WILDFIRE AND SALVAGE LOGGING

Recommendations for Ecologically Sound Post-Fire Salvage Management
and Other Post-Fire Treatments On Federal Lands in the West

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PREFACE

This paper offers a scientific framework of principles and practices that are provided to guide development of federal policy concerning wildfire and salvage logging and other post-fire treatments. A common thread throughout the recommendations is that most native species are adapted to natural patterns and processes of disturbance and recovery in the landscape and that preventing additional human disturbance (and reducing the effects of past disturbance) generally will provide the best pathway to regional ecological recovery. We assume that maintenance of viable populations of native species across their native ranges and the protection of critical ecosystem functions and services are desired objectives of federal land management, as stated in relevant legislation.

Land management practices in the interior Columbia and upper Missouri basins have profoundly impacted forest, grassland, and aquatic ecosystems. Watersheds and forests have been degraded (e.g., ecosystems fragmented, habitats simplified or lost, disturbance regimes altered). At every level of biological organization -- within populations, within assemblages, within species, and across the landscape -- the integrity of biological systems has been severely degraded. This is best seen in the marked reduction in the biological diversity in the region.

The entire range of land management practices is implicated in this regionwide decline. Streamside development, logging, grazing, mining, fire suppression, removal of beaver and large predators, water withdrawals, introduction of exotic species, and chronic effects of roadbuilding have cumulatively altered landscapes to the point where local extirpation of sensitive species is widespread and likely to continue. Areas dominated by healthy populations of native species of vertebrates are exceptional. Many of these changes began long before the establishment of wilderness areas and other protections, and therefore, the majority of the region has been impacted.

Western ecosystems have evolved with, and in response to, fire. While some have argued that fire is the major imminent "threat" to the health of the region's forest ecosystems, it must be recognized that there are a number of threats to the integrity of ecosystems in the interior west.

Land management based on controlling fire will not set the region on a course toward recovery, especially when conceived in a crisis mode. Rather, it will be necessary to take an approach based on fundamental principles of ecosystem patterns and processes, something the current crisis mode does not foster. The objective of this document is to propose guidelines concerning wildfires, salvage logging, and other post-fire treatments, particularly from an aquatics perspective, that maintain or improve the integrity of ecosystems and landscapes and maintaining the ecological processes that support sustainable resource extraction and utilization.

If historical land uses have contributed to the decline in forest ecosystem health, then the pattern of human land use must be changed for regional ecological recovery to occur. By narrowly concentrating on forest health (often a euphemism for tree health, recently referring to carbon cycling), federal land managers have embarked on an ambitious attempt to address forest management in ways that risk neglecting watershed health and the ecology of aquatic ecosystems. The problem is not that we do not have the knowledge to control all disturbances. The problem is we have tried to control all disturbances rather than letting them play out -- the forests depend on disturbances to maintain their integrity just like rivers depend on floods and droughts coming along in irregular patterns. Human disturbances, unlike Mount St. Helens or El Niño, tend to be incessant, and thereby may produce conditions outside the evolutionary experience of native species. In view of the extent and persistence of human disturbance throughout forest and watershed ecosystems, continuing to simply manage fire risk without controlling the adverse effects of logging, grazing, roadbuilding, and mining is unsound resource management; it is an approach that without careful thought could lead to further damage rather than to the intended goal of protecting forest and stream health, as such an approach addresses the symptoms rather than the causes. Because we are currently unable to understand and control all human perturbations, we must instead seek to manage the human impacts on these systems. However, given our imperfect knowledge of ecosystem processes, functions, and disturbance regimes, we face high risks of exacerbating the degradation that already exists, especially in aquatic ecosystems. Rather than focusing on fires -- before or after their occurrence -- managers should focus on the pattern and consequences of current and proposed human manipulations and disturbances of all types at the landscape level.

The Current Policy Framework

The National Forest Management Act (NFMA) and the National Environmental Policy Act (NEPA) allow greater liberties to be taken following fire than in other aspects of land management. On National Forests, post-fire salvage activities are treated differently than other logging in the course of environmental review. Salvage may be conducted on lands not otherwise eligible for logging; may exceed allowable sale quantities and maximum logging area rules; may be exempt from anti-clearcutting rules; and may be exempt from most forest plan standards and NFMA standards, e.g., soil protection and water quality standards. Furthermore, some salvage activities are exempt from NEPA review and administrative appeal.

New policies are forming. Two ongoing federal land planning processes which address fire and salvage policies on federal lands in the region are in progress -- the "Interior Columbia Basin Ecosystem Management Project" and the "Western Forest Health Initiative." Most recently, there have been Congressional salvage initiatives and amendments. In addition there are a host of site-specific initiatives and projects being implemented on accelerated timetables in reaction to 1994 fires. Our recommendations apply to both regional and site-specific initiatives.

FINDINGS AND RECOMMENDATIONS FOR FIRE MANAGEMENT AND SALVAGE LOGGING

Ongoing human activity and the residual effect of past activity continue to threaten watershed ecosystem integrity.

Throughout the west, many scientific assessments of current conditions have come to remarkably similar conclusions: a century and a half of logging, grazing, roadbuilding, mining, water withdrawals, channelization, introduction of exotics, and streamside development have degraded watersheds, modified stream flows and temperatures, altered ecosystem processes, and removed ecosystem elements with the result that sensitive native species have frequently been extirpated or limited to refuges. The ability of ecosystems to recover has been substantially compromised. These conclusions have been reached by a wide variety of observers and over a wide range of scales. (Nehlsen et al., 1991; Johnson et al., 1991; Frissell 1993; FEMAT 1994; Henjum et al., 1994; McIntosh et al., 1994)

Forests of the interior west can be viewed as a sea of relatively recently altered ecosystems surrounding a few "islands" of relative ecosystem integrity (Frissell 1993a). In this context, attempting to continue to manage fire and its consequences without altering or controlling other threats to ecosystem integrity is scientifically and pragmatically unsound.

Fires are an inherent part of the disturbance and recovery patterns to which native species have adapted.

Western ecosystems evolved with and in response to fires. Fires are a part of the pattern of disturbance and recovery that provides a physical template for biological organization at all levels. Fires reset temporal patterns and processes that, if allowed to proceed undisturbed by additional human impacts, provide dynamic and biologically critical contributions to ecosystems over long time frames. The "patchiness" of fire is a desirable characteristic, and many species depend on the environmental influences that fires create.

While fire suppression and other practices has doubtlessly increased the likelihood of high intensity fire in some places, it is important to recognize that this increased risk does not exist equally across the landscape. Certain forest types (low elevation ponderosa pine, for example) may currently be susceptible to burning in ways that have not been seen for centuries, but in other areas (the higher elevation and moister, mixed-conifer forest types for example) the fire situation is probably not too different from historical patterns.

The historical and paleoecological record reveal periods of time when fire occurrence was frequent, others when scarce. We need to acknowledge that some forests are simply going to burn. We also need to accept that in many drier forest types throughout the region, forest management may have set the stage for fires larger and more intense than have occurred in at least the last few hundred years.

There is no ecological need for immediate intervention on the post-fire landscape.

With respect to the need for management treatments after fires, there is generally no need for urgency, nor is there a universal, ecologically-based need to act at all. By acting quickly, we run the risk of creating new problems before we solve the old ones. Ecologically speaking, fires do not require a rapid human response. We should not talk about a "fire crisis" but rather of managing the landscape with the anticipation that fire will eventually occur. Given the high degree of variability and high uncertainty about the impacts of post-fire responses, a conservative approach is warranted, particularly on sites susceptible to on-site erosion.

Existing conditions should not be used as "baseline" or "desired" conditions upon which to base management objectives.

In landscapes disturbed by human activities, it is ecologically inappropriate to use current conditions as the baseline for analysis. To do so effectively ignores the chronic or

continuing effects of past management activities. Analysis of sediment impacts, for example, that accept existing conditions as the baseline are highly inappropriate because these have been increased over natural background levels for 50-100 years in many cases. There is considerable evidence that current conditions are insufficient to maintain viable populations of many native species, including sensitive and declining trout, salmon, and other fishes (FEMAT 1993; PACFISH 1995; Frissell 1993b, Reeves and Sedell 1992; and others).

Fire suppression throughout forest ecosystems should not automatically be a management goal of the highest priority.

Making fire prevention a high priority management goal is a commitment to continuous fire suppression and a prescription for long-term "addiction." Such an attempt requires continual high cost inputs, and fails to capitalize on the self-repairing and self-perpetuating capabilities of ecosystems. Attempts to perpetuate a certain "state" or forest condition are unsustainable. Land managers should be managing for the naturally evolving ecosystems, rather than perpetuating artificial ones we have attempted to create. By imposing management schemes structured to optimize timber production at the expense of other ecosystem attributes, we have suppressed certain disturbance regimes, (e.g., fire), while potentially increasing the effects of others, (e.g., floods). The net result is a loss of ecosystem function and loss of the values that ecosystems provide including high quality water and abundant fisheries. Our actions have led to increased probabilities that various series of natural events will be increasingly viewed as catastrophic. Therefore, we need to consider the whole landscape, not just the forest. The overall management goal must be to preserve (and reestablish) the fire and other disturbance regimes that maintain ecological systems and processes, while protecting human life and property.

The region's ecosystems, not just forests, are under severe strain.

Virtually all western landscapes, including forests, have been subjected to severe disruption by human activities. The conceptualization that we face a problem only of forest health misrepresents the problem and misdirects our attention from appropriate remedies. From a watershed perspective, the region suffers an ecosystem health problem, but the primary cure rests in curtailing human activities known to be damaging and counterproductive, and repairing or restoring roads that act as permanent sources of adverse impact. Fire influences but does not obscure this basic template.

LAND MANAGEMENT AFTER FIRES

Research results and new knowledge regarding the management of forest ecosystems increasingly indicates that dramatic changes in human impacts and fire management policies are needed. As an overriding principle, we seek ways of decreasing human impacts while allowing natural disturbance regimes to reestablish their historical influence in maintenance of the diversity and productivity of regional landscapes. Instead of focusing on effects of the fires, land managers should focus on the sources of the anthropogenic disturbances and the departure from natural disturbance regimes. Land managers should particularly examine current consequences of human disturbances at the landscape level.

POST-FIRE PRINCIPLES

We recommend that management of post-fire landscapes should be consistent with the following principles:

Allow natural recovery and recognize the temporal scales involved with ecosystem evolution.

Human intervention on the post-fire landscape may substantially or completely delay recovery, remove the elements of recovery, or accentuate the damage. Many such adverse consequences are difficult or impossible to predict or foresee in specific situations. *In this light there is little reason to believe that post-fire salvage logging has any positive ecological benefits*, particularly for aquatic ecosystems. There is considerable evidence that persistent, significant adverse environmental impacts are likely to result from salvage logging, based on many past cases of salvage projects, plus our growing knowledge of ecosystem functions and land-aquatic linkages. These impacts include soil compaction and erosion, loss of habitat for cavity nesting species, loss of structurally and functionally

important large woody debris. Human intervention should not be permitted unless and until it is determined that natural recovery processes are not occurring.

No management activity should be undertaken which does not protect soil integrity.

Soil loss and soil compaction are associated with both substantial loss of site productivity and with off-site degradation. Decreased infiltration, increased overland flow, and excess sedimentation all directly contribute to the degradation of forest soils and the off-site degradation of aquatic systems and reduced survival of aquatic species, including salmonids. Reduction of soil loss is associated with maintaining the litter layer. Although post-burn soil conditions may vary depending upon fire severity, steepness of slopes, inherent erodibility, and others, soils are particularly vulnerable in a burned landscape. Soil and soil productivity are irreplaceable in human timescales; therefore, post-burn management activities that accelerate erosion or create soil compaction must be prohibited.

Preserve species' capability to naturally regenerate.

From an ecological perspective, there is frequently no need for artificial regeneration. Artificial reintroduction of species will circumvent natural successional changes, are often unsuccessful and will have unanticipated side effects even if successful. If native species are failing to reestablish naturally, that failure will frequently be associated with other reasons than the absence of seed sources or colonists. If warranted, artificial regeneration should use only species and seed sources native to the site, and should be done in such a way that recovery of native plants or animals is unhampered.

Do not impede the natural recovery of disturbed systems.

Delays in recovery may increase the likelihood of extirpation of stressed populations, or may alter the pathway of recovery altogether. As a practical example, areas that have experienced the effects of a severe burn and are likely to exhibit high erosion should not be subjected to additional management activities likely to contribute to yet more sedimentation. Efforts should focus on reducing erosion and sedimentation from existing human-caused disturbances, e.g., roads, grazing, salvage logging.

RECOMMENDATIONS ON POST-FIRE PRACTICES

Salvage logging should be prohibited in sensitive areas.

Logging of sensitive areas is often associated with accelerated erosion and soil compaction (Marston and Haire 1990), and inherently involves the removal of large wood which in itself has multiple roles in recovery. Salvage logging may decrease plant regeneration, by mechanical damage and change in micro-climate. Finally, logging is likely to have unanticipated consequences concerning micro-habitat for species that are associated with recovery, e.g., soil microbes. Salvage logging by any method must be prohibited on sensitive sites, including:

- in severely burned areas (areas with litter destruction),
- on erosive sites,
- on fragile soils,
- in roadless areas,
- in riparian areas,
- on steep slopes,
- any site where accelerated erosion is possible.

On portions of the post-fire landscape determined to be suitable for salvage logging, limitations aimed at maintaining species and natural recovery processes should apply.

Dead trees (particularly large dead trees) have multiple ecological roles in the recovering landscape including providing habitat for a variety of species, and functioning as an important element in biological and physical processes (Thomas 1979). In view of these roles, salvage logging must:

- leave at least 50% of standing dead trees in each diameter class;
- leave all trees greater than 20 inches dbh or older than 150 years;
- generally, leave all live trees.

Because of soil compaction and erosion concerns, conventional types of ground-based yarding systems (tractors and skidders) should be generally prohibited. New equipment or techniques may be suitable where it can be demonstrated that soil integrity will be protected, that is, where acceleration of soil erosion and increased soil compaction can be demonstrated not to occur, and where there is no impairment of hydrologic and biological soil integrity. Helicopter logging and cable systems (particularly those that provide partial or full suspension) using existing roads and landings may be appropriate as may be horse logging; however, even these methods are not without potential problems and could locally increase runoff and sediment. Therefore, they must be actively monitored and

avoided where sedimentation is already a major problem for salmonids or other sensitive aquatic species. Any activity that disturbs litter layers or soil surface horizons, either pre- or post-fire, can accelerate soil erosion and sediment delivery to aquatic systems.

Building new roads in the burned landscape should be prohibited.

Roads are associated with a variety of negative effects on aquatic resources, including disruption of basin hydrology and increased chronic and acute sedimentation. Under no circumstances should new roads be introduced into sensitive areas, including roadless or riparian areas. Outside of these areas, road building should be avoided except where new road construction may be necessary to complete a larger program of partial or complete road obliteration. In such instances, offsetting benefits must be demonstrated. These may include cases in which a new road segment has been demonstrated to be necessary to enable the obliteration of other roads that cause significant potential or existing adverse environmental impacts.

Active reseeding and replanting should be conducted only under limited conditions.

Introduction of non-native species or exotic genotypes of native species should be prohibited from all reseeding/replanting programs. Seeding grasses into burned forests has been shown to disrupt recovery of native plants and is likely to create more problems than it solves (Amaranthus et al 1993). The use of pesticides, herbicides and fertilizers should generally be prohibited.
Spot-specific hand application of herbicides only for the removal of exotics may occasionally be considered if there is evidence that such action is likely to lead to long term reclamation of the site.

In general, active planting and seeding has not been shown to advance regeneration and most often creates an entirely new, exotic flora. In addition, reseeding is associated with additional problems and costs. Therefore, such practices should be employed only where there are several years of evidence that natural regeneration is not occurring. For example, native species from regional stocks that may enhance fire resistance of a site may be planted if the effect is not to homogenize the landscape, (e.g., alder in southwestern Oregon and Northern California).

Structural post-fire restoration is generally to be discouraged.

Frequently, post-fire restoration efforts involve the installation of hard structures including sediment traps, fish habitat alterations, bank stabilization, hay bales, weirs, check dams, and gabions. Such hard structures are generally not modeled or sited on the basis of natural processes, and their ability to function predictably may be particularly low in dynamic post-fire landscapes. Hard structures have high rates of both failure and unanticipated side effects. Therefore, structures are generally an undesirable and unsuccessful method for controlling adverse environmental impacts.

Sediment management should focus on reducing or eliminating anthropogenic sources prior to their initiation (e.g., improve stream crossings to prevent culvert failure), and protecting and maintaining natural sediment control mechanisms in burned landscapes, particularly the natural recruitment of large woody debris on hillslopes and in streams. The goal should be to reestablish the natural post-fire background quality, quantity and timing of sediment, including the presence of large woody debris, and this level should be considered the baseline.

Post-fire management requires reassessment of existing management.

For example, the condition of a transportation system (i.e., pre-existing roads and landings) should be reassessed after a fire. By increasing runoff, erosion, and sedimentation, fires may increase the risks posed by existing roads. Therefore, post-fire analysis is recommended to determine the need for undertaking road maintenance, improvement, or obliteration. There is some urgency to this reassessment as the longer appropriate treatments are put off, the more likely it is that failure will be triggered by a large runoff event. Additionally, post-fire livestock grazing should be altered or eliminated to allow natural recovery processes to occur.

Continued research efforts are needed to help address ecological and operational issues.

There is a need to research certain questions in order to guide post-fire management decisions. For example, some argue that salvage logging is needed because of the perceived increased likelihood that an area may reburn. It is the fine fuels that carry fire, not the large dead woody material. We are aware of no evidence supporting the contention that leaving large dead woody material significantly increases the probability of reburn. There is a regional need for retrospective analysis concerning the probability and effects of "reburn". Sites exist throughout the western United States where the risk and consequences of reburning of already burned landscapes may be retrospectively addressed. This analysis must precede any management recommendation based on the probability of reburning.

Research is needed on the role of dead wood in terrestrial ecosystems -- in particular, how much wood should be left on a particular site and across the landscape to provide for the full range of ecosystem processes and the needs of species. Some whole watershed retrospectives should be developed. Continued research is needed on the fire ecology of forest and riparian areas.

Although historical research and experience has highlighted the adverse effects of ground based heavy equipment, roads, and harvest in riparian areas, new research efforts are needed to evaluate the environmental effects of alternative post-fire/salvage operations, roading activities, and site preparation.

Public must be educated regarding natural fires and post-burn landscapes to provide balance to the "Smokey Bear" perspective of fires and forests.

Although post-fire landscapes are often portrayed as "disasters" in human terms, from an ecological perspective, fire is part of the normal disturbance regime and renewal of natural forest ecosystems. An increased appreciation and understanding of natural disturbance regimes in the ecology of forest ecosystems is needed by the public, and the public's land managers.

RECOMMENDATIONS CONCERNING FIRE MANAGEMENT

Fires should be allowed to burn naturally when feasible. In some drier forest types that may be prone to intense fires and are irreplaceable wildlife habitat, prescribed fires or underthinning to remove fire ladders (leaving the larger, fire resistent trees) may be considered to reduce fuel loads. Fire suppression may also be necessary to accomplish the short-term goals of protecting human lives and structures. Prescribed burning may be a useful tool in reducing fuels around developed areas and may make it easier to protect those areas. Large fires could be necessary (and inevitable) to maintain or restore some landscapes in the western United States, particularly lodgepole and spruce fir forests, to their historical patterns (Baker 1992, 1994; Turner and Romme 1994).

Policies should be developed to reduce the number of human structures within areas with high potential for fires. New structures must be discouraged in fire prone areas. If healthy forests are to be recovered, then one has to be able to manage those without undue concern for human structures. Fire suppression policies across forest ecosystems should not become hostage to the encroachment of inappropriate human developments in fire-prone areas.

Fire suppression activities should be conducted only when absolutely

necessary and with utmost care for the long-term integrity of the ecosystem and the protection of natural recovery processes.

The use of surface water from small streams and ponds has not proven generally effective in fire suppression. Pumping from small streams and rivers increases the risks to aquatic ecosystems from post-fire events. When pumping is utilized, it should be conducted from sufficiently large streams and lakes that the effects on aquatic biota are negligible.

Fire suppression activities should not include bulldozing stream channels, riparian areas, wetlands, or sensitive soils on steep slopes or using such areas as access routes for vehicles and other ground-based equipment.

Fire lines created by mechanical equipment should not be permitted in riparian zones, sensitive soils on steep slopes, or other ecologically sensitive areas.

Virtually no fire suppression should be permitted in wilderness areas.

When land ownerships are mixed, the federal land management agencies should establish policies to prevent conflicts between re-establishment of natural disturbance regimes on federal land and the protection of private property.

For example, federal agencies may decide to purchase easements or issue insurance policies under procedures analogous to flood insurance that would reimburse those landowners who had practiced proper forest management for the value of lost timber from natural wildfires. These policies should obviously be prospective. Recent fires only underline the need for these policy changes.

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