions that reflect late-successional characteristics, including stand structure, stand size, species composition, snags and down logs, and decadence. Minimum amounts of large trees, large snags, and coarse wood are typically required. Definitions of old growth generally vary by forest type, depending on the disturbance regimes that may be present. Also, within a given forest type, considerable variability can exist across the type's geographical range for specific ecological attributes that characterize late seral and climax stages of development. This variability among and within multiple (often 10-20) forest types makes old growth characteristics difficult to identify, monitor, and compare to desired vegetative conditions.

opening (created)
Related to vegetation management, openings are created only by planned, even-aged, regeneration timber harvesting. Only those even-aged timber harvest practices that reduce stocking levels to less than 10 percent create openings. Canopy cover will normally be used to determine stocking levels. Residual stands of mature trees will generally have less than 10 percent stocking when fewer than 10 to 15 trees per acre remain following harvest. Even-aged harvest practices that may result in the creation of openings include clear-cutting, reserve tree clear-cutting, seed tree cutting, shelterwood seed cutting, and overstory removal.

operable forests
Forests where wood product operations are currently functioning and generating outputs.

ordinary high water mark
The mark on all watercourses that will be found by examining the beds and banks and ascertaining where the presence and action of waters are so common and continuous in ordinary years as to mark upon the soil a character distinct from that of the abutting upland.

Outstandingly Remarkable Value (ORV)
In the Wild and Scenic Rivers Act, river values identified include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values and their immediate environments. The Act does not further define outstandingly remarkable values. The Intermountain Region defines outstandingly remarkable value as, *"Characteristic of a river segment that is judged to be a rare, unique, or exemplary feature that is significant at a regional or national scale"*.

Pacfish
Interim strategies for managing Pacific anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California.

Pacific Northwest Rivers Study
A component of the Northwest Power Planning Council's Pacific Northwest Hydro Assessment Study. The study produced a comprehensive rating for five major classes of data including Resident Fish, Wildlife, Cultural Features, Natural Features, and Recreation. The study also identified reaches already protected by other State or Federal institutional constraints. Ratings were on a scale of 1-5, where 1 represented outstanding resource, 2 a substantial resource, 3 a moderate resource, 4 a limited resource, and 5 an unknown or absent resource.

Partial Retention (PR)
A category of Visual Quality Objective (VQO) where human activities may be evident to the casual Forest visitor but must remain subordinate to the characteristic landscape.

parturition
The act or process of giving birth

Passport In Time
A nationwide Forest Service program that provides opportunities for "hands-on" public involvement in cultural resources management, such as archeological excavations, historical research, and oral history collection.

patches
In landscape ecology, patches are spatial units at the landscape scale. Patches are areas surrounded by matrix, and may be connected by corridors. Patch size can affect species habitat, resource availability, competition, and recolonization. Patch shape and orientation also play an important ecological role. Interpatch distance refers to the distance between two or more patches

patchworks
Arrangement, size and pattern of distinct, interacting patches that can be used to predict biodiversity and species persistence.

patchy habitat
Habitat that is naturally isolated from near-by pieces that are similar. Habitat that is patchy should not be referred to a being fragmented because it is not a man-induced condition.

pattern, or spatial pattern
The spatial arrangement of landscape elements (patches, corridors, matrix) that determines the function of a landscape as an ecological system.

perennial stream
A stream that typically maintains year-round surface flow, except possibly during extreme periods of drought. A perennial stream receives its water from springs or other permanent sources, and the water table usually stands at a higher level than the floor of the stream.

Persons At One Time (PAOT)
A recreational capacity measurement term indicating the number of people who can use a facility or area at one time.

population
The people, wildlife, fish, or plants that inhabit and reproduce in a specific area. Also, a group of individuals of the same species occupying a defined locality during a given time that exhibit reproductive continuity from generation to generation. For anadromous fish species, this is the population within a 4th field HU.

potential classification
For Wild and Scenic Rivers, when rivers are considered for eligibility, river segments are tentatively classified either as wild, scenic, or recreational, based on the degree of access and amount of development along the river area.

potential outstandingly remarkable value assessment
For Wild and Scenic Rivers, a general look at each river, to determine if the resource values are below average, average, or above average. Rivers determined to contain at least one resource value that is above average will be evaluated in the eligibility process.

Potential Vegetation Group
A group of habitat types that share similar environmental characteristics, site productivity, and disturbance regimes.

preclude
To put a barrier before; hence, to shut out; to hinder; to stop; to impede. (The Collaborative International Dictionary of English v. 0.44).

prescribed fire
Any fire ignited by management actions to meet specific objectives.

prescription (fire)
Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations.

Preservation (P)
Category of Visual Quality Objective (VQO) that allows for ecological change only.

primitive
A Recreation Opportunity Spectrum classification for areas characterized by an essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted.

priority wildlife habitats
Those habitats that have most decreased or changed from historic times. They can be used to rank the need for restoration or management emphasis.

priority watershed
Governor's Bull Trout Conservation Plan (7/96) - A watershed that is either in the best condition for this species or is most recoverable with the greatest opportunity for success. Priority watersheds can be classified as follows:

> *Focal* - highly occupied, existing protection and maintenance, cost for protection is low, chance of success is high over the short term.

Adjunct - considerable restoration may be needed, riparian and in-channel restoration stand a good chance of succeeding, good opportunity for colonizing from adjacent habitat, restoration can improve adjacent refuge populations.

Nodal - critical to sustaining existing populations within the watershed, connected and accessible to migrating populations, restoration potential is high.

Critical Contributing Area - restoration is necessary to secure functional value for associated focal, adjunct, or nodal habitats.

Lost Cause - level of effort exceeds benefits.

private road
A road under private ownership authorized by an easement to a private party, or a road that provides access pursuant to a reserved or private right.

professional judgment
Intuitive conclusions and predictions dependent upon training; interpretation of facts, information, observations, and/or personal knowledge.

promote
In the context of recommended wilderness management, to take measures that actively encourage non-conforming uses within recommended wilderness. These measures would include the development or improvement of facilities and infrastructure within recommended wilderness in support of non-conforming uses. These measures would not include actions taken to reduce safety hazards and routine maintenance of existing facilities and infrastructure.

Properly Functioning Condition (PFC)
Properly Functioning Condition means that the resource condition is within the range of desired conditions.

proposed action
A proposal made by the Forest Service or other federal agency to authorize, recommend, or implement an action to meet a specific purpose and need.

public road
Any road or street under the jurisdiction of, and maintained by, a public authority and open to public travel [23 U.S.C. 101(a)].

RARE I and RARE II
Roadless area inventory processes, conducted by the Forest Service in 1972 and 1977, respectively, mandated by the Wilderness Act of 1964.

rear
To feed and grow in a natural or artificial environment.

reclamation (mine facilities)
Reclamation can include removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing, or removing toxic or potentially toxic materials; salvage and replacement of topsoil, and/or seedbed preparation, and revegetation.

recreation residences
Cabins on National Forest System lands that normally were established in tracts and built for recreation purposes with agency approval and supervision. These cabins are authorized by special use permit and are not the primary residences of the owners.

Recreation Opportunity Spectrum (ROS)
A framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities. The settings, activities, and opportunities for obtaining experiences are arranged along a continuum or spectrum divided into six classes--primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban.

recreational river
In the National Wild and Scenic River System, a river or river segment that is readily accessible by road or railroad, may have some development along their shorelines, and may have undergone some impoundment or diversion in the past.

Recreation Visitor Day (RVD)
Twelve hours of recreation use in any combination of persons and hours (one person for 12 hours, three persons for four hours, etc.).

redundant
Communities and ecosystems occur in multiple locations across a planning area in order to ensure large-scale disturbances or other threats that affect one or more locations do not jeopardize conservation targets.

reference
The range of a factor/indicator that is representative of its recent historical values prior to significant alteration of its environment resulting from unnatural disturbance. The reference could represent conditions found in a relic site or sites having little significant disturbances, but does not necessarily represent conditions that are attainable. The purposes of references are to establish a basis for comparing what currently exists to what has existed in recent history. References can be obtained through actual data, such as paired or well-managed watersheds, or through extrapolated techniques such as modeling. Sources of information include inventory and records, general land office and territorial surveys, settlers' and explores' journals, ethnographic records, local knowledge, and newspapers.

refugia
Watersheds or large areas with minimal human disturbance, having relatively high quality water and fish habitat, or having the potential of providing high-quality water and fish habitat with the implementation of restoration efforts. These high-quality water and fish habitats are well distributed and connected within the watershed or large area to provide for both biodiversity and stable populations (Quigley and Arbelbide 1997).

replacement facilities
Reconstruction of pre-existing facilities.

representative
Conditions within landscapes that provide the biological features and historical range of variability under which ecosystems evolved. The assumption of a representative approach is that providing a wide-range of conditions will sustain the greatest percentage of the species which utilize those characteristics.

resident fish
Fish that are non-migratory and spend their entire life cycle within a given freshwater area.

resilient, resiliency
The ability of a system to absorb disturbances before changing to a state or trajectory that is entirely new to the system. The ability to absorb disturbances depends on the health of states, functions and processes that facilitate recovery. Resiliency is one of the properties that enable the system to persist in many different states of successional stages. In human communities, refers to the ability of a community to respond to externally induced changes such as larger economic or social forces.

resistance-to-control hazard
Conditions that, given the same topography and weather, have a higher likelihood of becoming a crown fire, which in turn can lead to fire behavior that makes the fire difficult to control.

restoration
Management actions or decisions taken to restore the desired conditions of habitats, communities, ecosystems, resources, or watersheds. For soil, water, riparian, or aquatic resources, restoration may include any one or a combination of active, passive, or conservation management strategies or approaches.

restoration priority
A means used in this Forest Plan revision to prioritize water quality and aquatic restoration using beneficial uses, current condition, imperiled fish species, 303(d)-listed water bodies, and TMDL-assigned subbasins. This process also includes whether restoration should be active or passive based upon district-level properly functioning condition analyses for 6th level hydrologic units (subwatersheds).

restore
For biological and physical resources, restore means to repair, re-establish, or recover ecosystem functions, processes, or components so that they are moving toward or within their range of desired conditions.

For the Recreation, Scenic Environment, Heritage, Lands, Special Uses, Wilderness, Roads and Facilities resources, restore means to use management actions to re-establish desired resource conditions.

retard attainment of desired resource conditions
When an effect resulting from a management action, individually or in combination with effects from other management actions, within a specified area and time frame, measurably slows the recovery rate of existing conditions moving toward the range of desired resource conditions.

Retention (R)
A category of Visual Quality Objective (VQO) where human activities are not evident to the casual Forest visitor.

riparian areas or zones
Terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated with high water tables, and soils that exhibit some wetness characteristics.

Riparian Conservation Areas (RCAs)
Portions of watersheds where riparian-dependant resources receive primary emphasis, and management activities are subject to specific goals, objectives, standards, and guidelines. RCAs include traditional riparian corridors, perennial and intermittent streams, wetlands, lakes, springs, reservoirs, and other areas where proper riparian functions and ecological processes are crucial to maintenance of the area's water, sediment, woody debris, nutrient delivery system, and associated biotic communities and habitat.

riparian ecosystems
The area of influence of the riparian ecological functions and processes that serve as a transition between terrestrial and aquatic ecosystems that includes: streams, lakes, wet areas, and adjacent vegetation communities and their associated soils which have free water at or near the surface; an ecosystem whose components are directly or indirectly attributed to the influence of water.

riparian function and ecological processes
The regulation and exchange of ecological processes and disturbances as they relate to geology, landform, climate and micro-climate, soil, water, vegetation and terrestrial and aquatic species in providing a range of habitats, their conditions and trends. Riparian functions and ecological processes can be affected by changes including among others: streambank and hillslope root strength, large wood recruitment to RCAs, nutrient input to streams, shading, water quality (sediment, nutrients, temperature) water yield and timing (including stream subsurface flow), migration barriers, vegetation composition and structure, and micro-climate (soil moisture, soil temperature, solar radiation, air temperature, relative humidity, wind speed).

Riparian Habitat Conservation Area (RHCAs)
To be used for the No Action Alternative only. As defined in Pacfish and Infish:

Fish-bearing streams - 100-year floodplain, outer edges of riparian area, to top of inner gorge, 300 feet slope distance, or two site potential tree heights, whichever is greatest.

Perennial nonfish-bearing streams - 100-year floodplain, outer reach of riparian area, to top of inner gorge, 150 feet slope distance, or one site potential tree height, whichever is greatest.

Intermittent streams (includes landslide-prone areas and wetlands less than 1 acre) - top of inner gorge, extent of landslide-prone area, outer edges of riparian area, and for key watersheds one site potential tree height or 100 feet slope distance (whichever is greatest), and for non-key watersheds half site potential tree height or 50 feet slope distance (whichever is greatest).

Ponds, lakes, and wetlands greater than 1 acre - outer edges of seasonally saturated soils, edge of riparian area, extent of any unstable soils, one site potential tree height, or 150 feet from maximum pool elevation, whichever is greatest.

risk
The danger that damage or loss will occur; for example, for landslides and other mass soil movements, risk is a measure of the socio-economic consequences (susceptibility to losses) of slope failure (Prellwitz 1994).

river segment
For Wild and Scenic River studies, a portion of the river area, which has been delineated for evaluation and planning purposes,that usually breaks at a change in river character, land status, or classification.

road
A motor vehicle travelway over 50 inches wide, unless designated and managed as a trail. A road may be classified, unclassified, or temporary.

road decommissioning
Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1, FSM 7703).

road maintenance
The ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective (FSM 7712.3).

road maintenance level
Road maintenance is classified in terms of the following levels:

- *Maintenance level 1* - Assigned to intermittent service roads during the time they are closed to vehicular traffic. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities.

- *Maintenance level 2* - Assigned to roads open for public or permitted use by high clearance vehicles. Passenger car traffic is not a consideration.
- *Maintenance level 3* - Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities.
- *Maintenance level 4* - Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Some roads may be paved and/or dust-abated.
- *Maintenance level 5* - Assigned to roads that provide a high degree of user comfort and convenience. These roads are normally paved.

road obliteration
Road decommissioning technique used to eliminate the functional characteristics of a travelway and re-establish the natural resource production capability. The intent is to make the corridor unusable as a road or a trail and stabilize it against soil loss, which can involve re-contouring and restoring natural slopes.

road reconstruction
Activity that results in improvement or realignment of an existing classified road as defined below:

(a) *Road Improvement* – Activity that results in an increase of an existing road's traffic service level expansion of its capacity, or a change in its original design function.

(b) *Road Realignment* – Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway (36 CFR 212.1).

roads subject to the Highway Safety Act
National Forest System roads open to use by the public for standard passenger cars. This includes roads with access restricted on a seasonal basis and roads closed during extreme weather conditions or for emergencies, but which are otherwise open for general public use.

roaded natural
A Recreation Opportunity Spectrum classification for areas characterized by a predominantly natural or natural-appearing environment with moderate evidence of the sights and sounds of people. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities.

roadless area
See Inventoried Roadless Area.

rotational slides
Landslides that move along a surface of rupture that is curved and concave. Rotational slides are uncommon and occur infrequently within the Forest.

RS 2477 claim
A claim for a pre-existing road right-of-way based upon a mining law passed in 1866. The law was later repealed as a part of the Federal Land Policy and Management Act (FLPMA) of 1976.

RS 2339 claim
A claim for a pre-existing ditchline or other water transmission structure.

rural
ROS classification for areas characterized by a natural environment that has been substantially modified by development of structures, vegetative manipulation, or pastoral agricultural development. Resource modification and utilization practices may be used to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sound of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate user densities are present away from developed sites. Facilities for intensified motorized use and parking are available.

scale
Defined in this framework as geographic extent; for example broad, mid, fine or site scale.

Scenery Management System (SMS)
An updated system for the management of scenery resources designed to replace the Visual Management System (VMS) and instituted by the Forest Service in 1995. The SMS differs from the VMS in that:

- It increases the role of constituents throughout the inventory and planning process; and
- It borrows from and is integrated with the basic concepts and terminology of Ecosystem Management.

The SMS provides for improved integration of aesthetics with other biological, physical, and social/cultural resources in the planning process. It also incorporates different terminology and planning elements including Ecological Unit Description, Scenic Attractiveness, Scenic Integrity, Landscape Visibility, and Constituent Analysis. Under SMS, Scenic Integrity Objectives (SIOs) are established that define relative levels of deviation from the character valued by constituents for its aesthetic appeal. Implementation of SMS does not necessarily confer greater or less protection for scenic resources. It is merely a different system for managing them.

scenic river
In the National Wild and Scenic River System, a river or river segment that may be accessible in places by roads, but the shorelines or watersheds are largely primitive and undeveloped.

scoping
The process the Forest Service uses to determine, through public involvement, the range of issues that the planning process should address.

security cover or habitat
See habitat security.

sedimentation
The action or process of forming and depositing sediments. Stream sedimentation occurs when water velocity cannot transport the bed load and suspended matter is deposited by gravity along the streambed.

semiprimitive motorized
ROS classification for areas characterized by predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but would be subtle. Motorized use of primitive roads with predominantly natural surfaces and trails suitable for motorcycles is permitted.

semiprimitive nonmotorized
ROS classification for areas characterized by predominantly natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but would be subtle. Motorized recreation use is not permitted, but primitive roads used for other resource management activities may be present on a limited basis. Use of such roads may be restricted to minimize impacts on recreational experience opportunities or other resources.

sensitive species
A Forest Service or BLM designation, sensitive plant and animal species are selected by the Regional Forester or the BLM State Director because population viability may be a concern, as evidenced by a current or predicted downward trend in population numbers or density, or a current or predicted downward trend in habitat capability that would reduce a species' existing distribution. Sensitive species are not addressed in or covered by the Endangered Species Act.

sensitivity level
A measure of the degree of visitor sensitivity to the visual environment that is used as a component for the determination of Visual Quality Objectives under the Visual Management System. Three sensitivity levels are employed, each identifying a different level of user concern for the visual environment:

- Level 1 – Highest Sensitivity
- Level 2 – Average Sensitivity
- Level 3 – Lowest Sensitivity

short-term effects
Effects lasting from 3 to 15 years in duration.

significant cave
A cave located on federal lands that has been determined to meet the criteria in 36 CFR 290.3(c) or (d) and has been designated in accordance with 36 CFR 290.3(e). A cave considered significant may contain biotic, cultural, mineralogical, paleontologic, geologic, hydrologic, or other resources that have important values for scientific, educational or recreational purposes.

silviculture
The care and tending of stands of trees to meet specific objectives.

site potential tree height
For delineating RCAs, a site potential tree height is the height that a dominant or co-dominant tree within a stand is expected to attain at an age of 200 years. Outside of RCAs, a site potential tree height is the average height that the dominant or co-dominant tree within a stand will attain within 100 years.

site-scale
Any scale less than a broad, mid or fine scale.

snag
A standing dead tree.

soil erosion
Soil erosion is the detachment and transport of soil particles or aggregates by wind, water, or gravity. Management practices may increase soil erosion hazard when they remove ground cover and detach soil particles. .

soil-loss tolerance
Soil-loss tolerance is the maximum rate of soil erosion at which plant productivity can be sustained indefinitely. It is dependent on the rate of soil formation.

soil mass movement or soil mass erosion
Soil mass movement is the downslope movement of earth caused by gravity. This includes but is not limited to landslides, rock falls, debris avalanches, and creep. It does not, however, include surface erosion by running water. It may be caused by natural erosional processes, or by natural disturbances (e.g., earthquakes or wildland fire) or human disturbances (e.g., mining or road construction).

soil productivity
Soil productivity includes the inherent capacity of a soil under management to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight/unit area/year, percent plant cover, or other measures of biomass accumulation.

source habitat
Source habitats are those characteristics of macrovegetation (i.e. cover types and structural stages) that contribute to stationary or positive population growth for a species in a specified area and time (Wisdom 2000).

source habitat capacity
The extent of PVGs or covertypes capable of developing source habitat conditions at some point in time and within some defined area.

source environment
The composite of all environmental conditions that result in stationary or positive population growth for a species in a specified area and time (Wisdom 2000). Source habitats contribute to source environments (Pulliam 1988, Pulliam and Danielson 1991).

spawning
The act of fish reproduction. The mixing of the sperm of a male fish and the eggs of a female fish.

special use authorization
A permit, term permit, lease, or easement that allows occupancy or use rights or privileges on National Forest System lands (36 CFR 261.2).

special-use permit
A special-use authorization that provides permission, without conveying an interest in land, to occupy and use National Forest System lands or facilities for specific purposes, and which is both revocable and terminable.

species of concern
An unofficial status for a species whose abundance is at low levels.

species composition
The mix of species that occur within a vegetative unit. This is actually not unique to vegetation. Should vegetation be used as an example of species composition and this should say "A mix of species that occurs"?

species richness
A measure of biological diversity, referring to the number of species in a given area.

split estate
Lands where ownership of the surface estate and mineral estate has been separated.

stand
See forest stand.

standard
As Forest Plan management direction, a standard is a binding limitation placed on management actions. It must be within the authority and ability of the Forest Service to enforce. A project or action that varies from a relevant standard may not be authorized unless the Forest Plan is amended to modify, remove, or waive application of the standard.

State Historic Preservation Officer (SHPO)
A person appointed by a state's Governor to administer the State Historic Preservation Program.

stream
A natural watercourse of perceptible extent, with definite beds and banks, which confines and conducts continuously or intermittently flowing water. Definite beds are defined as having a sandy or rocky bottom that results from the scouring action of water flow.

strongholds
For fish, strongholds are watersheds that: (1) include all major life-history forms (resident, fluvial, adfluvial) that historically occurred there; (2) have numbers that are stable or increasing, with local populations at least half of their historical size; and (3) have populations with at least 5,000 individuals or 500 adults.

structure
The size and arrangement, both vertically and horizontally, of vegetation.

subbasin
A fourth field hydrologic unit that nests within the hierarchical system developed by the U.S. Geological Survey to describe watersheds. Typically 800,00 to 1,000,000 acres in size, a subbasin is smaller than a river basin (third field unit), and larger than a watershed (fifth field unit).

subpopulation
A well-defined set of interacting individuals that compose a proportion of a larger, interbreeding population.

substrate
The composition of a streambed, including mineral and organic materials.

subwatershed
An area of land that drains to a common point. A subwatershed is smaller subdivision of a watershed but is larger than a drainage or site. Subwatersheds are often synonymous with sixth-field hydrologic units, which are nested within larger watersheds (fifth-field units), and are comprised of smaller drainages, sites, and stream reaches.

subwatershed vulnerability
Subwatershed vulnerability is an assessment of a subwatershed's sensitivity to disturbance and its resiliency or natural ability for restoration. The disturbance may be human-caused and/or natural. This assessment uses several criteria, including soil erosion rates, natural sediment yields, and percentage of landslide-prone areas within the subwatershed.

succession
The replacement in time of one plant community with another. The prior plant community (or successional stage) creates conditions that are favorable for the establishment of the next stage. These changes often occur in a predictable order. More specifically, the gradual and natural progression in composition and structure of an ecosystem toward a climax condition or stage.

suitability
For Wild and Scenic Rivers, an assessment or determination as to whether eligible river segments should be recommended for inclusion in the National Wild and Scenic Rivers System by Congress or the Secretary of the Interior. Wild and Scenic River suitability involves determining the best use of the eligible river and the best method to protect the outstandingly remarkable values within the river corridor.

suited land
Forest land designated in the Forest Plan to be managed for timber production on a regulated basis.

sustainability
The ability to maintain a desired condition or flow of benefits over time.

sustainability outcome
A characterization of the potential capability of the Forest to support focal species and their habitat.

- **Outcome A—**Suitable environments are either broadly distributed or of high abundance compared to their historical distribution. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the focal species. Species with this outcome are likely well distributed throughout the planning area.
- **Outcome B—**Suitable environments are either broadly distributed or of high abundance compared to their historical distribution, but gaps exist where suitable environments are absent or only present in low abundance. However, the disjunct areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well distributed throughout most of the planning area.
- **Outcome C—**Suitable environments are distributed frequently as patches and/or exist at low abundance. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations are isolated, limiting opportunity for intraspecific interactions. Opportunity exists for subpopulations in most of the planning area to interact, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical

condition, reduction in the species' range in the planning area may have resulted. Species with this outcome are likely well distributed in only a portion of the planning area.

- **Outcome D**—Suitable environments are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these environments may be self-sustaining, limited opportunity exists for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition, reduction in the species' range in the planning area may have resulted. These species are likely not well distributed in the planning area.
- **Outcome E**—Suitable environments are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches and little likelihood of recolonization of such patches. There has likely been a reduction in the species' historical range, except for some rare, local endemics that may have persisted in this condition since the historical time period. Species with this outcome are not well distributed throughout much of the planning area

sweet smelling toilet
Vault toilet construction and management technology that has been developed specifically to reduce odor problems associated with vault toilets.

temporary effects
Effects lasting from 0 to 3 years in duration.

temporary road
Roads authorized by contract, permit, lease, other written authorization, or emergency operation, that are not intended to be a part of the forest transportation system, and that are not necessary for long-term resource management.

thermal cover
Vegetation used by animals to lessen the effects of weather. For elk, thermal cover is typically a stand of conferous trees, 40 feet or taller, with an average crown closure of 70 percent or more.

threatened species
Designated by the FWS or NMFS; a plant or animal species given federal protection because it is likely to become endangered throughout all or a specific portion of its range within the foreseeable future.

Total Maximum Daily Load (TMDL)
TMDL is the sum of waste load allocations for point sources, non-point sources, natural background, and a margin of safety. A TMDL specifies the amount of a pollutant that needs to be reduced to meet water quality standards set by the state. TMDL is used in a process to attain water quality standards that (1) identifies water quality problems and contributing pollutant sources, (2) allocates pollution control responsibilities among sources in the watershed, and (3) provides a basis for taking actions needed to restore a water body.

Total Soil Resource Commitment (TSRC)
TSRC is the conversion of a productive site to an essentially non-productive site for a period of more than 50 years. Examples include classified or unclassified roads, inadequately restored haul roads, designated skid roads, landing areas, parking lots, mining dumps or excavations, dedicated trails (skid trails also), developed campgrounds, other dedicated facilities, and some stock driveways. Productivity on these areas ranges from 0 to 40 percent of natural.

Standards for detrimentally disturbed soils are to be applied to existing or planned activities that are available for multiple uses. These standards do not apply to areas with dedicated uses such as mines, ski areas, campgrounds, and administrative sites.

traditional cultural property
Traditional cultural property is defined as a property that is associated with cultural practices or beliefs or a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community (National Register Bulletin 38)

trail
A pathway for purposes of travel by foot, stock, ski, snowshoe, or trail vehicles.

trail vehicle
Vehicles designed for trail use, such as bicycles, snowmobiles, trail bikes, trail scooters, and all terrain vehicles (ATVs).

translational slides
Landslides where the mass displaces along a planar or undulating surface of rupture, sliding out over the original ground surface. Translational slides generally are relatively shallower than rotational slides. Translational slides frequently grade into flows or spreads. Shallow translational landsliding is the dominant type of landslide found within the Forest (Megahan 1978, Clayton 1983, Dixon 2001).

transportation facility jurisdiction
The legal right to control or regulate use of a transportation facility derived from fee title, an easement, an agreement, or other similar method. While jurisdiction requires authority, it does not necessarily reflect ownership.

travel corridor
A linear strip of land defined for the present or future location of transportation facilities within its boundaries. This is a common term for wildlife biologists too. For wildlife a travel corridor is a pathway that connects patches of habitat such as migration routes for big game between winter and summer range.

travel management
The integrated planning of and providing for appropriate movement of people and products to and through National Forest System lands.

travel map or plan
Physical documentation of the outcome of the travel management process reflecting the access decisions (travel orders) issued by the responsible official to restrict, prohibit, or allow the use of a described area or transportation facility to entry or mode of travel.

travelway
Travelways existing on the national forest but not inventoried as part of the forest development transportation system. These routes vary in width, length and structure. Their origin is typically from off-road public travel, but may also be abandoned routes from past management activities such as mining, oil and gas exploration, grazing, and timber harvesting (see also unclassified roads). These roads may also include roads referred to as "two-tracks," "non-system roads," or "ghost roads".

tree size class
The categorization of trees for a vegetative unit to a descriptive class based on the largest trees that meet a set of criteria. Classes are Grass/Forb/Shrub/Seedling (GFSS), sapling, small, medium or large.

uncharacteristic wildfire
A fire that is burning in a way that does not emulate historical effects. This may include fire intensity, severity, size, and landscape patterns.

uncharacteristic wildfire hazard
Conditions with the potential to lead to undesirable outcomes, in this case an uncharacteristic wildfire.

unclassified road
Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as trails. Unclassified roads also include those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1).

undertaking
Any project, activity, or program that can result in changes in the character or use of any historic properties located in the area of potential effects (36 CFR 800.2). The project, activity, or program must be under the direct or indirect jurisdiction of a federal agency or licensed or assisted by a federal agency.

undeveloped character
In the context of land management, an area of land retaining its primeval character and influence, without permanent improvements or human habitation, which is managed so as to preserve its natural conditions and which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.

unroaded areas
Areas that do not contain classified roads.

unstable areas
Land areas that have a higher probability of increased erosion, landslides, and channel adjustment disturbances during climatic or physical events such as major storms or fires.

urban
ROS classification for areas characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Renewable resource modification and utilization practices are often used to enhance specific recreational activities. Vegetative cover is often exotic and manicured. Sights and sounds of humans are predominant on the site. Large numbers of users can be expected both on the site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.

utility corridor
A linear strip of land defined for the present or future location of utility facilities within its boundaries.

variety class
A measure of the degree of variety within a visual landscape. There are three variety classes that identify the degree of variation of the natural landscape:

- Class A - Distinctive
- Class B - Common
- Class C - Minimal

verification
Testifying, ascertaining, confirming, or testing the truth or accuracy of, asserting or proving to be true (Prellwitz 1994).

viable population
A population that is regarded as having the estimated numbers and distribution of reproductive individuals to ensure that it will continue to exist over time and will be well distributed within a given area.

Visual Management System (VMS)
A system for the management of scenery resources instituted by the Forest Service in 1974. It provides criteria for identification and classification of scenic quality on National Forest System lands. Scenic quality objectives are expressed in terms of Visual Quality Objectives (VQOs) that define the extent of allowable alteration of the natural-appearing landscape character. VQOs are determined based on a combination of natural landscape features and human use zones as expressed by Variety Class and Sensitivity Level.

Visual Quality Objective (VQO)
Categories of acceptable landscape alteration measured in degrees of deviation from the natural-appearing landscape. The categories include Preservation, Retention, Partial Retention, Modification, and Maximum Modification.

vulnerability
Refers to lack of animal security during the hunting season. Vulnerability can be affected by conditions such as road density, road closures, openings, and hunting pressure. Also means "Increased susceptibility to hazards." The hunting season definition seems too narrow and only applicable to species that are hunted rather than affected by humans or activities in other ways.

water quality integrity
Water quality integrity is an assessment and comparison of existing water quality conditions with historical conditions that existed before Euro-American settlement. Physical, chemical, and biological water conditions are assessed to determine how their integrity and resilience may have changed due to effects from past or current human-caused (road construction, timber harvest, livestock grazing, etc.) or natural (wildfire, floods, etc.) disturbance. Conditions or values assessed include streambank damage, sediment loads, channel modification, flow disruption, thermal changes, chemical contamination, and biological stress. Relative integrity ratings are assigned at the subwatershed scale and are based on whether any designated beneficial use is not fully supported or any condition/value is seriously degraded.

water quality limited water bodies
Denotes streams or other water bodies not meeting state Water Quality Standards. For purposes of Clean Water Act listing, these are waters that will not meet standards even with application of required effluent limitations.

watershed
Region or area drained by surface and groundwater flow in rivers, streams, or other surface channels. A smaller watershed can be wholly contained within a larger one, as watersheds are hierarchal in structure. For this document, watersheds are often synonymous with 5th field hydrologic units, which are nested within larger subbasins (4th field units), and are comprised of smaller subwatersheds (6th field units).

Watershed Condition Indicator (WCI)
WCIs are an integrated suite of aquatic (including biophysical components), riparian (including riparian –associated vegetation species), and hydrologic (including uplands) condition measures that are intended to be used at the a variety of watershed scales. They assist in determining the current condition of a watershed and should be used to help design appropriate management actions, or to alter or mitigate proposed and or ongoing actions, to move watersheds toward desired conditions. WCIs represent a diagnostic means to determine factors of current condition and assist in determining future conditions associated with implementing management actions or natural restoration over time.

wetlands
Land areas that are wet at least for part of the year, are poorly drained, and are characterized by hydrophytic vegetation, hydric soils, and wetland hydrology. Examples of wetlands include swamps, marshes, and bogs.

wilderness areas
Areas that are without developed and maintained roads, and that are substantially natural, and that Congress has designated as part of the National Wilderness Preservation System.

wildfire
An unwanted wildland fire. Wildfires can be further described by two basic categories:

(a) *characteristic,* which produce effects similar to those that occurred in the historical fire regime, or
(b) *uncharacteristic,* which produce effects much different than those in the historical fire regime.

wildfire risk
Wildfire risk comprises the probability of an undesired wildfire event and the outcome of it. The undesired event realizes a hazard.

wildland fire
Any fire not involving a home or other structure, other than prescribed fire, that occurs in the wildland.

wildland fire use
Refers to any fire of natural causes that is monitored but allowed to burn

wildland fire use (for resource benefits)
The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outlined in Fire Management Plans.

wildland fire use planning area
Portions of the Forest that may be considered for wildland fire use consistent with the selected alternative. Delineation of the planning area or areas consider proximity to designated Wilderness, area size, location of administrative boundaries, adjacency to wildland-urban interface, and other factors. Further refinements to identify a feasible implementation area may take place during Fire Management Planning.

wildland/urban interface (WUI)
The line, area, or zone where structures and other human developments meet or intermingle with wildland or vegetative fuel. Interface is further delineated into the following types:

(a) *wildland/urban interface*—developed areas with residential structures where many structures border wildland on a broad front.
(b) *wildland/rural interface*—developed areas with private residential structures where developments are few in number scattered over a large area surrounded by wildland.

wild river
In the National Wild and Scenic River System, a rivers or river segment that is generally inaccessible (no roads) except by trail, with watersheds or shorelines that are essentially primitive (free of impoundments and polluted waters).

winter range
An area or areas where animals (usually ungulates such as elk, deer, bighorn sheep) concentrate due to favorable winter weather conditions. Conditions are often influenced by snow depth, and the availability or forage and thermal cover.

xeric
Dry conditions. Can refer to a habitat characterized by, or a species adapted to dry conditions, rather than hydric (wet) or mesic (moderate) moisture conditions.

Zone of Influence (ZOI)
The area that is economically and socio-economically influenced by Forest Service management.

ACRONYMS AND SYMBOLS

ACS	Aquatic Conservation Strategy
ADC	Animal Damage Control
AMR	Appropriate Management Response
AMS	Analysis of the Management Situation
APHIS	Animal and Plant Health Inspection Service
ASQ	Allowable Sale Quantity
ATV	All Terrain Vehicle
AUM	Animal Unit Month
BA	Biological Assessment
BAER	Burned Area Emergency Rehabilitation
BE	Biological Evaluation
Bg	Background (visual quality distance)
BLM	Bureau of Land Management
BMP	Best Management Practice
BO	Biological Opinion
CAA	Clean Air Act
CAP	Continuous Assessment and Planning
CCC	Civilian Conservation Corps
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMAI	culmination of mean annual increment
CPI	Conservation Principle Indicators
CPZ	community protection zone
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
CWD	Coarse Woody Debris
CWPPs	Idaho County Wildfire Protection Plans
d.b.h	Diameter at Breast Height
DC	Desired Condition
DD	Detrimental Disturbance (soils)
DEIS	Draft Environment Impact Statement
DFC	Desired Future Condition
EA	Environmental Assessment
EAWS	Ecosystem Analysis at the Watershed Scale
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EM	Ecosystem Management
EMSI	Economic Modeling Specialists, Inc.
EPA	Environmental Protection Agency
ERU	Ecological Reporting Unit
ESA	Endangered Species Act
ESP	Environmental Site Potential
EVT	Existing Vegetation Types
FACA	Federal Advisory Committee Act
FEIS	Final Environmental Impact Statement

FERC	Federal Energy Regulatory Commission
Fg	Foreground (visual quality distance)
FIA	Forest Inventory and Analysis
FRCC	fire regime condition class
FSH	Forest Service Handbook
FSM	Forest Service Manual
GFRG	General Forest, Rangeland/Grassland
GFSS	Grass/Forb/Shrub/Seedling
GI	Geomorphic Integrity
GIS	Geographic Information System
HFRA	Healthy Forest Restoration Act
HRV	Historical Range of Variability
HU	Hydrologic Unit
HUC	Hydrologic Unit Code
ICB	Interior Columbia Basin
ICBEMP	Interior Columbia Basin Ecosystem Management Project
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDT	interdisciplinary team
IIT	Interagency Implementation Team
IRA	Inventoried Roadless Area
IWM	Integrated Weed Management
KEC	Key Environmental Correlates
KEF	Key Ecological Function
LAU	Lynx Analysis Units
LRMP	Land and Resource Management Plan
LTSYC	Long-Term Sustained Yield Capacity
LUCID	Local Unit Criterion Indicators
M	Modification (visual quality category)
MBF	Thousand board feet
MFSR	Middle Fork Salmon River
Mg	Middleground (visual quality distance)
MIS	Management Indicator Species
MM	Maximum Modification (visual quality category)
MMBF	million board feet
MMCF	million cubic feet
MOU	Memorandum of Understanding
MPC	Management Prescription Category
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act
NF	National Forest
NFMA	National Forest Management Act
NFS	National Forest System
NHPA	National Historic Preservation Act
NIPF	nonindustrial private forests

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPCC	Northwest Power and Conservation Council
NRI	Nationwide Rivers Inventory
NWPPC	Northwest Power Planning Council
OHV	Off Highway Vehicle
ORV	Outstandingly Remarkable Value (for Wild and Scenic Rivers)
P	Preservation (visual quality category)
PAOT	Persons At One Time
PFC	Properly Functioning Condition
PILT	Payment in Lieu of Taxes
PNWRS	Pacific Northwest Rivers Study
PR	Partial Retention (visual quality category)
PVG	Potential Vegetation Group
PVT	Potential Vegetation Type
R	Retention (visual quality category)
RAC	Resource Advisory Council
RAP	Roads Analysis Process
RARE	Roadless Area Review and Evaluation
RCA	Riparian Conservation Area (from ICBEMP)
RHCA	Riparian Habitat Conservation Area (from Pacfish/Infish)
RMO	Riparian Management Objective
RNA	Research Natural Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
RPA	Forest and Rangeland Renewable Resources Planning Act of 1974
RVD	Recreation Visitor Day
SFSR	South Fork Salmon River
SMS	Scenery Management System
SINMAP	Stability Index Mapping
SNRA	Sawtooth National Recreation Area
SPM	semi-primitive motorized
SST	Sweet Smelling Toilet
SRS	Secure Rural Schools
SWRA	Soil-Water-Riparian-Aquatics resources
TEPC	Threatened, endangered, proposed/petitioned, and candidate (species)
TEPCS	Threatened, endangered, proposed/petitioned, candidate, and sensitive (species)
TES	Threatened, endangered, and sensitive (species)
TERO	Tribal Employment Rights Ordinance
TMDL	Total Maximum Daily Load
TOC	Threshold of Concern
TSPQ	Total Sale Program Quantity
TSRC	Total Soil Resource Commitment
UCRB	Upper Columbia River Basin
USDA	United States Department of Agriculture

USDI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
VDDT	Vegetation Dynamics Development Tool
VMS	Visual Management System
VQO	Visual Quality Objective
WARS	Watershed and Aquatic Recovery Strategy
WCI	Watershed Condition Indicator
WCS	Wildlife Conservation Strategy
WLF	Wildfire Frequency
WQI	Water Quality Integrity
WQLWB	Water Quality Limited Water Body
WSR	Wild and Scenic River
WUI	Wildland Urban Interface
ZBP	ZIP Code Business Patterns
ZOI	Zone of Influence
>	Greater than
<	Less than

SCIENTIFIC NAMES

alder	*Alnus* spp.
American three-toed woodpecker	*Picoides tridactylus*
aspen	*Populus* spp
bald eagle	*Haliaeetus leucocephalus*
bark beetle	*Scolytidae* sp.
black bear	*Ursus americanus*
black-backed woodpecker	*Picoides arcticue*
bluebunch wheatgrass	*Pseudoroegneria spicata*
boreal owl	*Aegolius funereus*
Canada lynx	*Lynx canadensis*
Chinook salmon	*Oncorhynchus tshawytscha*
Columbia spotted frog	*Rana luteiventris*
common loon	*Gavia immer*
cottonwood	*Populus* spp.
cougar	*Felix concolor*
deer	*Odocoileus* spp.
Douglas-fir	*Pseudotsuga menziesii*
Douglas-fir bark beetle	*Dendroctonus pseudotsuqae*
Douglas-fir tussock moth	*Orgyia pseudotsugata*
dusky grouse	*Dendragapus obscurus*
elderberry	*Sambucus* spp.
elk	*Cervus canadensis*
Engelmann spruce	*Picea engelmannii*
fir engraver beetle	*Scolytus ventralis*
fisher	*Martes pennant*
flammulated owl	*Ous flammeolus*
grand fir	*Abies grandis*
gray wolf	*Canis lupus*
great gray owl	*Srix nebulosa*
greater sage grouse	*Centrocercus urophasianus*
hawthorn	*Crataegus* spp.

Idaho fescue	*Festuca idahoensis*
Lazuli bunting	*Passerina amoena*
Lewis' woodpecker	*Melanerpes lewis*
lodgepole pine	*Pinus contorta*
mistletoe	*Arceuthobium* spp.
moose	*Alces alces*
mountain pine beetle	*Dendroctonus ponderosae*
mountain quail	*Oreortyx pictus*
mule deer	*Odocoileus hemionus*
ninebark	*Physocarpus* spp.
northern flying squirrel	*Glaucomys sabrinus*
northern goshawk	*Accipiter gentilis*
northern Idaho ground squirrel	*Spermophilus brunneus brunneus*
pileated woodpecker	*Dryocopus pileatus*
ponderosa pine	*Pinus ponderosa*
red squirrel	*Tamiasciurus hudsonicus*
red-backed vole	*Clethrionomys* spp.
redosier dogwood	*Cornus sericea*
Rocky Mountain bighorn sheep	*Ovis canadensis*
Rocky Mountain elk	*Cervus canadensis nelsoni*
serviceberry	*Amelanchier* spp.
silver-haired bat	*Lasionycteris noctivagans*
snowberry	*Symphoricarpus* spp.
snowshoe hare	*Lepus americanus*
southern Idaho ground squirrel	*Spermophilus brunneus endemicus*
spotted bat	*Euderma maculatum*
spruce budworm	*Choristoneura fumiferana*
steelhead trout	O*ncorhynchus mykiss*
subalpine fir	*Abies lasiocarpa*
Townsend's big-eared bat	*Corynorhinus townsendii*
western larch	*Larix occidentalis*
western pine beetle	*Dendroctonus brevicomis*

whitebark pine	*Pinus albicaulis*
white-headed woodpecker	*Picoides albolarvatus*
wild rose	*Rosa californica*
wolverine	*Gulo gulo*
yellow-billed cuckoo	*Coccyzus americanus*

Forest Plan Maps -- 2010 Updates

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Alternative B - 2010 Selected Alternative

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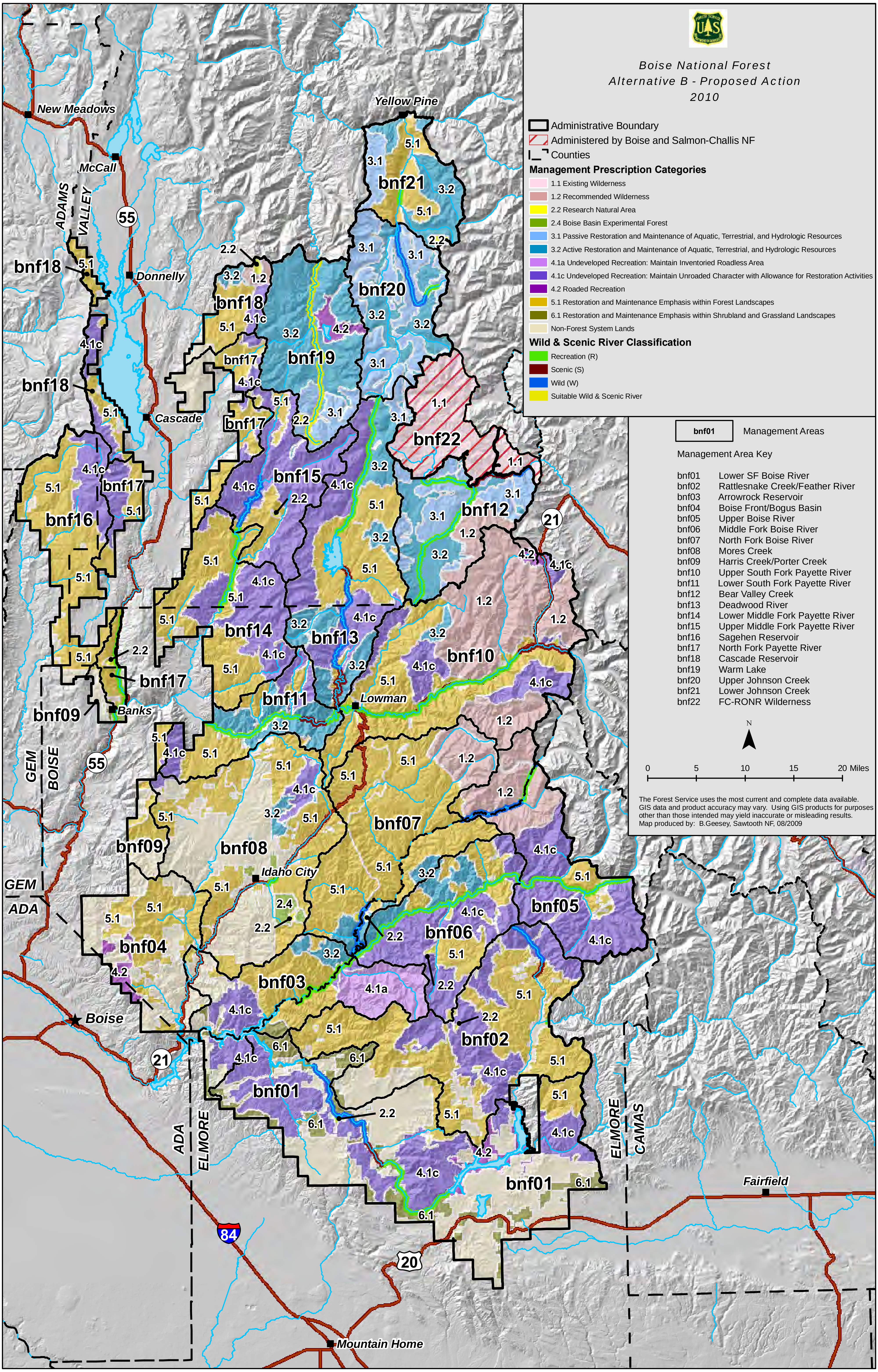
Map 1 - Management Prescription Category Map
Map 2 - Vegetation and Wildlife Habitat Restoration Priorities
Map 3 - Source Environment Priority Map
Map 4 - Fire Regimes



Boise National Forest
Alternative B - Proposed Action
2010

Administrative Boundary
▨ Administered by Boise and Salmon-Challis NF
Counties

Management Prescription Categories

- 1.1 Existing Wilderness
- 1.2 Recommended Wilderness
- 2.2 Research Natural Area
- 2.4 Boise Basin Experimental Forest
- 3.1 Passive Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources
- 3.2 Active Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources
- 4.1a Undeveloped Recreation: Maintain Inventoried Roadless Area
- 4.1c Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities
- 4.2 Roaded Recreation
- 5.1 Restoration and Maintenance Emphasis within Forest Landscapes
- 6.1 Restoration and Maintenance Emphasis within Shrubland and Grassland Landscapes
- Non-Forest System Lands

Wild & Scenic River Classification

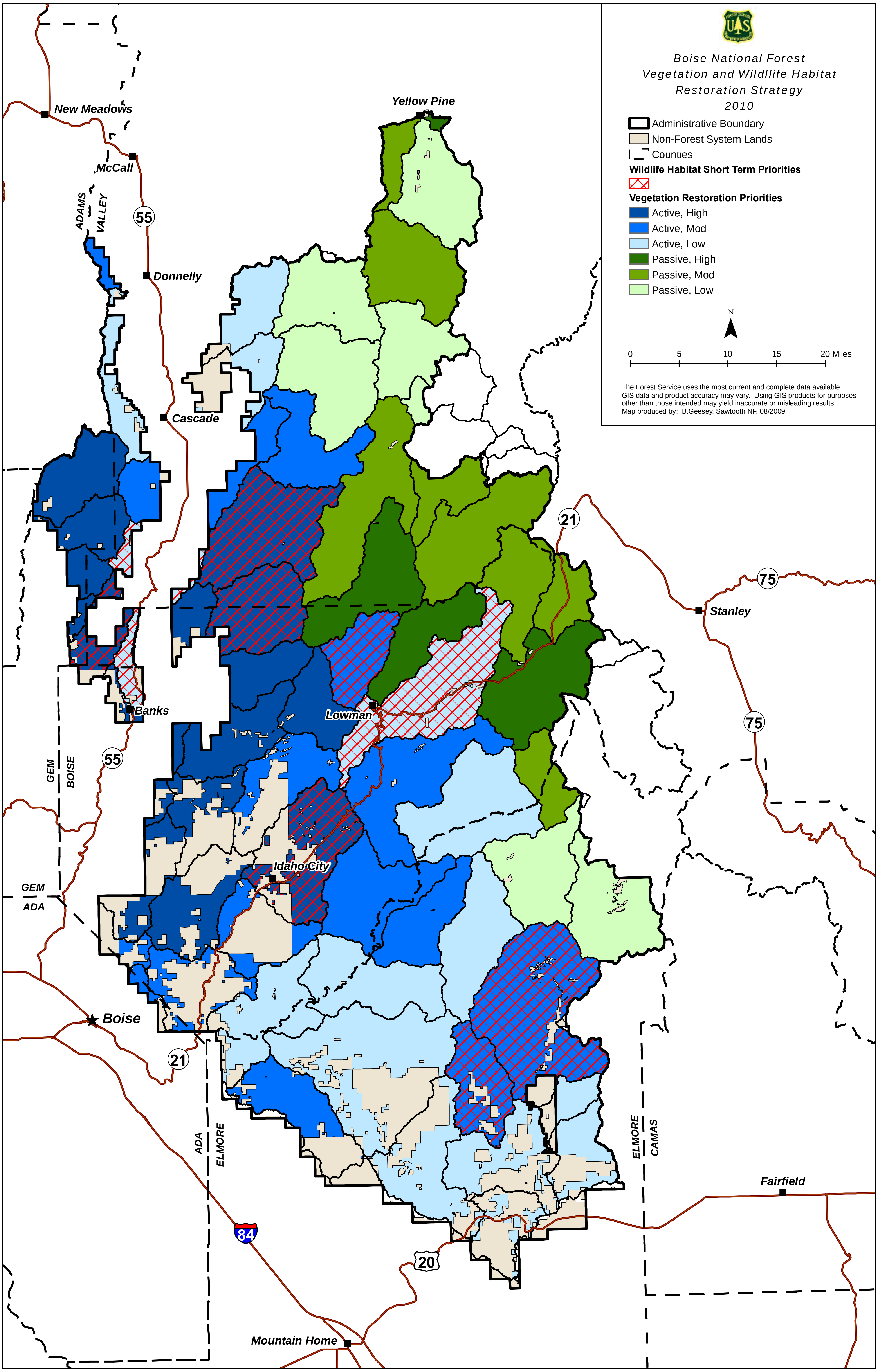
- Recreation (R)
- Scenic (S)
- Wild (W)
- Suitable Wild & Scenic River

bnf01 Management Areas

Management Area Key

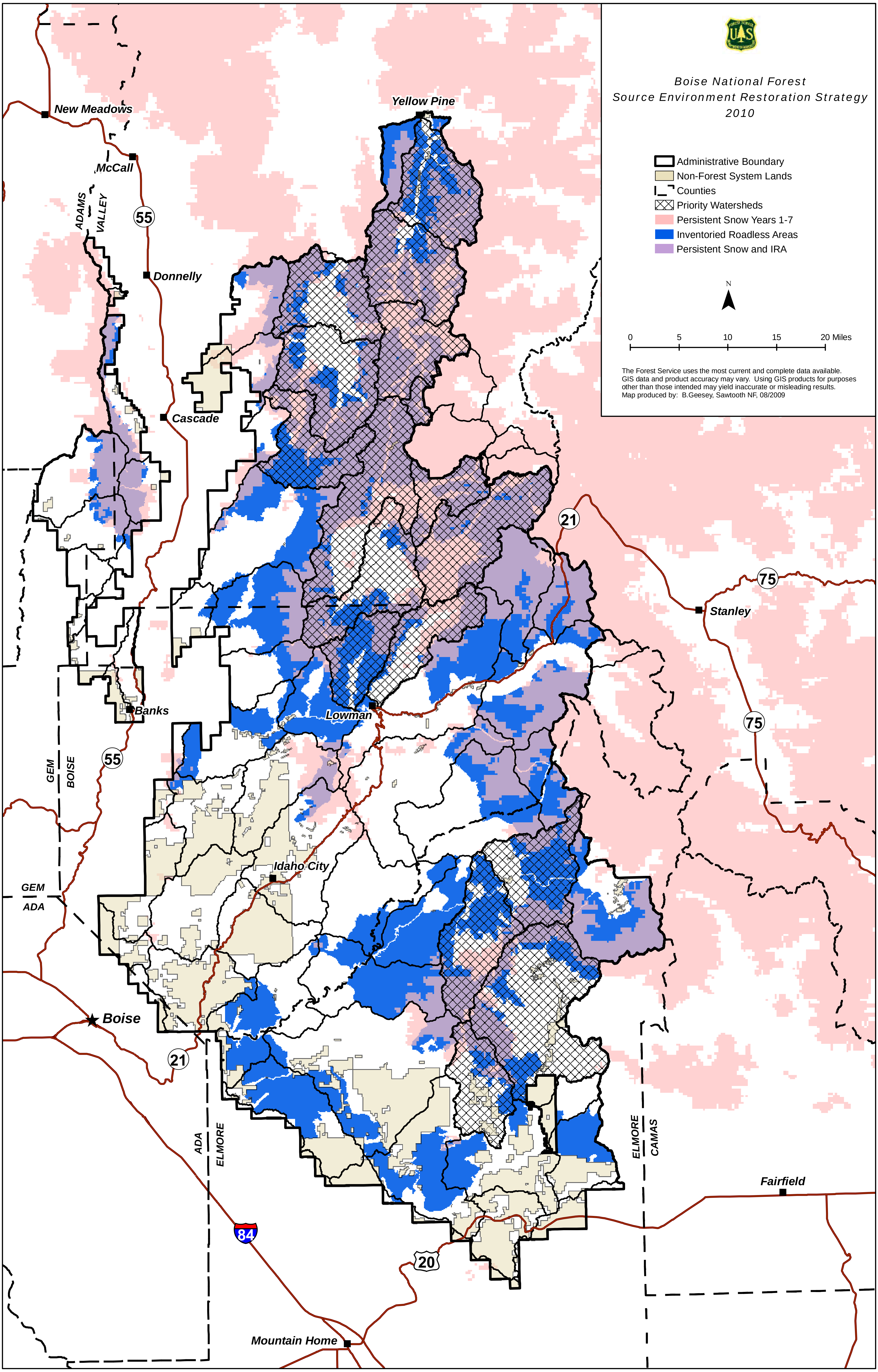
bnf01	Lower SF Boise River
bnf02	Rattlesnake Creek/Feather River
bnf03	Arrowrock Reservoir
bnf04	Boise Front/Bogus Basin
bnf05	Upper Boise River
bnf06	Middle Fork Boise River
bnf07	North Fork Boise River
bnf08	Mores Creek
bnf09	Harris Creek/Porter Creek
bnf10	Upper South Fork Payette River
bnf11	Lower South Fork Payette River
bnf12	Bear Valley Creek
bnf13	Deadwood River
bnf14	Lower Middle Fork Payette River
bnf15	Upper Middle Fork Payette River
bnf16	Sagehen Reservoir
bnf17	North Fork Payette River
bnf18	Cascade Reservoir
bnf19	Warm Lake
bnf20	Upper Johnson Creek
bnf21	Lower Johnson Creek
bnf22	FC-RONR Wilderness

The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009



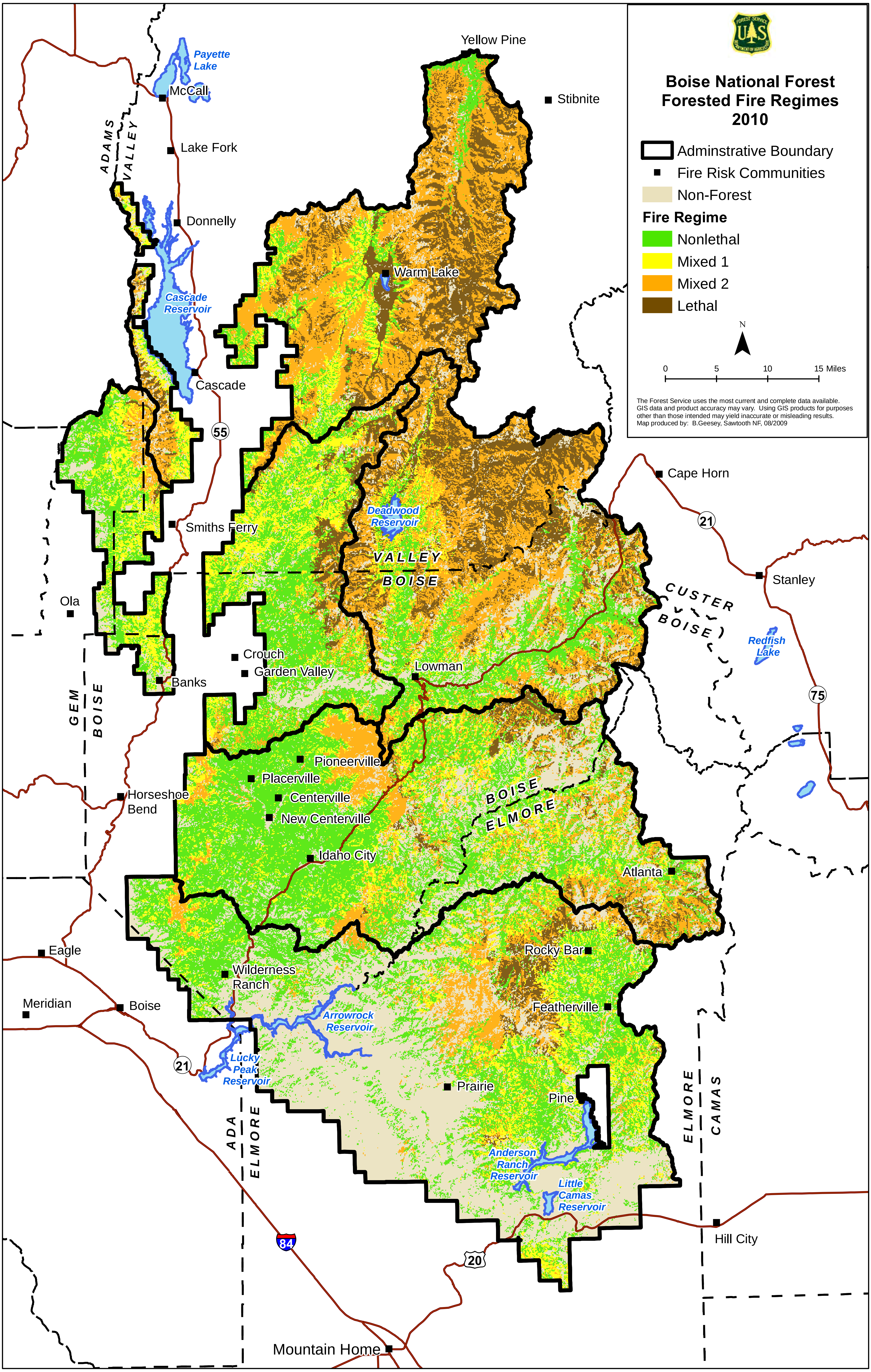
Boise National Forest
Vegetation and Wildllife Habitat
Restoration Strategy
2010

The Forest Service uses the most current and complete data available.
GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009



Boise National Forest
Source Environment Restoration Strategy
2010

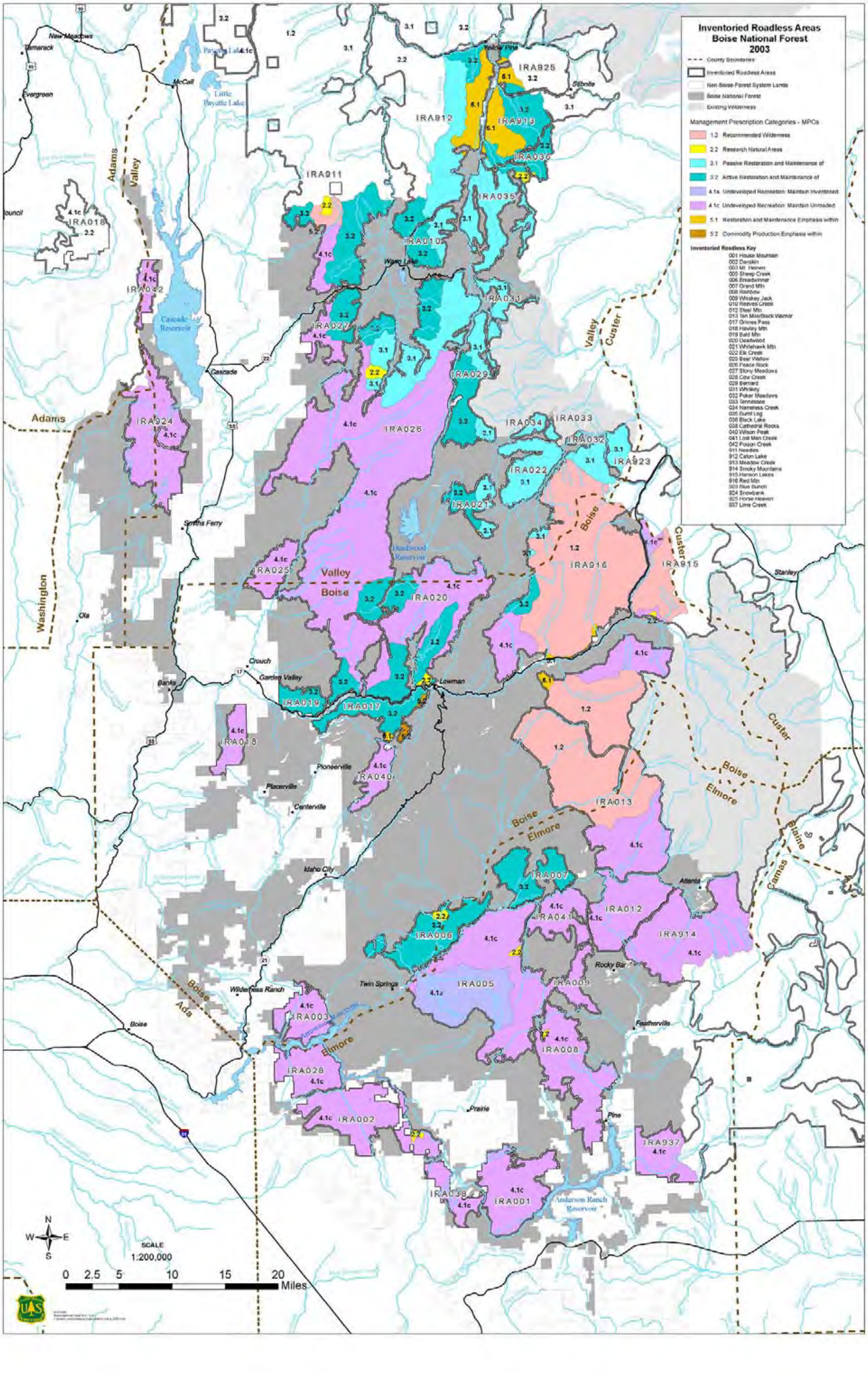
The Forest Service uses the most current and complete data available.
GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.
Map produced by: B.Geesey, Sawtooth NF, 08/2009



Boise National Forest Forested Fire Regimes 2010

The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. Using GIS products for purposes other than those intended may yield inaccurate or misleading results.

Map produced by: B.Geesey, Sawtooth NF, 08/2009



1.2 - Recommended Wilderness
This prescription applies to areas the Forest Service recommends for Wilderness designation. The primary management objective is to maintain wilderness attributes until Congress decides to designate the areas as wilderness or release them to some other form of management. Although these areas do not fall under the authority of the Wilderness Act, they are managed to maintain wilderness attributes where feasible, and to generally allow ecological processes to prevail.

MPC 1.2 Standards and Guideline
Standard
Management actions, including wildland fire use and prescribed fire, must be designed and implemented in a manner that maintains wilderness values, as defined in the Wilderness Act.
Standard
Mechanical vegetation treatments, including salvage harvest, are prohibited.
Standard
Road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty.
Standard
No new motorized or mechanical uses will be allowed, except where these uses must be allowed in response to reserved or outstanding rights, statute, or treaty.
Standard
Existing motorized or mechanical uses are allowed only if they do not lead to long-term adverse changes in wilderness values.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize the impacts of suppression activities on wilderness values.

2.2 - Research Natural Areas
This prescription applies to areas that have been administratively established as Research Natural Areas and that provide unique opportunities for research. Existing and proposed Research Natural Areas are managed to protect the unique values for which they were established. Management plans are developed for each area to provide guidance and protection of values.

MPC 2.2 Standards and Guideline
Standard
Mechanical vegetation treatments, salvage harvest, prescribed fire, and wildland fire use may only be used to maintain values for which the areas were established, or to achieve other objectives that are consistent with the RNA establishment record or management plan.
Standard
Road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty, or
c) To maintain the values for which the RNA was established.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize fire suppression strategies and tactics that minimize impacts to values for which the RNA was established.

3.1 - Passive Restoration and Maintenance of Aquatic, Terrestrial and Hydrologic Resources
This prescription is designed to minimize temporary-term risks and avoid short- and long-term risks from management actions to soil/hydrologic conditions and aquatic and terrestrial habitats. The objective of 3.1 is to keep management-related impacts from degrading existing conditions for TEPCS fish, wildlife, and botanical species, or 303(d) impaired water bodies. Low levels of management activities occur, and these activities are expected to have minimal and temporary degrading effects to soils, water quality, riparian areas, and aquatic and terrestrial habitats. Other uses and activities, such as salvage harvest or Wildland Fire Use, may occur and may have some temporary effects, provided they do not retard attainment of short- and long-term objectives for aquatic and terrestrial habitat, or soil/hydrologic resources. Tools associated with this prescription-such as special order restrictions, operating plan adjustments, and prescribed fire-are typically of low intensity and designed to maintain existing conditions, primarily through ecological processes.

MPC 3.1 Standards and Guideline
Standard
Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary time period (up to 3 years), and must be designed to avoid resource degradation in the short term (3-15 years) and long term (greater than 15 years). Degrade and degradation are defined in the glossary.
Standard
Wildland fire use and prescribed fire may only be used where they:
a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species, or
b) Maintain or restore habitat for native and desired non-native wildlife and plant species.
Standard
Mechanical vegetative treatments, excluding salvage harvest, may only occur where:
a) The responsible official determines that wildland fire use or prescribed fire would result in unreasonable risk to public safety and structures, investments, or undesirable resource effects; and
b) They maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or
c) They maintain or restore habitat for native and desired non-native wildlife and plant species.
Standard
Road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty, or
c) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

3.2 - Active Restoration and Maintenance of Aquatic, Terrestrial, and Hydrologic Resources
This prescription is designed to minimize temporary and short-term risks and avoid long-term risks from management actions to soil/hydrologic conditions and aquatic and terrestrial habitats. The objective of this prescription is to actively restore or maintain conditions for TEPCS fish, wildlife, and botanical species, or 303(d) impaired water bodies through a combination of management activities and natural processes. Management activities used to achieve this objective include watershed restoration, noxious weed treatments, and vegetative treatments that include prescribed fire, wildland fire use, and mechanical. Restoration is focused on those components of the ecosystem that are not functioning properly, or are outside the range of desired conditions, while maintenance helps to preserve those components that are functioning properly.

MPC 3.2 Standards and Guideline
Standard
Management actions, including salvage harvest, may only degrade aquatic, terrestrial, and watershed resource conditions in the temporary (up to 3 years) or short-term time periods, and must be designed to avoid resource degradation in the long term (greater than 15 years).
Standard
Vegetative restoration or maintenance treatments-including wildland fire use, mechanical, and prescribed fire-may only occur where they:
a) Maintain or restore water quality needed to fully support beneficial uses and habitat for native and desired non-native fish species; or
b) Maintain or restore habitat for native and desired non-native wildlife and plant species; or
c) Reduce risk of impacts from wildland fire to human life, structures, and investments.
Standard
Road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty, or
c) To support aquatic, terrestrial, and watershed restoration activities, or
d) To address immediate response situations where, if the action is not taken, unacceptable impacts to hydrologic, aquatic, riparian or terrestrial resources, or health and safety, would result.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize suppression strategies and tactics that minimize impacts on aquatic, terrestrial, or watershed resources.

4.1a - Undeveloped Recreation: Maintain Inventoried Roadless Areas
This prescription applies to lands where dispersed and undeveloped recreation uses are the primary emphasis. Providing dispersed recreation opportunities in an inventoried roadless area is the primary objective. Both motorized and non-motorized recreation opportunities may be provided. Other resource uses are allowed to the extent that they do not compromise the roadless and undeveloped character of the IRA. The area has a predominantly natural-appearing environment, with slight evidence of the sights and sounds of people. Species habitat and recreational uses are generally compatible, although recreation uses may be adjusted to protect TEPCS species.

MPC 4.1a Standards and Guideline
Standard
Management actions-including wildland fire use, prescribed fire, and special use authorizations-must be designed and implemented in a manner that does not adversely compromise the area's roadless and undeveloped character in the temporary, short term, and long term. "Adversely compromise" means an action that results in the reduction of roadless or undeveloped acres within any specific IRA. Exceptions to this standard are actions in the 4.1a road standard, below.
Standard
Road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the roadless or undeveloped character of the area.

4.1c - Undeveloped Recreation: Maintain Unroaded Character with Allowance for Restoration Activities
This prescription applies to lands where dispersed recreation uses are the primary emphasis. Providing dispersed recreation opportunities in an unroaded landscape is the predominant objective. Both motorized and non-motorized recreation opportunities may be provided. Other resource uses are allowed to the extent that they do not compromise ROS settings. The area has a predominantly natural-appearing environment, with slight evidence of the sights and sounds of people. Species habitat and recreational uses are generally compatible, although recreation uses may be adjusted to protect TEPCS species.

MPC 4.1c Standards and Guideline
Standard
Management actions-including mechanical vegetation treatments, salvage harvest, wildland fire use, prescribed fire, special use authorizations, and road maintenance-must be designed and implemented in a manner that would be consistent with the unroaded landscape in the temporary, short term, and long term. Exceptions to this standard are actions in the 4.1c road standards, below.
Standard
Within Inventoried Roadless Areas (IRAs), road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty.
Standard*
Outside IRAs, road construction or reconstruction may only occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty, or
c) To provide transportation systems that support accomplishment of Management Area ROS objectives.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize tactics that minimize impacts of suppression activities on the unroaded landscape.
* 4.1c allocations in most Management Areas occur completely within IRAs, and therefore those Management Areas do not include this standard.

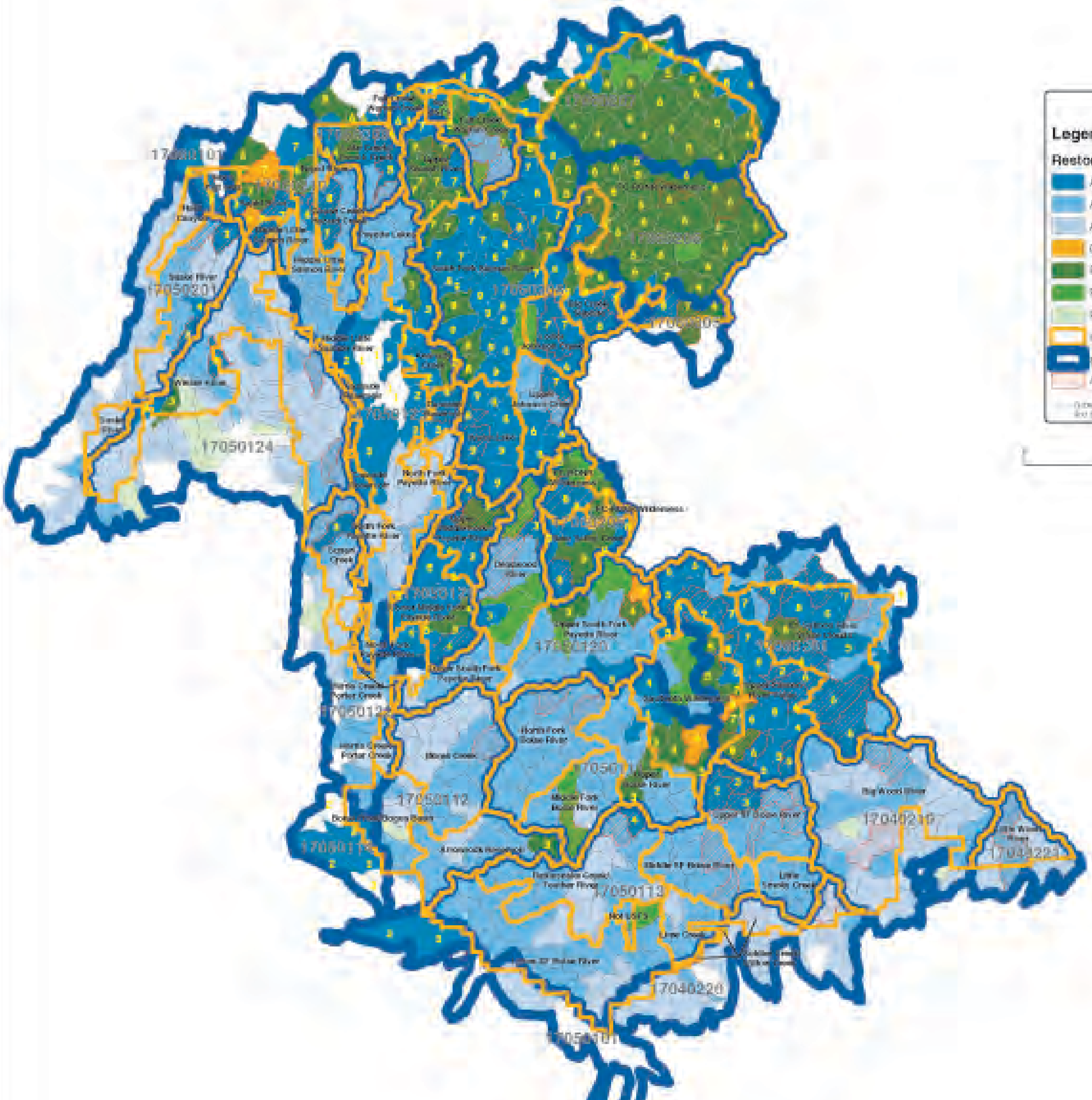
5.1 - Restoration and Maintenance Emphasis within Forested Landscapes
This prescription applies to lands that are predominantly (> 50 percent) forested. Emphasis is on restoring or maintaining vegetation within desired conditions in order to provide a diversity of habitats, reduced risk from disturbance events, and sustainable resources for human use. Commodity production is an outcome of restoring or maintaining the resilience/resistance of forested vegetation to disturbance events; achievement of timber growth and yield is not the primary purpose. The full range of treatment activities may be used. Restoration occurs through management activities and succession. Combinations of mechanical and fire treatments are used to restore forested areas while maintaining or improving resources such as soils, water quality, fish and wildlife habitat, and recreation settings. The risk of temporary and short-term degradation to the environment is minimized, but impacts may occur within acceptable limits as resources are managed to achieve long term goals and objectives.

MPC 5.1 Guidelines
Guideline
The full range of treatment activities may be used to restore and maintain desired vegetation and fuel conditions. The available vegetation treatment activities include wildland fire use. Salvage harvest may also occur.
Guideline
Road construction or reconstruction may occur where needed:
a) To provide access related to reserved or outstanding rights, or
b) To respond to statute or treaty, or
c) To achieve restoration and maintenance objectives for vegetation, water quality, aquatic habitat, or terrestrial habitat, or
d) To support management actions taken to reduce wildfire risks in wildland-urban interface areas, or
e) To meet access and travel management objectives.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to habitats, developments, and investments.

5.2 - Commodity Production Emphasis within Forested Landscapes
This prescription applies to lands that are predominantly forested. Emphasis is on achieving sustainable resource conditions that support commodity outputs, particularly timber production in forested settings, and forage production in non-forested settings. Management activities are also designed to maintain and restore forest ecosystem health to reduce potential for long-term impacts from uncharacteristic disturbance events. Goods and services are provided within the productive capability of the land, and may or may not fully meet demand. Mitigation activities are an important element of project design. Forested landscapes range in appearance from near natural to altered where management activities are evident.

MPC 5.2 Standard and Guidelines
Standard
Wildland fire use is prohibited.
Guideline
Prescribed fire may be used to:
a) Maintain or restore desired vegetative conditions on unsuited timberlands; or
b) Maintain or restore desired fuel conditions for all vegetation types; or
c) Maintain desired vegetative conditions on suited timberlands within PVGs 2 through 10.
Guideline
The full range of fire suppression strategies may be used to suppress wildfires. Emphasize strategies and tactics that minimize impacts to developments and investments.

Watershed and Aquatic Recovery Strategy
SW Idaho Ecogroup
2003



Legend

count of beneficial uses for high priority subwatersheds

Restoration, Priority

🟦	Active, High (187 of 712, 26%)
🟦	Active, Moderate (201 of 712, 28%)
🟦	Active, Low (184 of 712, 26%)
🟧	Conservation, High (5 of 712, 1%)
🟩	Passive, High (101 of 712, 14%)
🟩	Passive, Moderate (20 of 712, 3%)
🟩	Passive, Low (14 of 712, 2%)
▭	management areas
▭	subbasins – clipped to area of interest
▨	Aquatic Conservation Strategy priority subwatersheds

[illegible]

0 25 50 Miles

1:600,000

N

[illegible]

MATRIX USED TO DETERMINE APPROPRIATE TYPE OF SUBWATERSHED RESTORATION:

[illegible]	WQI	Restoration Type	If Highly Vulnerable
High	High	Passive or Conservation [illegible]	Passive or Conservation [illegible]
Moderate	High	Passive	Active
Low	High	Active	Active
High	Moderate	Passive	Active
Moderate	Moderate	Passive	Active
Low	Moderate	Passive	Active
High	Low	Active	Active
Moderate	Low	Active	Active
Low	Low	Active	Active

	Beneficial use or concern
1	[illegible]
2	[illegible]
3	[illegible]
4	[illegible]
5	[illegible]
6	[illegible]
7	[illegible]
8	[illegible]
9	[illegible]
10	[illegible]
11	[illegible]
12	[illegible]
13	[illegible]
14	[illegible]
15	[illegible]
16	[illegible]
17	[illegible]

RESTORATION PRIORITIZATION:

HIGH PRIORITY – [illegible]
OR
[illegible]
OR
[illegible]
OR
TMDL [illegible]

MODERATE PRIORITY – [illegible] "current presence" [illegible]
OR
[illegible]
OR
[illegible]

LOW PRIORITY – [illegible]

ACS Priority Subwatersheds

- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

Pacific Lamprey 2018 Regional Implementation Plan *for the*

Snake River Region: Lower Snake, Clearwater and Salmon Regional Management Units

Submitted to the Conservation Team August 22, 2018

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Jody Brostrom – U.S. Fish and Wildlife Service
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Benjamin Clemens, Oregon Department of Fish and Wildlife
Kris Buelow – Snake River Salmon Recovery Board
Katherine Thompson – US Forest Service
Aaron Jackson – Confederated Tribes of the Umatilla Reservation
Cynthia Tait, U.S. Forest Service
Erin Butts – U.S. Fish and Wildlife Service

Projects proposed and discussed within this Regional Implementation Plan are in accordance with direction provided within the *Conservation Agreement for Pacific Lamprey in the States of Alaska, Washington, Idaho, Oregon and California, 2012.* Cooperative efforts through the Agreement intend to: a) develop regional implementation plans derived from existing information and plans; b) implement conservation actions; c) promote scientific research; and d) monitor and evaluate the effectiveness of those actions.

Projects identified in this Regional Implementation Plan do not imply or intend a funding obligation or any related activity from any of the government agencies, tribes or non-governmental entities discussed within this document.

I. Status and Distribution of Pacific Lamprey in the RMU

A. General Description of the RMU

The Snake River Region includes the Snake River and all waters draining into it downstream of Hells Canyon Dam (river km 397) to its confluence with the Columbia River (Figure 1). There are three Regional Management Units (RMUs): the Lower Snake Basin, the Clearwater River Basin, and the Salmon River Basin (Figure 1) with five major tributaries: Imnaha, Salmon, Grande Ronde, Clearwater, and Tucannon rivers. Within these RMUs there are 23 Hydrologic Unit Code (HUC) 4 subbasins. The watersheds within this region that are still accessible to Pacific Lamprey range in size from 552-6,242 km^2.

The HUC 4 subbasins include: Lower Clearwater (17060306), Middle Fork Clearwater (#17060304), South Fork Clearwater (#17060305), Lochsa (#17060303), Lower Selway (#17060302), Upper Selway (#17060301). Lower Salmon (#17060209), Little Salmon (#17060210), South Fork Salmon (#17060208). Middle Salmon-Chamberlain (#17060207), Lower Middle Fork Salmon (#17060206), Upper Middle Fork Salmon (#17030505), Middle Salmon-Panther (#17060203), Lemhi (#17060204), Pahsimeroi (#17060202), Upper Salmon (#17060201); Lower Snake-Asotin (17060103), Lower Grande Ronde (#170602105), Upper Grande Ronde (#17060104), Wallowa (#17060105), Mainstem Snake Hells Canyon (#17060101), and Lower Snake Tucannon (#17060107).

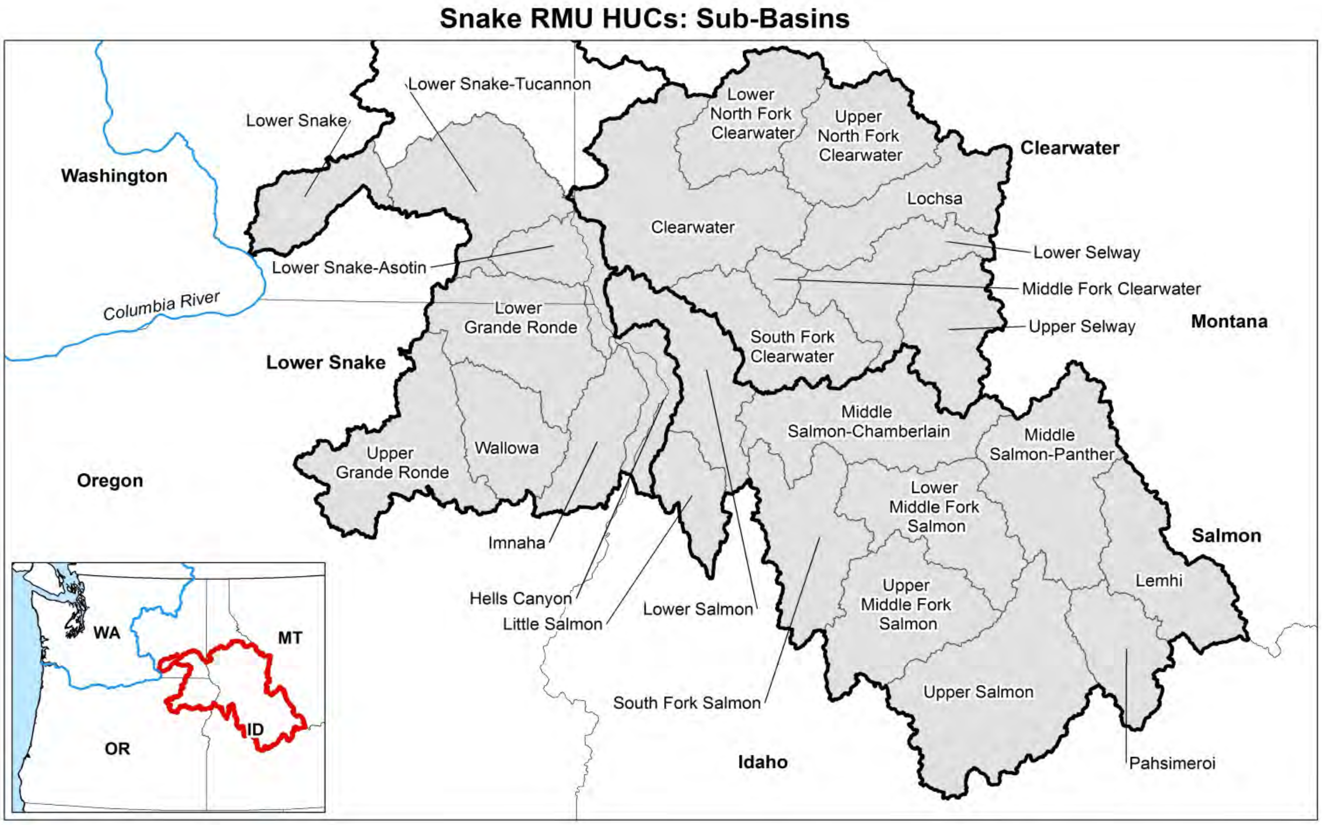

Figure 1. Map of 4th Code watersheds within the Snake River Region.

B. Status of Species

Conservation Assessment and New Updates

Historic occupancy of Pacific Lamprey is believed to have been extensive in all watersheds depicted in Figure 2 as well as the Snake River up to Shoshone Falls, and all major tributaries between the Hells Canyon Dam Complex and Shoshone Falls (Weiser River, Payette River, Bruneau River). Current population size is still unknown in most areas of historic occupancy, but the current distribution was assessed to be reduced from historic ranges (Luzier et al. 2011) with revisions in 2018 (Table 17-x USFWS 2018 draft). Recently changes to known presence of lamprey in the Snake River have been significantly affected by an active supplementation program ongoing by the Nez Perce Tribe (NPT) whereby adult lamprey collected from locations downstream in the Columbia River are released into Snake basin tributaries. The current information describing known occurrences of Pacific Lamprey is displayed in Figure 2 a product of the U.S. Fish and Wildlife Service (USFWS) data Clearinghouse https://www.sciencebase.gov/catalog/item/53ad8d9de4b0729c15418232).

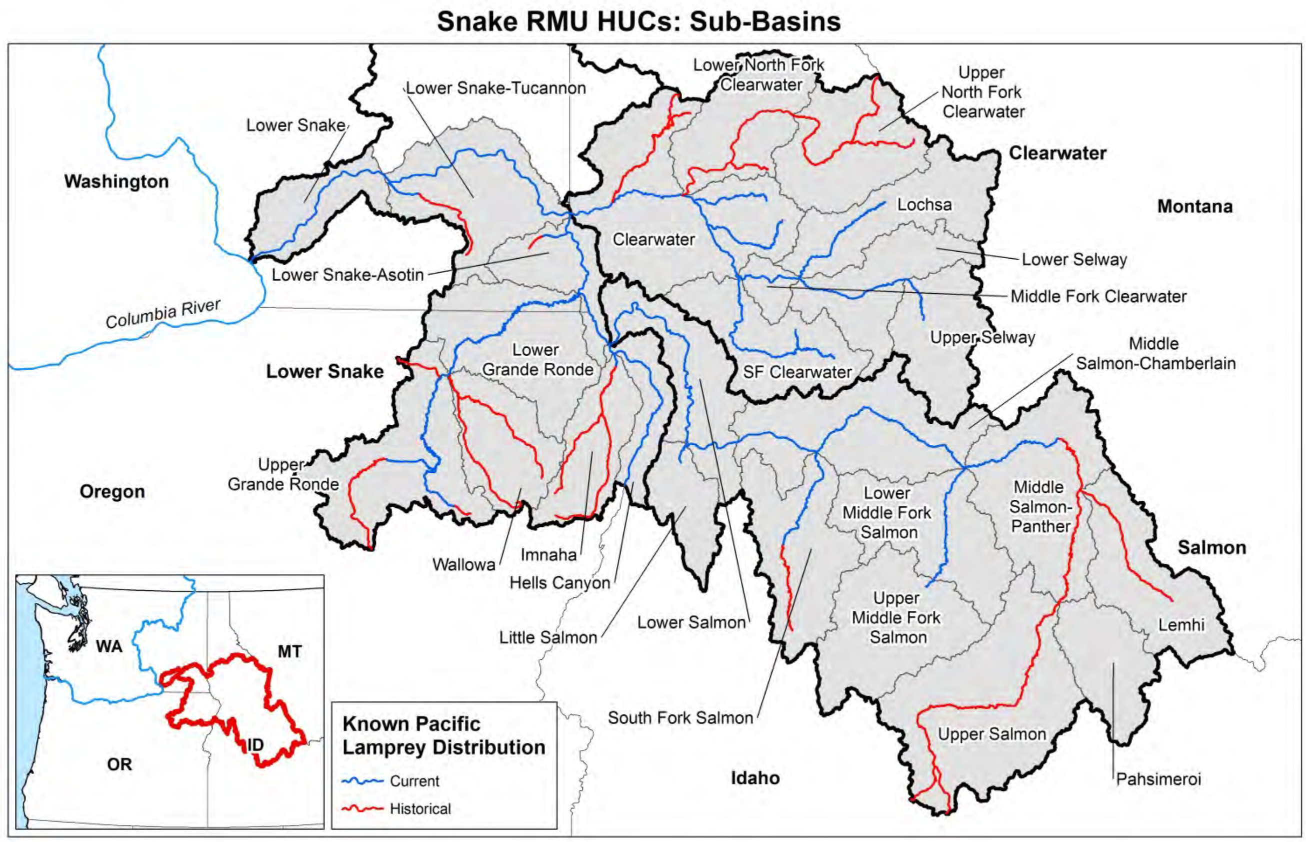

Figure 2. Current and historic known distribution for Pacific Lamprey in the Snake Regional Management Units: Lower Snake, Clearwater and Salmon (USFWS Data Clearinghouse 2018).

Distribution and Connectivity

Passage to the Snake River Region is restricted downstream by four Federal Columbia River Power System (FCRPS) dams in the mainstem Columbia River (Bonneville, Dalles, John Day and McNary). Within the Snake River Region another four FCRPS dams on the mainstem Snake River impede passage in the lower portion (Ice Harbor, Lower Monumental, Little Goose and Lower Granite). The Hells Canyon Complex (Brownlee, Oxbow and Hells Canyon) on the Snake River as well as Dworshak Dam on the North Fork Clearwater River have permanently blocked upstream access for all native aquatic species. Culverts, irrigation diversions and smaller dams are widespread throughout the watersheds of the Snake River Region.

The combined impacts from this series of passage impediments are the most significant impact on the natural distribution and connectivity for Pacific Lampreys in most of the HUCs. Recent (since 1996) annual counts of adult lamprey at Ice Harbor Dam are low, ranging from 5 to 1,702 with even fewer adults seen at Lower Granite Dam (Figure 3).

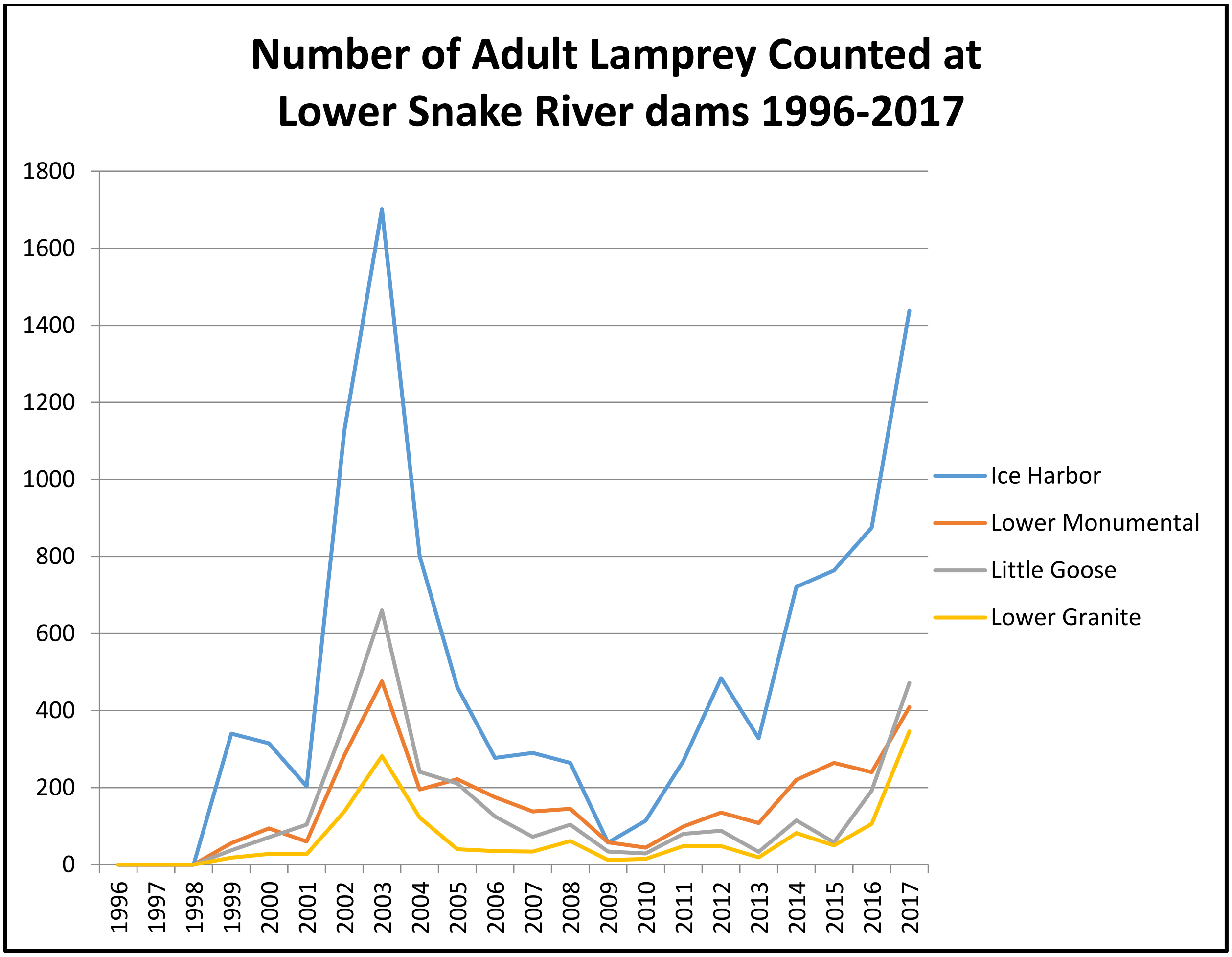

Figure 3. Number of adult Pacific Lamprey counted at Lower Snake River Dams, 1996-2017. Data obtained from [http://www.cbr.washington.edu/dart on July 11](http://www.cbr.washington.edu/dart), 2018.

Stream surveys conducted in the Clearwater River 2000 to 2002 (Cochnauer and Claire 2009) reported that larval Pacific Lamprey were present in the mainstem and Middle Fork Clearwater River up to and including the Lochsa and Selway rivers, in the South Fork Clearwater River and in the Red River but not American or other tributaries of the South Fork Clearwater River. Similar surveys conducted in the Salmon River 2006 confirmed the presence of larval Pacific Lamprey in the mainstem Salmon River downstream of the North Fork Salmon River and in the lower segment of the Middle Fork Salmon River but in no other tributaries or segments of the Salmon River upstream of the North Fork (IDFG 2011). This section of the Salmon River was surveyed again in 2017 and larval Pacific Lamprey were detected at low relative abundance at all 13 sites surveyed (E. Felts, IDFG, pers. com). Recent (2015-2017) surveys have confirmed the continued presence of larval lamprey in the Mainstem, Middle and South forks of the Clearwater River and Lochsa and Selway rivers but lamprey are no longer present in the Red River of the South Fork Clearwater River (C. Peery, USFWS, pers. com.). In eastern Oregon, larval Pacific Lamprey were found in the Minam and Wallowa rivers during 2015 surveys (C. Peery, USFWS, pers. com.).

Beginning in 2007, the NPT began releasing adult Pacific Lamprey, collected from downstream areas in the Columbia River, into tributaries of the Snake River as a means to supplement natural production (Table 1; see Ward et al. 2012). Subsequent stream surveys confirmed the presence of larval lamprey in locations receiving adult lamprey but had previously not contained larval or juvenile lamprey in recent years. These sites include Lolo, Orofino, and Newsome creeks in the Clearwater River, Asotin Creek, the South Fork Salmon River and Wallowa River. In 2015 the Confederated Tribes of the Umatilla Reservation initiated releases into the Upper Grande Ronde River and it’s tributaries (Table 1).

C. Threats

Summary of Major Treats

The highest priority threat in the Snake River Region is the Federal Columbia River Power System dams on the mainstem Snake and Columbia rivers, which results in small effective population size in each of the watersheds still accessible to Pacific Lamprey (USFWS 2018 draft). Table 2 summarizes the known key threats that ranked Medium and High within the Snake River Region tributaries (H – High, M – Medium, L – Low, I – Insignificant). The Supplement to the Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan (NPCC 2004) in Strategy to Protect and Restore Habitat; recommends to improve dam passage for Pacific lamprey. Translocation is now called Supplementation, to better represent the range of actions that occur when Pacific Lamprey are moved from one place to another.

New Threats

No new threats have been identified since 2011 (USFWS 2018 draft)

Table 1. Releases of adult Pacific Lamprey into the Clearwater, Salmon, Grande Ronde and Asotin subbasins, 2007-2018, as part of the Nez Perce Tribe (NPT) and Confederated Tribes of the Umatilla Reservation (CTUIR) translocation program. Asterisk denotes CTUIR releases. Data supplied by the Nez Perce Tribe and The Confederated Tribes of the Umatilla Reservation.

	Year												
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Clearwater River (ID)													
Lolo Cr.	50	28	30	24	0	40	31	10	50	57	65	90	475
Newsome Cr.	50	26	45	23	0	40	30	10	50	56	61	95	486
Orofino Cr.	49	25	30	22	0	40	24	0	51	56	0	90	387
Little Canyon Cr.	0	0	0	0	0	17	12	0	32	41	0	0	102
Red R.	0	0	0	0	0	0	0	0	0	0	0	91	92
Subbasin Total	149	79	105	69	0	137	97	20	183	210	126	366	1542
Salmon River (ID)													
South Fork Salmon R.	0	0	0	0	0	40	30	11	50	56	62	90	339
Johnson Cr.	0	0	0	0	0	0	0	0	51	48	60	89	248
Secesh R.	0	0	0	0	0	0	0	0	0	50	65	90	205
Subbasin Total	0	0	0	0	0	40	30	11	101	154	187	269	792
Snake-Asotin (WA)													
Asotin Cr.	28	27	35	22	29	40	30	10	43	56	61	90	471
Grande Ronde River (OR)													
Minam R.	0	0	0	0	0	0	0	0	25	55	35	90	205
Wallowa R.	0	0	0	0	0	40	30	10	25	55	30	90	280
Chesnimnus Cr (Joseph Cr)	0	0	0	0	0	0	0	0	0	56	64	90	210
Catherine Cr.	0	0	0	0	0	0	0	0	0	167	250	212	629
*Upper Grande Ronde R.	0	0	0	0	0	0	0	0	0	400	201	527	1128
*Lookingglass Cr.	0	0	0	0	0	0	0	0	0	175	150	151	476
*Little Lookingglass Cr.	0	0	0	0	0	0	0	0	0	0	150	0	150
*Indian Cr.	0	0	0	0	0	0	0	0	0	0	0	92	92
*Meadow Cr.	0	0	0	0	0	0	0	0	0	0	0	82	82
*Sheep Cr.	0	0	0	0	0	0	0	0	0	0	0	82	82
Subbasin Total	0	0	0	0	0	40	30	10	50	908	880	1416	3334
Total Snake River Region	177	106	140	91	29	257	187	51	377	1328	1254	2141	6139

Table 2. Summary of the identified key threats of the Snake River Region, by RMU and Watershed, 2018. Harvest, Predation, Supplementation (formerly Translocation), Disease, Lack of Awareness and Climate Change were assessed and ranked Low or Insignificant in most HUC's.

RMU/Watershed	**Mainstem Passage**	**Small Population Size**	**Tributary Passage**	**Dewatering and Flow Management**	**Stream and Floodplain Degradation**	**Water Quality**	**Lack of Awareness**	**Climate Change**	**Predation**
Lower Snake RMU	**H**	**H**	**M**	**L**	**M**	**L**	**H**	**M**	**L**
Lower Snake-Asotin	H	H	L	L	M	M	H	H	M
Lower Grande Ronde	H	H	L	I	L	L	H	H	L
Upper Grande Ronde	H	H	M	M	H	M	H	M	L
Imnaha	H	H	M	M	H	M	H	M	L
Wallowa	H	H	M	M	M	M	H	M	M
Lower Snake-Hells Canyon	H	H	M	M	L	L	M	M	M
Lower Snake-Tucannon	H	H	M	L	M	M	H	M	L
Clearwater RMU	**H**	**H**	**L**	**I**	**L**	**L**	**L**	**L**	**I**
Lower Clearwater	H	H	L	L	M	M	M	M	L
Middle Fork Clearwater	H	H	L	L	L	L	M	L	L
South Fork Clearwater	H	H	L	L	M	L	M	L	L
Lochsa	H	H	L	I	L	I	L	I	I
Lower Selway	H	H	I	I	I	I	L	L	I
Upper Selway	H	H	I	I	I	I	L	I	I
Salmon RMU	**H**	**H**	**L**	**L**	**L**	**L**	**M**	**L**	**L**
Lower Salmon	H	H	L	L	L	L	M	L	L
Little Salmon	H	H	L	L	L	M	M	L	L
South Fork Salmon	H	H	L	I	L	L	M	L	L
Middle Salmon-Chamberlain	H	H	I	I	L	L	M	L	L
Lower Middle Fork Salmon	H	H	I	I	I	I	L	I	I
Upper Middle Fork Salmon	H	H	I	I	I	I	L	I	I
Middle Salmon-Panther	H	H	M	M	M	L	M	L	I
Lemhi	H	H	M	M	M	M	M	L	I
Pahsimeroi	H	H	M	M	M	L	M	I	I
Upper Salmon	H	H	L	L	M	L	M	I	I

D. Restoration Actions

Ongoing or planned restoration efforts in the Snake Basin are intended to improve anadromous and native resident salmonid production and connectivity. These projects will also benefit Pacific Lamprey but as lamprey production is primarily limited by low escapement, habitat improvement projects will have limited effect on Snake River lamprey population in the near future. Recovery of Pacific Lamprey in the Snake River will instead depend on actions taken within the Columbia and Snake rivers mainstem regional implementation plans. In the near term, translocation of adult Pacific Lamprey into Snake River sub-basins, coordinated stream monitoring for larval lamprey and target restoration efforts will comprise restoration actions. Actions that have been completed or are ongoing are in Table 3.

Table 3. Conservation actions specifically for or substantially benefitting lampreys that were initiated or completed in the Snake RMU from 2012-2017.

HUC	Threat	Action Description	Type	Status
RMU	Population	Environmental DNA, smolt trapping and occupancy sampling to better understand lamprey distribution.	Survey	Ongoing
Upper and Lower Grande Ronde	Population	Oregon DFW drafting a conservation plan for 4 species of lampreys.	Assessment	Ongoing
Clearwater	Population	Translocation of adult Pacific Lamprey in Little Canyon, Orofino and Lolo creeks. (NPT)	Instream	Ongoing
South Fork Clearwater	Population	Translocation of adult Pacific Lamprey in Newsome Creek. (NPT)	Instream	Ongoing
South Fork Salmon	Population	Translocation of adult Pacific Lamprey in South Fork Salmon River and Johnson Creek. (NPT)	Instream	Ongoing
Lower Grande Ronde	Population	Translocation of adult Pacific Lamprey in Wallowa River and Minam Creek. (NPT)	Instream	Ongoing
Upper Grande Ronde	Population	Translocation of adult Pacific Lamprey in Upper Grande Ronde River and Catherine Creek. (CTUIR)	Instream	Ongoing
Lower Snake-Asotin	Population	Translocation of adult Pacific Lamprey in Asotin Creek. (NPT)	Instream	Ongoing
South Fork Clearwater	Passage	Aquatic Organism Passage restoration in American River. The project improved access to 10+ miles of potential lamprey habitat.	Instream	Complete
South Fork Clearwater	Stream and Floodplain	Over 3 miles of channel reconstruction and riparian restoration in a previously dredged mine section of Newsome Creek	Instream	Ongoing
South Fork Clearwater	Stream and Floodplain	Three miles of stream and riparian area in Red River were restored from conditions created with past dredge mining activity.	Instream	Completed
South Fork Clearwater	Stream and Floodplain	Over three miles of stream and riparian area in Crooked River are being restored from impacts of past dredge mining activity.	Instream	Ongoing
Lower Clearwater	Stream and Floodplain	One mile of stream in the Collette Mine area of Lolo Creek is being reconstructed and the floodplain restored.	Instream	Ongoing

E. High Priority Proposed, Implemented or Funded Project Information:

Prioritization Process

The highest priority threat for Snake River Region RMU’s is mainstem passage in the Snake and Columbia rivers. The four proposed projects below are stakeholder priorities, as they are beneficial to, and increase our understanding of, populations. There has not been an attempt to prioritize one over the other. The two Translocation projects are meant to complement each other, and it is expected that the project proponents will coordinate so that efforts are not duplicated.

Proposal from RIP / RMU to the Conservation Team **Translocating Lamprey Past Snake River Dams**	**Reviewer’s Category Score 2, 1, 0**

Project Rationale:
In response to the dire status and extirpation trend of Pacific lamprey in the Snake Basin, and the association of this downturn to passage at mainstem Columbia/Snake River Dams, the Nez Perce Tribe Department of Fisheries Resources Management (NPTDFRM) began an adult Pacific lamprey translocation initiative in 2006. The NPTDFRM translocation effort consists of obtaining adult lamprey from the lower Columbia River dams (Bonneville, The Dalles and John Day) and transporting them upstream past the dams to the Nez Perce Tribal Hatchery (NPTH), located on the Nez Perce Reservation within the Clearwater Subbasin of the Snake River. The adult lamprey over-winter at NPTH and are released the following spring, typically mid- to late-May, into Snake Basin streams.

Translocation is specifically identified in the Columbia River Inter-Tribal Fish Commission (CRITFC) Tribal Pacific Lamprey Restoration Plan (2011). The NPT considers adult translocation an emergency stop-gap measure, and perhaps the only immediately available management tool, to partially address the limiting factor of adult mainstem passage and the threat to their continued existence that the mainstem dams pose.

The purposes of the translocation initiative are to:

- Maintain some level of production in the Snake Basin until mainstem passage improves
- Thwart further local extirpations
- Prevent loss of pheromone migration cues to migrating adults from larval lamprey
- Restore lamprey related ecosystem values to promote diversity, productivity and ecosystem health
- <u>Preserve cultural values associated with lamprey.</u>

Larval (ammocoete) and juvenile (macrophthalmia) are sampled in translocation and non-translocation streams to gauge effectiveness of the translocation actions. In coordination with the CRITFC Hagerman Genetics Laboratory, Hagerman, Idaho, parentage analysis is conducted for samples collected via electro-fishing and rotary screw trapping.

- <u>Please provide NPCC Subbasin name and Watershed 6th or 5th Field HUC;</u>
  - <u>Clearwater (#17060306) HUC 4 Subbasin</u>
  - <u>Middle Fork Clearwater (#17060304) HUC 4 Subbasin</u>
  - <u>Lower Selway (#17060302) HUC 4 Subbasin</u>

  - Lochsa (#17060303) HUC 4 Subbasin
  - Lower Salmon (#17060209) HUC 4 Subbasin
  - South Fork Salmon (#17060208) HUC 4 Subbasin
  - Lower Middle Fork Salmon (#17060206) HUC 4 Subbasin
  - Lower Snake (#17060107) HUC 4 Subbasin
  - Lower Snake-Asotin (#17060103) HUC 4 Subbasin
  - Hells Canyon (#17060101) HUC 4 Subbasin
  - Imnaha (#17060102) HUC 4 Subbasin)
  - Wallowa (#17060105) HUC 4 Subbasin
  - Lower Grande Ronde (#17060106) Subbasin
  - Upper Grande Ronde (#17060104) Subbasin
  - Middle Columbia-Hood (#17070105) Subbasin
  - Middle Columbia-Lake Wallula (#17070101) Subbasin
- Land ownership, regulatory responsibilities.

The Columbia River mainstem dams (Bonneville, The Dalles and John Day) from which adult Pacific lamprey will be collected and transported for translocation are owned by the Federal government, U.S. Army Corps of Engineers.

The Nez Perce Tribal Hatchery, Lenore, Idaho, where the translocated lamprey overwinter, is owned by the Nez Perce Tribe.

In Idaho, streams to which adult lamprey will be translocated are located primarily within National Forests. In Oregon and Washington, streams to which adult lamprey will be translocated primarily cross private lands.

- What Lamprey RMU population or portion of the river will benefit from action?

The Snake River RMU will benefit from this action.

- What is the RMU HUC4 risk level?

Based on the USFWS 2011 Pacific Lamprey (*Entosphenus tridentatus*) Assessment and Template for Conservation Measures, populations within all 4th Field Hydrologic Unit Codes (HUCs) in the Snake River RMU are ranked either presumed extirpated, possibly extirpated or critically imperiled. A follow-up USFWS five rear re-assessment reported an increase in numbers of Pacific lamprey larvae in translocation streams

- What life stage or stages that will benefit from action? How?

Adults – Migration and spawning - The NPTDFRM has been releasing translocated adult lamprey into Snake Basin streams since 2007. Successful spawning of translocated adult lamprey has been verified by parentage analysis for translocation streams.
Larvae – Distribution and numbers of Pacific lamprey larvae per stream have increased as a result of adult translocation in the Snake Basin. Increased presence of larvae further the goals of augmenting Pacific lamprey production until such time as volitional migration through the mainstem substantively improves, thwarts further local extirpations, prevents loss of pheromone migration cues to migrating adults from larval lamprey, adds to the distribution data base, and restores lamprey related ecosystem values to promote diversity, productivity and ecosystem health.
Macrophthalmia – Parent-based tagging has documented macrophthalmia production from

translocated adults released in Snake Basin streams.

- What other species may benefit from action?

Translocated adults and their progeny reestablish the presence of Pacific Lamprey in streams previously devoid of lamprey. Improved associated ecosystem values include the influx of marine derived nutrients and increased conversion of detritus based energy to biomass assessable as food for a host of aquatic life, including bull trout, cutthroat trout, steelhead and salmon.

- How will the project provide meaningful and measureable results to improve lamprey populations and/or their habitat conditions?

The project leverages efforts among cooperating entities, including the Columbia River Inter-Tribal Fish Commission, US Fish and Wildlife Service, US Forest Service and various Nez Perce Tribe fisheries staff to conduct parentage analysis and parentage-based tagging. This effort documents and measures production from translocated adult lamprey and provides valuable life history data, including larval distribution, length at age of larvae, length at age of macrophthalmia, , age at emigration from natal streams, and size and age of macrophthalmia at various migration points, and relative production of translocated vs. volitional migrated adults.

- Does the action specifically address the Lamprey Strategy and Measures as defined in the 2014 F&W Program? (Specific to BPA Cost Savings $)

Yes, the action addresses the following:
The Northwest Power and Conservation Council, consistent with the Lamprey Strategy and Measures as defined in the 2014 F & W Program approved for funding the Pacific Lamprey Conservation Initiative Columbia River Basin Projects. This project is facilitated by the USFWS and administered through Pacific States Marine Fisheries Commission (PSFMC). Restoration actions in the appropriate RMU's are reviewed and selected by the Agreement Conservation Team based on the following criteria as outlined in the Pacific Lamprey Conservation Agreement Operating Guidelines;

1. Project Rationale
2. Linkage of Actions to Threats
3. Project Feasibility
4. Partner Engagement and Support
5. Monitoring and Evaluation – Contribution to Knowledge Gaps
6. Budget and Timelines

The Agreement Conservation Team's selection criteria are consistent with those of the Council in regard to whether they:

1. Are based on sound science principles;
2. Benefit fish and wildlife;
3. Have clearly defined objectives and outcomes; and
4. Have provisions for monitoring and evaluation of results.

Linkage of Actions to Threats:

- What threat(s) does this project address?

Mainstem passage. Mainstem passage has been identified as the most serious limiting factor

affecting Pacific lamprey in the Snake Basin, with mainstem dams being the most serious threat (Luzier et al. 2011). • How does the project address this key threat(s)? Translocation Lamprey Past Snake River Dams bypasses the serious passage problems at the dams via collection and transport. This avoids the loss of, on average, 50% of migrating adult lamprey, per dam. Transported adult lamprey overwinter at the Nez Perce tribal Hatchery and are released the following year into Snake basin streams. The intent is to maximize productive success of translocated adults. • Does this project address a threat(s) specific only to this RMU or does the project address the threat(s) for multiple RMUs? This project addresses adult Pacific Lamprey mainstem passage problems specific to the Snake Basin. Other translocation programs in their respective RMUs address mainstem passage problems posed by dams.	
Project Feasibility: • Have the designs for the project been completed already or will they be completed before planned project implementation (within the period of performance)? • Designs for the project have been completed. The NPTDFRM has been releasing translocated adult lamprey into Snake Basin streams since 2007. Successful spawning of translocated lamprey has been verified by parentage analysis for all translocation streams. Parentage analyses has also provided valuable life history data, such as lengths at age, ages of ammocoetes and macrophthalmia, and age at emigration from the natal stream. Translocation into Snake Basin streams is expected to continue, adding new translocation streams within the Snake Basin, with broader and more intensive larval assessments of translocation and non-translocation streams. This will further the goals of augmenting Pacific lamprey production until such time as volitional migration through the mainstem substantively improves, thwart further local extirpations, prevent loss of pheromone migration cues to migrating adults from larval lamprey, add to the distribution data base, and restore lamprey related ecosystem values to promote diversity, productivity and ecosystem health • Are the appropriate permits (ESA and environmental compliance) in place already or will they be in place before planned project implementation (within the period of performance)? Yes. • Can the project be implemented within the defined time frame? Yes.	
Partner Engagement and Support: • What partners are supporting the project? Coordination with relevant stakeholders has been and is expected to continue to be very good. Partners include: the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, CRITFC, Bonneville Power Administration, University of Idaho, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife and Asotin County Public Utility District. • What partners are actively in implementing the project? US Fish and Wildlife Service, US Army Corps of Engineers, US Forest Service (eDNA) and Columbia River Inter-Tribal Fish Commission. • What partners are providing matching funds or in-kind services that directly contribute to this project? Nez Perce Tribe, CRITFC and US Fish and Wildlife Service. • Are the partners able to contribute to the proposed project in a timely and appropriate manner?	

Yes. • Does this action link to other projects in the watershed? Yes. The action links to Implement Tribal Pacific Lamprey Restoration Plan, NPT Lolo Creek Watershed Restoration, Newsome Creek Watershed Restoration, American River Watershed Restoration, Crooked River Watershed Restoration, Red River Watershed Restoration, South Fork Salmon River Watershed Restoration and other watershed restoration efforts.	
Monitoring and Evaluation - Contribution to Knowledge Gaps: • If this is a monitoring or evaluation project or an on the ground project with a monitoring or evaluation component: • Is there a monitoring framework in the proposal? Yes. This proposal is supported by a monitoring framework contained in the Nez Perce tribe Pacific Lamprey Translocation and Assessment project and the CRITFC Larval Lamprey Surveys in the Snake River Basin project. • Does the monitoring framework provide clear objectives and measureable metrics that can be observed over time? Yes. • Does the framework provide a clear description of the expected outcome? Yes. • Does the framework provide a clear description of the expected outcome? Yes. • If this is an on the ground project without a monitoring or evaluation component: No. o How is completion of the project going to be documented? N/A. o Is this project's effectiveness linked to another M&E project? N/A.	
Budget and Timelines: • Is the budget within the guidelines provided by the Conservation Team (project maximum budget is $100,000) (Specific to BPA Cost Savings $)? Yes. • Is there a detailed budget describing personnel, equipment and supplies, travel, publication, overhead needs? Yes. • Does the project describe a reasonable and feasible approach for the project to be completed within the performance period and within budget? Yes. • Does the proposal demonstrate meaningful cost share (cash, equipment, labor)? Yes.	
Total	
2 = Fully Meets Criteria 1 = Needs Some Additional Information 0 = Insufficient	

Proposed and ongoing: Stream Surveys for Larval Lamprey

Associated with the adult translocation program, stream surveys have been conducted to document the presence of larval lamprey in both the streams that have received adult lamprey and nearby streams that would presumably contain only natural production. Surveys are being jointly conducted by the NPT and the USFWS. To date, surveys have been conducted in the Clearwater, Salmon and

Grande Ronde rivers and tributaries of the lower Snake River (see Figure 2 for current presence data). Information is added to the regional database tracking lamprey distribution and abundance.

The Idaho Department of Fish and Game (IDFG) monitors Pacific Lamprey larval distribution in both streams that are presumed to contain natural production and those which may be influenced by the adult translocation programs. Currently, distribution is monitored by electrofishing surveys which are most often conducted during wilderness float trips. Biologists have used the results of recent opportunistic sampling to establish index sites which will be surveyed during each float trip within a given drainage, and will randomly select additional roving sites on future float trips.

In addition to standard electrofishing surveys conducted on wilderness float trips IDFG is currently evaluating sampling efficiency of three different electrofishing protocols. These protocols include two types of electrofishing units: 1) ETS model AbP-2 “Wisconsin” electrofisher, and 2) Smith-Root LR-24 model electrofisher. Electrofisher setting for ammocoete sampling include two wave forms: 1) a low frequency wave to draw ammocoetes out of substrate, and 2) a high frequency wave form to immobilize ammocoetes once drawn out of the substrate. Two protocols using the Smith-Root LR-24 electrofisher are being evaluated, one which uses a standard setup with a single anode pole and a “rat-tail” and a second which uses dual anode poles. These three electrofishing protocols were implemented across 21 sites on the Selway River in 2018, with protocols being randomly selected across sites. Additional sites will be surveyed prior to analysis of sampling efficiency, and results will ultimately be used to recommend standard electrofishing survey methods which maximize efficiency.

Monitoring activities associated with salmonid monitoring bring IDFG staff to many locations throughout Idaho which, if surveyed, could add to understanding of Pacific Lamprey distribution and the effects of the adult translocation program within Idaho. However, IDFG currently has no funding to conduct Pacific Lamprey monitoring. Environmental DNA (eDNA) sampling for Pacific Lamprey is currently being researched and refined by the United States Forest Service Rocky Mountain Research Station, and offers the opportunity to monitor distribution with minimal time investment. This method, along with established electrofishing methods, could be implemented by IDFG staff conducting salmonid monitoring if funding were available. Additional monitoring would involve collaboration of NPT, IDFG and USFWS. Partners would work together to select sampling locations in a manner which would contribute to further evaluation of the adult translocation program and improve assessment of Pacific Lamprey status in Idaho.

Stakeholders will explore the efficacy and details for developing eDNA sampling and processing methods and protocol to facilitate low-cost observations of lamprey distribution. As other eDNA projects are likely to be proposed in other RMU’s, stakeholders will coordinate within the region so methods are consistent and replicable with other areas.

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