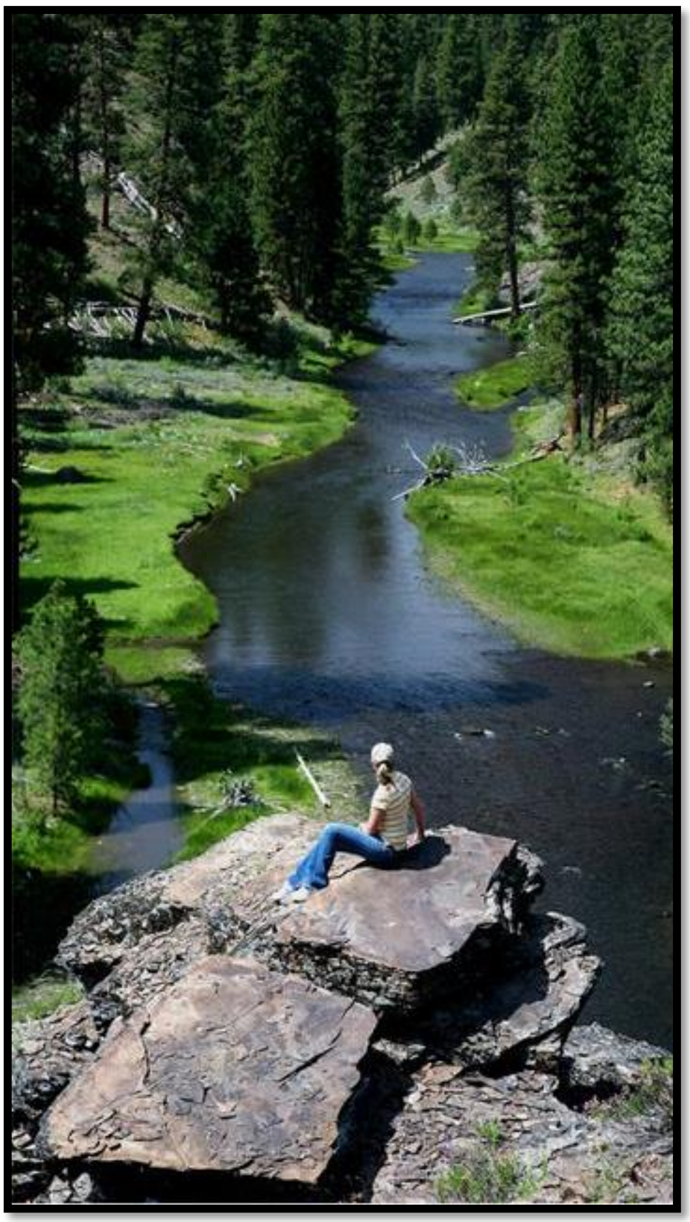
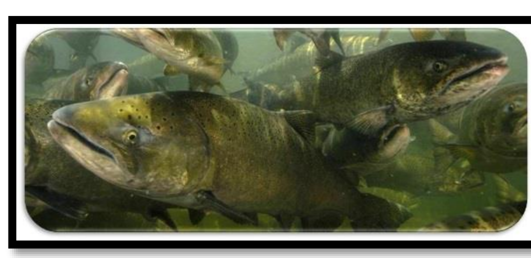
Aquatic and Riparian Conservation Strategy

USDA Forest Service
Pacific Northwest and Pacific Southwest Regions





March 2018

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1. Introduction

Background and Purpose

This Aquatic and Riparian Conservation Strategy (ARCS) is a broad-scale strategy to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on National Forest System (NFS) lands throughout the Pacific Northwest Region (Oregon and Washington) and portions of the Pacific Southwest Region (California). ARCS is a synthesis and refinement of three existing aquatic strategies: the *Northwest Forest Plan (NWFP)-Aquatic Conservation Strategy (ACS)* (USDA and USDI 1994a and 1994b); *Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California* (PACFISH, USDA and USDI 1995a and 1995b); and the *Inland Native Fish Strategy* (INFISH, USDA and USDI 1995c and 1995d). This version of ARCS (ARCS-2017) is intended to guide Forest plan revisions under the 2012 Planning Rule (USDA Forest Service 2012a) on NFS lands throughout the NWFP area, which comprises western Oregon (OR), western Washington (WA) and northwestern California (CA), and lands in eastern OR and WA that are currently implementing the PACFISH and INFISH strategies (Figure 1).

The goal of ARCS is to develop networks of properly functioning watersheds that support populations of fish, other aquatic and riparian-dependent organisms, and State-designated uses of water while enabling provision of multiple other goods and services such as outdoor recreation, timber, forage, and habitats for plants and wildlife. Like the existing strategies, it focuses on maintaining and restoring the dynamic ecological processes responsible for creating and sustaining habitats and providing high-quality water at landscape scales, as opposed to individual project or small watershed scales (USDA and USDI 1994a and 1994b).

ARCS maintains the goals of the three existing strategies and, for the following reasons, adopts and builds upon their basic structure and elements. First, new science completed since they were developed support their general framework and assumptions (Spence et al. 1996, Naiman et al. 2000, Reeves et al. 2017). In particular, recent science reinforces the need for a landscape approach to aquatic habitat conservation that focuses on protection and restoration of the natural processes that create and maintain habitats at multiple scales (Rieman et al. 2015). Recent science also augments previous understanding of the ecological importance of headwater streams, the need to protect streamside forests, and the critical role of disturbance in maintaining watersheds and aquatic ecosystems (Reeves et al. 1995, National Research Council 2002, Benda et al. 2004, Moore et al. 2005, Rieman et al. 2006, Burnett and Miller 2007, Wipfli et al. 2007, Benda et al. 2015, Reeves et al. 2017).

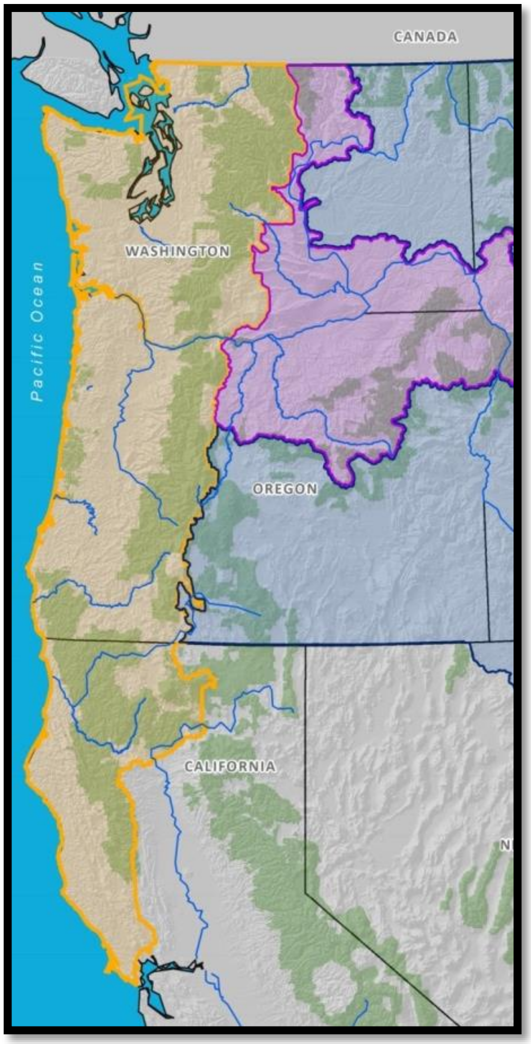
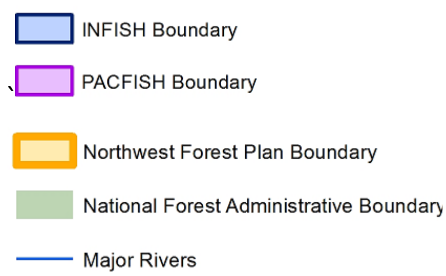


Figure 1. Geographic applicability of ARCS.

ARCS applies to Forest plan revisions under the 2012 Planning Rule within the NWFP area and lands in eastern Oregon and Washington that are currently implementing the PACFISH and INFISH strategies.



Second, there is evidence the existing strategies are working. Independent assessments, for instance, concluded that their basic components and associated management direction are fundamentally sound, are generally understood, valued, and implemented by Forest personnel, and have significantly improved the ways in which aquatic resources are managed on NFS lands (Heller and McCammon 2003, Reeves 2006, Reeves et al. 2006). Recent monitoring and assessments also suggest the strategies appear to be achieving their goals of maintaining or restoring aquatic and riparian habitats and key ecological processes at watershed and larger scales (Archer and Ojala 2016a, Miller et al. 2017, Reeves et al. 2017, Kershner et al. 2017).

A third reason to build upon the existing strategies is that they are generally supported by the public. This is critical for effective habitat conservation and restoration (Rieman et al. 2015). Recent listening sessions associated with Forest plan revisions in the NWFP-area, for example, revealed that the public would like water and aquatic resources to be addressed as a key component of future plans. Specifically, most people supported the continuation or expansion of existing programs to protect and improve water quality, habitat for salmon and other aquatic species, and overall watershed health. In particular, the public suggested that the NWFP-ACS, including Riparian Reserves, should be retained, that the Key Watershed network should be revised or expanded, and that the scope and scale of watershed and stream restoration should be increased (Triangle Associates Inc. 2015, USDA Forest Service 2015a).

The existing strategies also provide a solid foundation for addressing new regulations, policy and guidance pertaining to Forest plans. Specifically, they address significant portions of the 2012 Planning Rule, including requirements to develop plan components and other plan content that: (1) maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds, (2) maintain or restore riparian areas, water quality and water resources, (3) contribute to the recovery of Federally-listed species, conserve proposed or candidate species, and maintain viable populations of species of conservation concern, and (4) identify watershed(s) that are a priority for maintenance or restoration (36 CFR 219.7-219.9). The existing strategies are also generally aligned with recent interagency guidance on Forest planning, specifically *the Framework to Guide Forest Service and Bureau of Land Management Land Use Plan Revisions and Amendments in Western Oregon, Western Washington, and Northern California* ("RIEC Framework"; Regional Interagency Executive Committee, 2011) and the *Updated Interior Columbia Basin Strategy* ("Columbia Basin Strategy"; Interior Columbia Basin Interagency Deputy Regional Executive Team, 2014).

Nonetheless, recent science, assessment and monitoring, and policy direction point to the need to integrate and refine these existing strategies. First, PACFISH and INFISH were adopted as interim, short-term strategies to be replaced with a longer-term strategy. Moreover, Heller and McCammon (2003), identified the need for and utility of a single, unified, regional-scale aquatic conservation strategy that incorporates new science, information and lessons learned from implementation. Finally, the existing strategies do not fully address all requirements of the 2012 Planning Rule, including some pertaining to climate change, species conservation and recovery, watershed restoration, and assessment and monitoring. Thus, while ARCS is similar to the existing strategies, it includes some modest, but meaningful refinements to them.

A general description of aquatic resources in the ARCS area is provided in Section 2 of this document. A summary of the existing strategies is provided in Section 3 and the ways in which they were integrated and refined into ARCS are summarized in Section 4. Section 5 provides the scientific basis for the strategy and Sections 6-13 describe in detail how the strategy will be executed via Forest plan development and implementation. Risks and uncertainties are outlined in Section 14.

This version of ARCS (ARCS-2017) may be updated in the future based on new management issues or science. For example, updates may be needed to provide greater consistency with other pending direction regarding forest plan revision (e.g., assessment, monitoring) in the Pacific Northwest and Pacific Southwest Regions.

Document Format

This document includes some sections in written in **bold text**. These sections of text are either: 1) plan components (e.g., desired conditions, suitable use determinations, standards and guidelines) which are generally expected to be included in plan direction as worded (see details in *Intended Use* section below); or 2) direction for Forests to develop plan components to address a specific issue. Other sections include language written in ***italicized bold text***. These sections of text provide either: 1) plan content other than plan components to be included in a plan as written; or 2) direction to Forests to develop other plan content. Lastly, some sections are written in **BOLD CAPITALIZED TEXT**, which is simply meant to emphasize important points.

Intended Use

ARCS is instruction from the Regional Foresters of the Pacific Northwest and Pacific Southwest Regions for revising Forest plans under the 2012 Planning Rule. Specifically, it outlines the minimum core set of Forest plan components and other plan content to guide watershed and aquatic and riparian resource management on NFS lands in Oregon, Washington and portions of northern California (Figure 1). **ALL FOREST PLAN REVISIONS WITHIN THE ARCS AREA SHOULD BE CONSISTENT WITH THE STRATEGY.**

COMPONENTS OF ARCS DO NOT BECOME FOREST PLAN DIRECTION UNTIL A DECISION IS MADE TO ADOPT THEM VIA FOREST PLAN REVISION OR AMENDMENT. AS SUCH, REFINEMENTS TO ELEMENTS OF ARCS CAN BE MADE THROUGH THE COLLABORATIVE FOREST PLANNING PROCESS, PROVIDED THEY ARE BASED ON BEST AVAILABLE SCIENCE, ARE ALIGNED WITH ARCS GOALS, PROVIDE COMPARABLE OUTCOMES AND ARE INFORMED BY DISCUSSIONS WITH THE REGIONAL DIRECTORS OF RESOURCE PLANNING AND MONITORING AND NATURAL RESOURCES.

FORESTS SHOULD ADD SPECIFICITY AND LOCAL DETAIL AS NEEDED TO TAILOR MANAGEMENT OF WATERSHEDS AND AQUATIC AND RIPARIAN RESOURCES TO LOCAL ECOLOGICAL, SOCIAL, AND ECONOMIC SYSTEMS AND CONDITIONS. IT IS ANTICIPATED THAT AS EACH FOREST WORKS THROUGH ITS INTERDISCIPLINARY TEAM AND COLLABORATIVE PUBLIC PROCESSES, THEY WILL ADD SCIENCE-BASED, FOREST-SPECIFIC PLAN COMPONENTS AND OTHER PLAN CONTENT.

TO ACHIEVE CONSISTENCY AND SUCCESS, ARCS WILL NEED TO BE STRONGLY INTEGRATED INTO THE BROADER SET OF FOREST-SPECIFIC REVISED PLAN DIRECTION. Some of that direction may not be directly associated with ARCS, but is still critical to achieving its goals and objectives. The NWFP, for example, was designed to achieve multiple, integrated landscape goals and objectives including those associated with old forests, aquatic biota, and sustainable supplies of timber. While it includes a comprehensive ACS, some elements of the NWFP that are not directly related to the ACS substantially contribute towards attaining its goals and objectives. Late Successional Reserves, for example, were developed primarily to maintain viable populations of northern spotted owls and other old growth-dependent species. Yet those reserves and management within them contribute substantially towards attainment of aquatic objectives at the landscape scale. The converse is also true. For example, many elements of the NWFP-ACS (e.g., Riparian Reserves) contribute towards conservation of terrestrial wildlife.

2. Resource Context

NFS lands in the Pacific Northwest Region and northwestern CA play a critical role in the provision of water for consumptive (e.g., municipal water supplies) and non-consumptive uses (e.g., instream flows for aquatic ecosystems), both on and off the National Forests. For example, about 20-35% of the flow in mainstem Columbia River originates on NFS lands, as does about 35-50% or more of the flow in most of its major tributaries such as the Willamette and Deschutes Rivers. NFS lands provide similar flow contributions to many other major rivers including the John Day, Rogue, Klamath and Trinity Rivers (Figure 2, Lute and Luce 2016). Relative contributions in many smaller, headwater streams are even greater.

As such, NFS lands comprise significant portions of drinking water source areas, which require protection and restoration programs to ensure they provide high-quality water to human communities (Figure 3). These lands are also critically important to aquatic and riparian biota, as they contain over 100,000 miles of streams, about 30,000 miles of which are fish-bearing, as well as many lakes and wetlands. They contain some of best remaining well-distributed, high-quality habitat in the region for some aquatic species (e.g., Wild Salmon Center 2012). In particular, NFS lands provide habitat for populations of salmon, Steelhead, Bull Trout, and other aquatic and riparian species listed under the Endangered Species Act (ESA) or designated by the Regional Foresters as 'sensitive' (i.e., population viability is at-risk, see Figure 4). NFS lands also provide water, nutrients, wood, and gravel to support downstream aquatic and riparian habitats on private, state, and Tribal lands (Vannote et al. 1980, Gregory et al. 1991, Reeves et al. 2017).

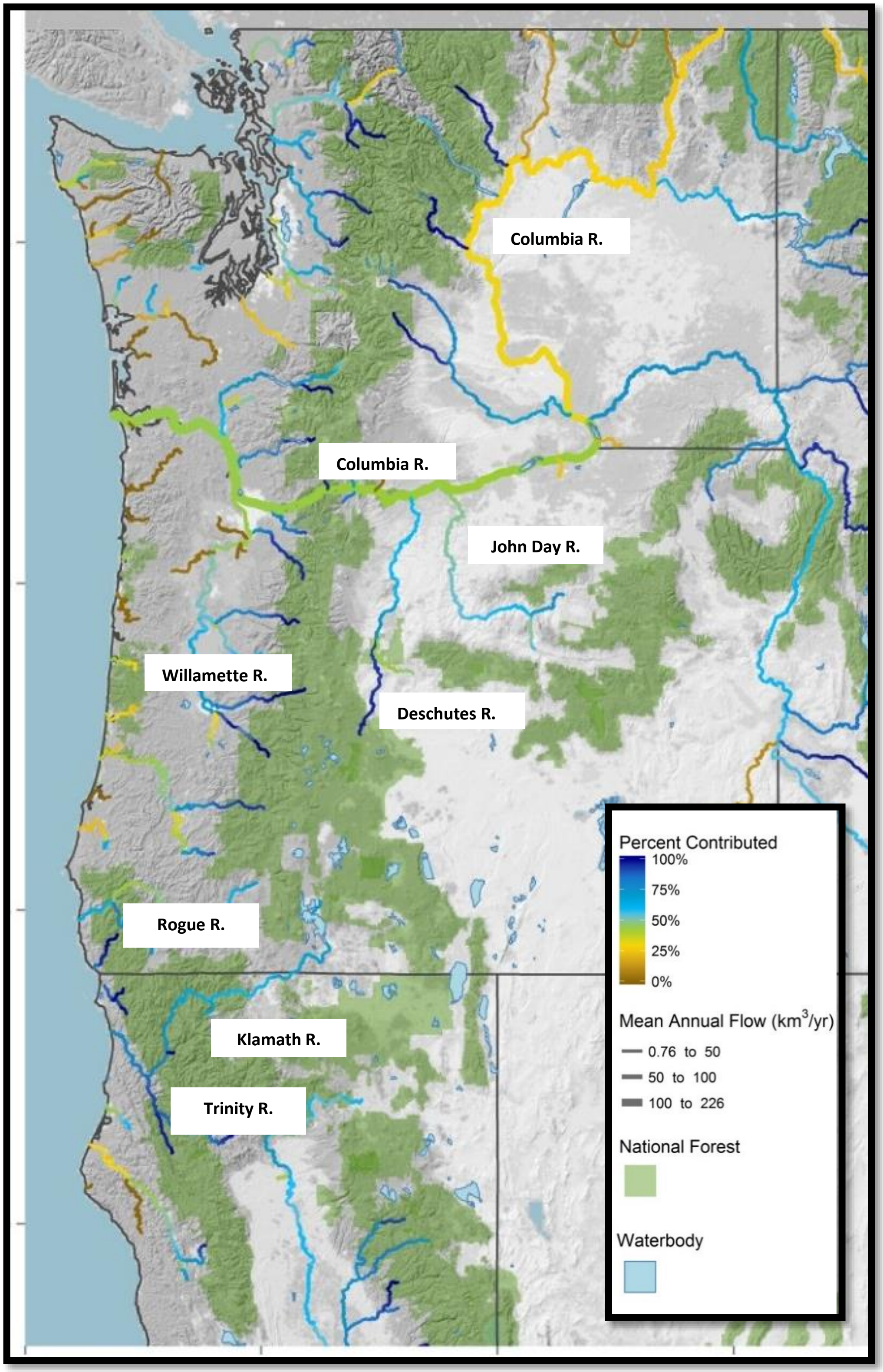


Figure 2. Average annual streamflow for major rivers in Oregon, Washington and northern California and relative flow contributions from NFS lands (Lute and Luce 2016).

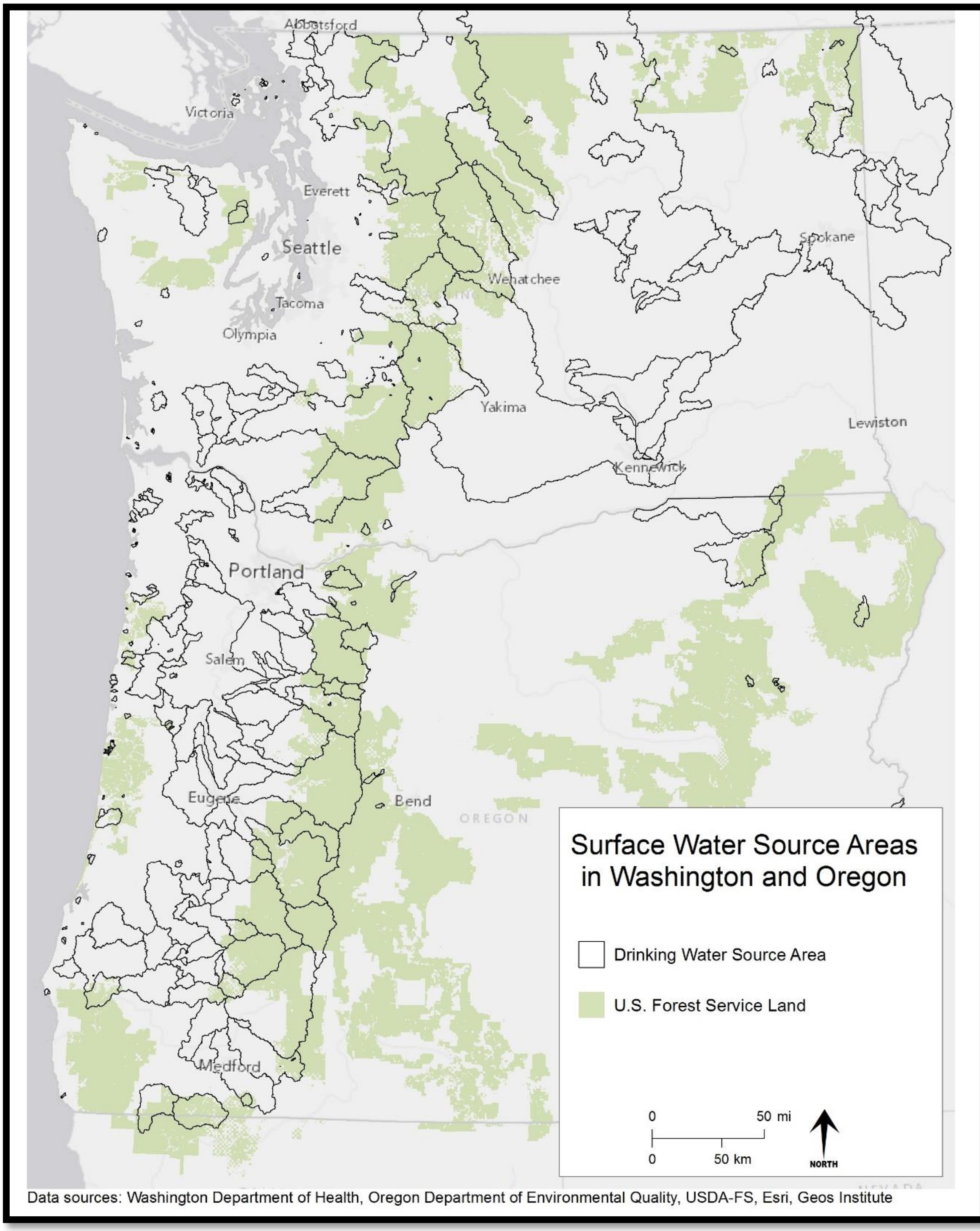


Figure 3. Drinking Water Source Areas (surface water) in Washington and Oregon. Significant portions of NFS lands in northern California (not shown) are also important sources of drinking water.

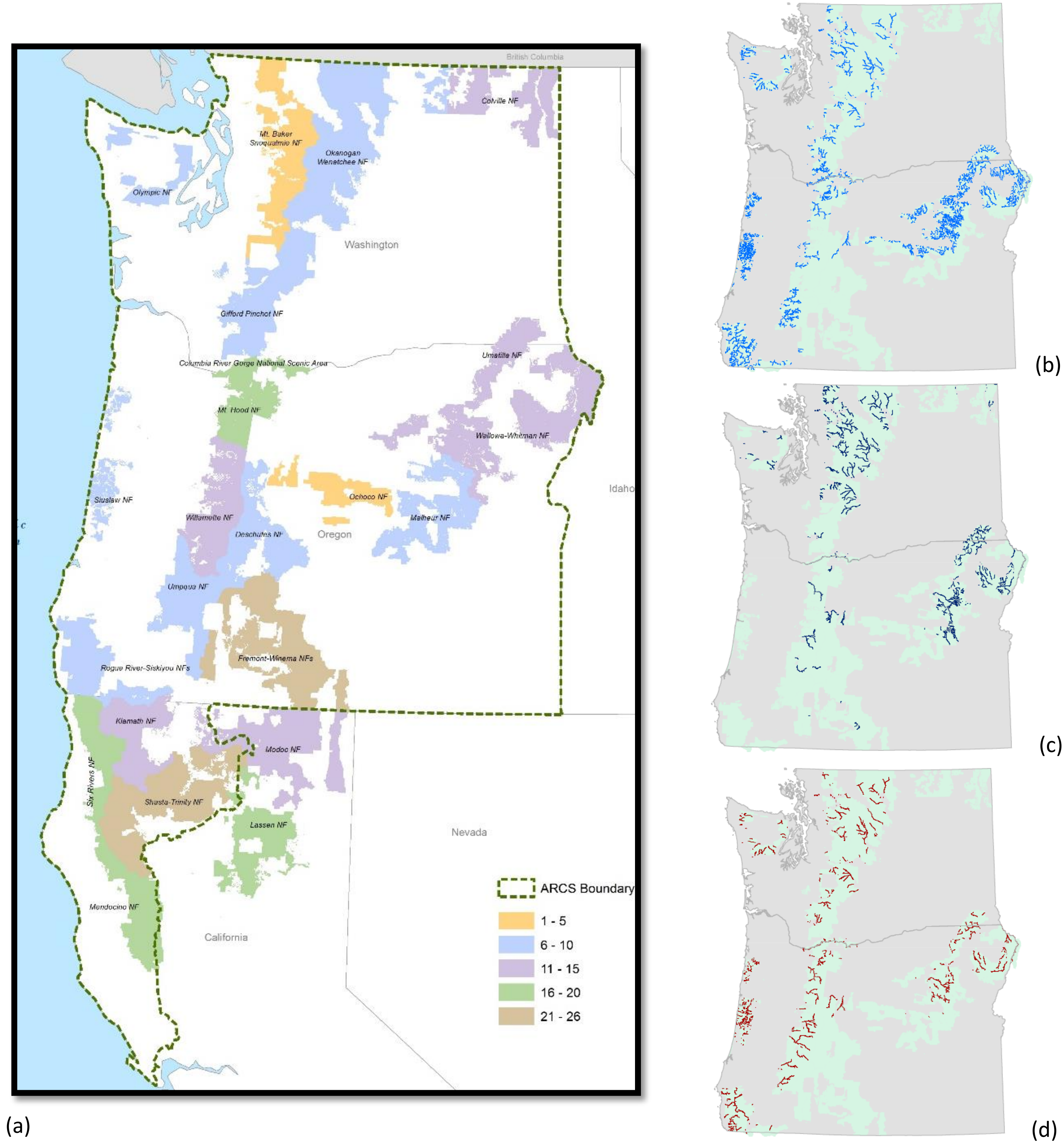


Figure 4. Number of aquatic species listed as threatened or endangered under the Endangered Species Act or considered 'sensitive' by the Regional Foresters (a). Distribution of three of these species, Steelhead (b), Bull Trout (c), and Chinook Salmon (d) on NFS lands in Oregon and Washington.

Steelhead and Chinook Salmon are also present on NFS lands in California (not shown).

Except during the first few years after severe fires, the quality of water from forests is generally high and suitable for most uses (National Research Council 2008). This is largely true of water from NFS lands in the region, but an appreciable number of streams and lakes on these lands do not currently meet State standards for one or more water quality parameters and are thus listed as impaired under the Clean Water Act (CWA, Figure 5). Among impaired waters, stream temperature listings are the most common, followed by listings associated with sediment, biological criteria, nutrients, bacteria, dissolved oxygen, pH, and toxics.

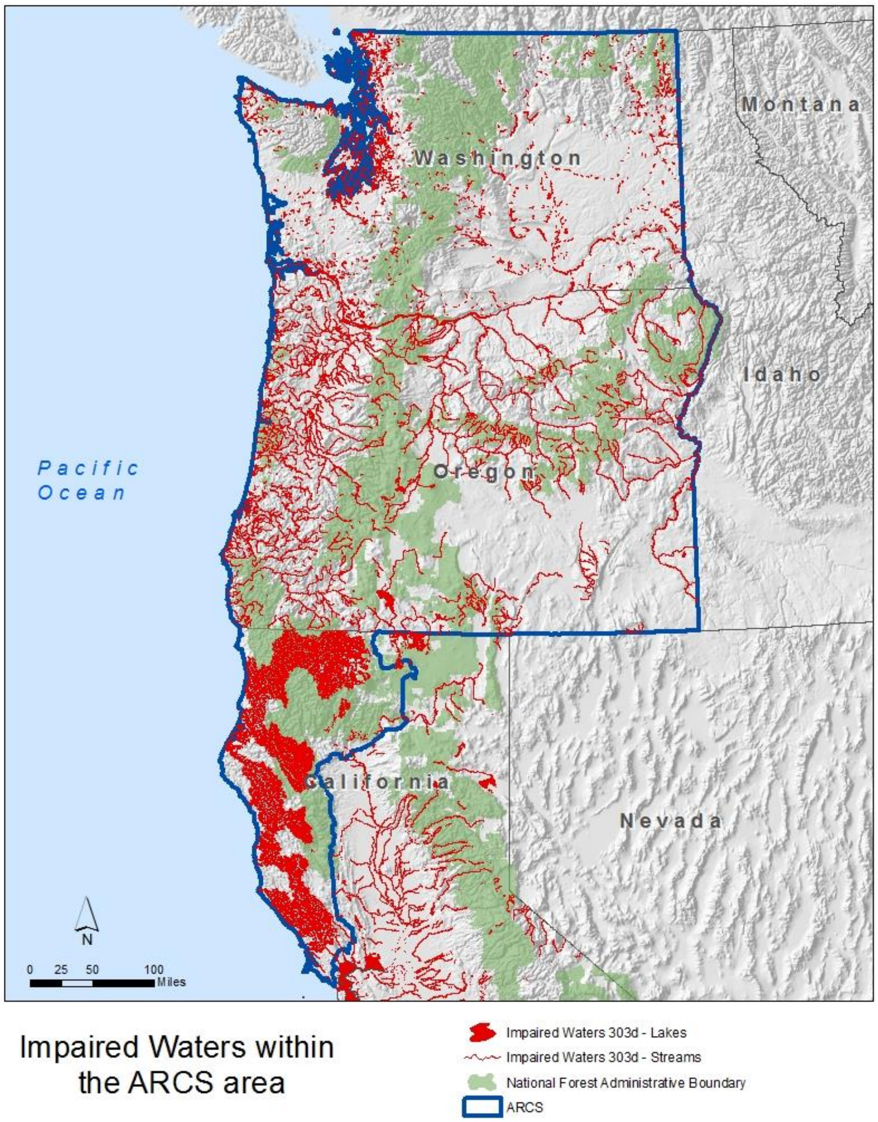


Figure 5. Waters listed by the States of Oregon, Washington and California as impaired under the Clean Water Act.

These waters do not meet the water quality standards that the States have established to support the uses they designated for them.

3. Existing Aquatic Strategies

Similarities and Differences

Prior to the existing three aquatic strategies (i.e., NWFP-ACS, PACFISH, INFISH), management direction for the protection and restoration of aquatic resources on NFS lands was inconsistent and frequently lacked a holistic ecosystem and watershed focus. The three strategies increased protection and restoration of aquatic and riparian ecosystems by establishing specific goals and objectives for these resources and codifying sound management direction to achieve them. Importantly, the strategies focused on managing key ecosystem processes and functions at watershed and broader scales (Heller 2002, Heller 2004, Reeves 2006, Reeves et al. 2017).

The existing strategies are broadly similar, but differ in some important ways. Perhaps the greatest distinction between them is that PACFISH and INFISH and an associated strategy to protect older forests in eastern OR and WA, commonly referred to as the “Eastside Screens” (USDA Forest Service, 1994a and 1994b), were adopted as interim, short-term strategies. Their interim approach focused on maintaining conditions and protecting against further degradation. In contrast, the NWFP and its ACS were developed as long-term, landscape-scale strategies to address an integrated set of issues associated with old forests, aquatic ecosystems, and sustainable supplies of timber to local communities (FEMAT 1993, USDA and USDI 1994a and 1994b). The emphasis of the NWFP and its ACS is protecting and restoring conditions over the long term (i.e., several decades to a century or more).

Despite these fundamental differences, the three aquatic strategies have fairly comparable strategic goals and objectives. These goals and objectives are, however, expressed differently. NWFP-ACS, for example, has nine descriptive “ACS Objectives” whereas PACFISH and INFISH have eight “Riparian Goals” and six quantifiable “Riparian Management Objectives”. The size of areas near waterbodies to which special protection and management direction applies is the same for most types of waterways under the three strategies, but the areas associated with some seasonally-flowing or intermittent streams are smaller under PACFISH and INFISH than under NWFP-ACS.

All three strategies identify networks of watersheds to which special management direction applies. These are referred to as Key Watersheds in the NWFP and PACFISH and Priority Watersheds in INFISH. Both Key and Priority Watersheds comprise areas with existing high-quality habitat for at-risk species or degraded habitats that can most readily be restored to provide habitat in the future. Key Watersheds also include consideration of the potential to produce high-quality water, while Priority Watersheds consider habitat for rare aquatic species. A restoration emphasis is more evident in the Key Watershed concept described in the NWFP than in the Priority Watershed concept described in INFISH.

All three strategies also include a watershed analysis component, which is important for their effective implementation. The NWFP-ACS, however, places a greater emphasis on watershed analysis, integrating the concept more thoroughly into the strategy and providing more specific direction. Watershed restoration and monitoring are discussed in each strategy, but the NWFP-ACS includes a more formalized and structured framework for implementing this work than the interim PACFISH and INFISH strategies. Many of the standards and guidelines are also comparable, but there are multiple differences between the strategies. Many of those differences are subtle, but some are substantive. Approaches to monitoring and adaptive management vary somewhat as well. For example, monitoring associated with the NWFP-ACS, conducted through the Aquatic and Riparian Effectiveness Monitoring Program (AREMP) focuses on the status and trend of watershed conditions based on a combination of watershed, riparian and aquatic habitat conditions (Miller et al. 2017). In contrast, the PACFISH-INFISH Biological Opinion (PIBO) monitoring program is focused only on the status and trend of aquatic habitats (Kershner et al. 2017).

Management Changes and Lessons Learned

Although there are differences between the NWFP-ACS, PACFISH, and INFISH, their similarities provided a fair degree of management consistency across the region. Their amendment of existing Forest Plans constituted a major shift away from a primarily commodity (e.g., timber) production focus, towards an ecosystem management approach that provides a range of goods and services from the land (e.g., commodities, clean water, salmon habitat). They dramatically changed the way in which watersheds and aquatic and riparian resources are managed on NFS lands (Heller 2002 and 2004, Reeves et al. 2006). For example, under the three strategies, management activities must now contribute to, or not retard attainment of aquatic and riparian goals and objectives. Before the strategies, management activities could occur unless unacceptable adverse impacts were demonstrated to be likely. Early implementation focused on halting certain activities, which slowed or halted degradation. Over time, this attention continued, with additional emphasis directed towards reducing the impacts of prior land use through watershed restoration. These protection and restoration activities now focus on the process and function of whole watersheds and aquatic ecosystems across ownerships. This contrasts with the past, when the management was concentrated on the condition of individual streams, stream segments or sites, primarily on public land. Now projects are often focused on achieving multiple resource objectives and they are informed by integrated, multi-scale ecosystem analyses. Before the strategies, projects were much more focused on individual resources and were usually based on analyses at one, often relatively small, spatial scale.

Much has been learned through the first 20 years of implementation of the strategies. This includes better understanding of the spatial and temporal scales of ecosystem processes and functions, the ranges of variability of key watershed conditions and processes, and the ways in which they can be maintained or restored. In addition, new science, watershed analysis, and broad-scale monitoring and evaluation (AREMP and PIBO) have helped to better define the timeframes of ecological responses to changes in management at multiple spatial scales. Approaches for maximizing the effectiveness of watershed restoration programs are now much better recognized (e.g., Roni et al. 2002, Beechie et al. 2010, Rieman et al. 2015) and are more widely implemented than in the past (Heller 2002 and 2004). For example, watersheds in the best condition are now generally treated first, with a focus on preventing impacts by reducing or eliminating conditions that alter or threaten key watershed processes. In contrast, past approaches generally focused on treating symptoms, rather than causes of degradation and this work was often first concentrated in the 'worst' watersheds. Historically, restoration often involved a relatively narrow range of treatments (e.g., stream habitat restoration) at individual sites scattered across many watersheds. Now, the practice has evolved towards implementing a broader, more integrated set of treatments (e.g., stream, road, and vegetation treatments) focused in a smaller set of priority watersheds at any given time. Once whole watershed restoration is completed in one set of priority watersheds, work shifts to another group of watersheds. Our understanding of the dominant role of ecosystem disturbances across the landscape has improved, influencing restoration approaches to manage for increased resiliency in the face of those disturbances.

There were also important advances in the social and legal dimensions of watershed and aquatic ecosystem management. For example, Federal agencies, Tribes, and various other agencies and diverse non-governmental organizations have improved understanding of each other's goals, objectives and modes of operation. This has advanced collaboration. Tribes, watershed councils and other organizations, for instance, are now heavily involved in the development and implementation of projects on NFS lands throughout OR, WA and northern CA. Integration of various governmental programs has improved as well. All three aquatic strategies, for instance, have been adopted into State water quality assessments and restoration plans (e.g., WDOE 2003, CalEPA 2005, ODEQ 2010, USDA Forest Service 2014) and ESA-recovery plans for salmon and other aquatic species (e.g., UCSRP 2007) throughout the region.

Integration of the existing strategies with ESA and CWA programs provides further evidence they are generally sound and broadly supported. Importantly, however, some ESA listing decisions and consultations on Forest plans indicate that NWFP-ACS is viewed by some as providing a greater level of protection than PACFISH and INFISH, given less uncertainty regarding the continued implementation of this long-term strategy (e.g., USDC-NMFS 1998).

4. ARCS Overview

The Strategy

ARCS integrates and refines the three existing aquatic conservation strategies into a single, unified strategy intended to build upon prior successes, reflect new science and policy, incorporate lessons learned, and address ongoing issues and new needs. The ARCS combines ecosystem and landscape perspectives to provide a management strategy to be applied over a broad, heterogeneous area of national forests in OR and WA and those portions of northern CA that are within the NWFP area. It focuses first and foremost on broad-scale aquatic resource conservation and protection, coupled with strategically-focused active restoration in priority areas (USDA Forest Service, 2005).

ARCS is comprised of five elements: (1) Riparian Management Areas (RMAs), (2) Key Watersheds, (3) watershed analysis, (4) watershed restoration, and (5) monitoring and adaptive management (Figure 6). Each of these is described below in further detail. Interaction of all five elements at the watershed and landscape-scales provides the basis for watershed, aquatic, and riparian ecosystem management and restoration. These elements work together and complement each other to achieve the goal of appropriately distributed watershed conditions. They will not achieve desired results if implemented alone or in limited combination (FEMAT 1993, USDA and USDI 1994a and 1994b). As such, they are designed to be applied in an integrated fashion.

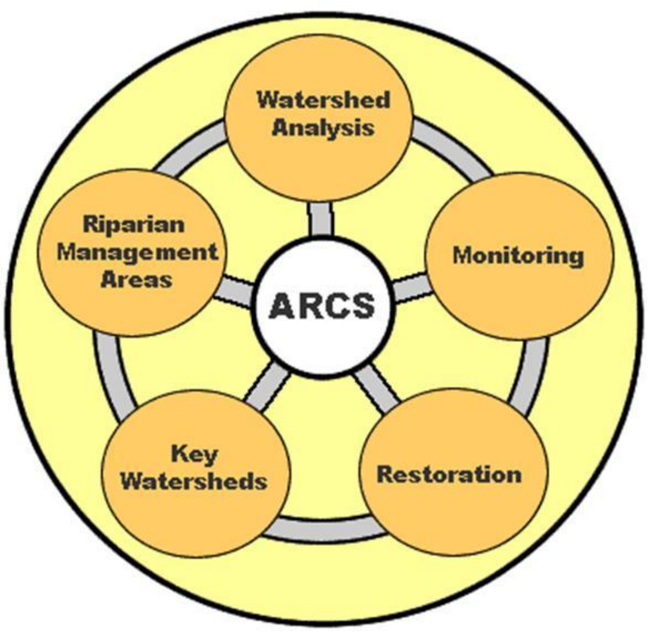


Figure 6. The five primary elements of ARCS.

These elements are intended to work together to maintain and restore aquatic and riparian ecosystems and water quality. They are implemented via Forest plan components (e.g., desired conditions, suitability determinations, objectives, and standards and guidelines), other plan content and other administrative direction (see Sections 6-12).

Riparian Management Areas

RMAs include lands along permanently-flowing streams, ponds, lakes, wetlands, seeps, springs, intermittent streams, and unstable sites that may influence these features. Aquatic and riparian-dependent resources receive primary emphasis in these areas and special management direction applies. Specifically, management activities in RMAs are designed to protect, restore, or enhance water quality and the ecological health and function of aquatic and riparian ecosystems and associated resources. These areas function at the ecosystem level (coarse filter) to represent and maintain the full range of aquatic and riparian ecological diversity. RMAs are further described in Section 8.

Key Watersheds

Key Watersheds are a network of watersheds providing habitat for aquatic and riparian species and/or serving as sources of high-quality water for municipalities. Protective management direction applies to these watersheds. They are designated because they may serve as strongholds for important aquatic or riparian species or have the potential to do so. They may be areas crucial to special status aquatic and riparian species (e.g., threatened or endangered species, species of conservation concern). Key Watersheds may also provide high-quality water important to downstream aquatic and riparian populations. In addition, they could serve as municipal drinking water sources for communities in the region. Management direction emphasizes minimizing risk and maximizing restoration or retention of ecological health. Because the selection and management of Key Watersheds is focused on maintaining or restoring key biophysical processes and conditions throughout the plan area as well as addressing the needs of Federally-listed species and/or species of conservation concern, the Key Watershed network helps address requirements of the ecosystem diversity and species diversity components of the 2012 Planning Rule. As such, they serve as both a "coarse filter" and "fine filter" for conservation. Key Watersheds are described in detail in Section 8.

Watershed Analysis

Watershed analysis is an interdisciplinary evaluation and synthesis of important geomorphic and ecological processes operating in specific watersheds. It provides watershed-scale context for management, facilitating the development of watershed protection and restoration strategies, more specifically defining desired conditions, management objectives and strategies, and developing monitoring programs. The analysis process involves (1) identification of key questions and issues, (2) evaluation of the condition and trend of riparian areas, water quality, and aquatic ecosystems and key watershed processes that influence them, (3) evaluation of the connectivity of the watershed for terrestrial and aquatic flora and fauna species, and (4) development of a list of recommended management actions to address conditions and trends. These analyses are conducted during the National Forest Management Act side of planning, which is separate from the National Environmental Policy Act process. Section 10 describes watershed analysis in further detail.

Watershed Restoration

Watershed restoration is the reestablishment of watershed functions and related physical, chemical, and biological characteristics needed to support aquatic and riparian ecosystems (National Research Council 1992). Restoration includes a mix of passive and active management activities. Restoration actions may not immediately result in attainment of desired conditions, but should increase the rate, scope, and scale of recovery.

In the USDA Forest Service (USFS), watershed and aquatic restoration work is primarily guided by the Watershed Condition Framework (WCF, USDA Forest Service 2011a[1]). WCF is a 6-step strategic framework for restoration that includes: (1) classification of watershed condition; (2) prioritization of watersheds for restoration; (3) development of Watershed Restoration Action Plans for selected Priority Watersheds; (4) implementation of the integrated restoration projects defined in those plans; (5) tracking of restoration accomplishments, and (6) monitoring and verification. As described in Sections 8 and 11, the watersheds selected as Priority Watersheds for near-term restoration are typically a subset of the broader, longer-term Key Watershed network. Other primary restoration guidance used by USFS includes ESA recovery plans, rare species conservation strategies and recovery plans, and water quality restoration plans.

Monitoring and Adaptive Management

Monitoring is a systematic process of collecting information to evaluate effects of actions or changes in conditions or relationships (36 CFR 219.19). It is continuous and provides feedback for the planning cycle by testing relevant assumptions, tracking relevant conditions over time, and measuring management effectiveness. Plan monitoring is designed to enable the responsible official to determine if a change in plan components or other plan content that guide management of resources in the plan area may be needed (36 CFR 219.12).

Adaptive Management is a continual process of adjusting management actions in response to new information or knowledge, including monitoring results.

[1] http://www.fs.fed.us/biology/resources/pubs/watershed/maps/Watershed_Condition_Framework2011FS977.pdf

Key Refinements to Existing Aquatic Strategies

As described in previous sections, the current strategies (NWFP-ACS, PACFISH, and INFISH) appear to be effective in achieving their goals and objectives and thus do not require substantial change. Nonetheless, ARCS varies somewhat from these existing strategies. Some of these differences are inherent to the process of integrating three strategies into a single, unified one. Other changes stem from the need to better align Forest plans with the 2012 Planning Rule and other policies, as well as to address new science and lessons learned during the 20-years of implementing the existing strategies.

Management Goals

One of the biggest differences between ARCS and PACFISH and INFISH is that, like the NWFP-ACS, it is intended to be a comprehensive, long-term strategy. In contrast, PACFISH and INFISH were originally intended as interim strategies, to be replaced by longer term strategies when Forest plans were revised. Beyond this important distinction, ARCS maintains the general goals of the existing strategies and expands upon them. Specifically, consistent with the 2012 Planning Rule, ARCS places additional emphasis on protecting and restoring water quality to support the full range of State-designated uses of water, while maintaining a focus on aquatic and riparian ecosystem health.

The more specific goals of ARCS, articulated as desired conditions (Section 9), are similar to existing strategies, but provide additional direction. ARCS, for example, has 17 desired conditions. These capture the substance of the nine NWFP-ACS Objectives and eight PACFISH-INFISH goals, and add emphasis to the role of disturbance in maintaining the integrity of watersheds and aquatic ecosystems. In addition, ARCS provides a broader set of goals for conditions and processes in RMAs and Key Watersheds and seeks to maintain or increase aquatic ecosystem resilience to climate change. ARCS also includes a desired condition specifying a goal to have the ever-changing distribution of stream conditions in watersheds across NFS lands to be similar to the dynamic distribution of conditions in reference watersheds (i.e., those that have been the least affected by past management activities) or to other ecologically-relevant benchmarks. This contrasts with PACFISH and INFISH, which established relatively uniform and static Riparian Management Objectives (RMOs) as interim targets for management. Besides more completely specifying management goals through additional desired conditions, ARCS more explicitly defines the spatial scale(s) over which the desired conditions apply than do the existing strategies.

Management Areas

ARCS management areas are also comparable to similar designations in the existing strategies, with some exceptions. RMA widths in the ARCS, for example, are the same as those associated with Riparian Reserves in the NWFP-ACS. RMA widths are also the same as those for Riparian Habitat Conservation Areas under PACFISH and INFISH for all waters except intermittent and seasonally-flowing streams that are not associated with ESA-listed fish. In those cases, RMA widths under ARCS are greater than those in PACFISH and INFISH.

Like the existing strategies, ARCS also includes a network of refugia for critical aquatic species and habitats, referred to as Key Watersheds[2]. However, in addition to aquatic biota, the provision of high-quality water for a full range of downstream uses is part of the criteria for Key Watershed selection in ARCS. These important uses are somewhat represented in the existing NWFP-ACS Key Watershed network, but less so in the PACFISH and INFISH watershed networks. Furthermore, ARCS provides direction to consider the potential effects of climate change in designating the Key Watershed network. This issue was not specifically considered when the networks in the existing strategies were developed. Like the existing strategies, ARCS specifies that Key Watersheds are a priority for restoration.

Watershed Analysis

Through implementation of the existing strategies, much has been learned about how to more efficiently and effectively conduct watershed analysis and use the results to inform implementation of Forest plans. These lessons learned are reflected in ARCS via updated direction that describes the purpose of these analyses, outlines the analysis process, specifies the products expected from the analyses, and provides an updated set of tools and resources that can be used to conduct the analyses (Section 10). In contrast to prior direction, the updated guidance and tools now address climate change and invasive species. It also emphasizes the critical role that line officers play in defining the scope of these analyses and ensuring they are completed in an efficient and effective manner.

[2] ARCS, NWFP-ACS and PACFISH use the term "Key Watersheds" to refer to a large-scale, long-term network of aquatic conservation watersheds. INFISH uses the term "Priority Watersheds" for this type of network. In ARCS, "Priority Watersheds" means something different. Consistent with WCF, they are watersheds that are the near-term (e.g., 5-7 years) focus for active restoration. See Sections 8 and 10.

Watershed Restoration

ARCS also includes a more formalized and structured process for watershed restoration than the existing strategies. Specifically, as described in Section 11, ARCS incorporates concepts from the Pacific Northwest Region's Aquatic Restoration Strategy (USDA Forest Service 2005) and adopts the six-step National WCF process for planning and implementing watershed restoration.

ARCS, for example, more explicitly recognizes broad-scale aquatic resource protection/passive restoration during all land management activities as an essential foundation for restoration. This is represented via robust standards and guidelines, including one that requires implementation of Forest Service National Water Quality Best Management Practices (USDA Forest Service 2012b). Active restoration builds upon this foundation, through targeted, strategically-focused active restoration implemented through the WCF process of watershed assessment, selection of Priority Watersheds, and development, implementation and monitoring of multi-year, watershed-scale restoration plans and projects (Sections 8 and 11).

Priority Watersheds identified through the WCF process are expected to typically be a subset of the broader Key Watershed network. ARCS incorporates WCF as a near-term (e.g., 5-7 years) implementation process for restoration within the broader, long-term Key Watershed network. Through this process, Forest plans will be better aligned with the goals of ESA and CWA, as selection of WCF Priority Watersheds and identification of needed restoration work will be informed by ESA-recovery plans and water quality restoration plans for impaired waters.

Unlike the current strategies, Forest plans that implement ARCS will include quantitative, measureable accomplishment objectives for restoration. That is, Forest plans will describe the general scope and scale of various restoration treatments (e.g., miles of streams restored, miles of road improved or decommissioned) expected to be implemented during the life of the Forest plan and ultimately, the number of watersheds in which all essential restoration actions are expected to be completed.

Standards and Guidelines

Overall, ARCS standards and guidelines are similar to those in NWFP-ACS, PACFISH, and INFISH, but there are some differences. Many of these differences result from the process of integrating and synthesizing direction from three strategies into one. In addition, consistent with recent direction for standards and guidelines (USDA Forest Service 2015b), those standards and guidelines associated with procedural requirements (e.g., watershed analysis, interagency coordination) were generally omitted from ARCS, as were standards or guidelines that were already addressed by comparable direction.

Besides these changes, ARCS includes some new or substantially modified standards and guidelines (Section 9). An example includes Watershed Management (WM-1), which was added to provide greater assurances that ARCS goals will be met. Standard WM-2 is another example. It requires implementation of BMPs, thereby meeting requirements of the 2012 Planning Rule, ensuring CWA compliance and providing a foundation for restoration and restoration and adaptive management. Revised Road Management standards RF-8 and RF-10 help implement direction to incorporate climate change into decision-making, especially that pertaining to infrastructure, while standard RF-12 aligns with new desired conditions by accelerating progress in addressing road impacts. Grazing Management guideline GM-3 was developed to provide more consistent, objective, science-based grazing management direction across the entire ARCS domain. It replaces older PACFISH *Recommended Livestock Grazing Guidelines* (USDA and USDI 1995e) that currently apply to only a portion of the ARCS area. Revised Fire Management standard FM-5 helps to better manage invasive species risks associated with water use in wildland firefighting and new standards FM-6 and FM-7 provide consistency with recent national policy associated with fire retardant application. The updated Riparian Management guideline RA-4 places additional emphasis on reducing risks associated with invasive species during water drafting. Additional examples include the Lands, Special Uses, and Hydropower guideline LH-8, which is intended to improve the effectiveness of the Key Watershed network, and the Watershed Restoration guideline RE-3, which ensures that potential climate change effects are considered in watershed restoration projects.

Monitoring and Adaptive Management

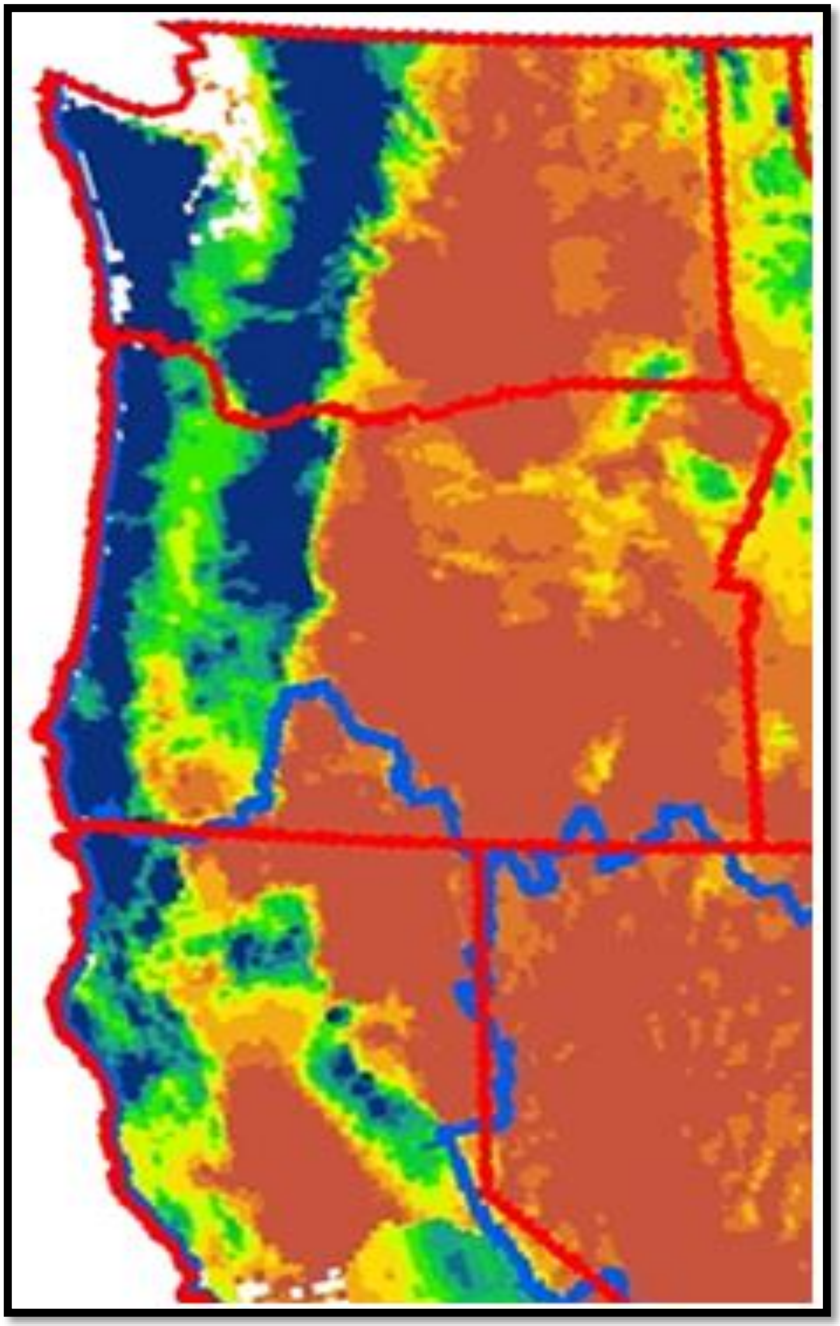
ARCS includes a more consistent, explicit, and structured approach to monitoring and adaptive management than the existing strategies. Per the 2012 Planning Rule, it includes both broad-scale and Forest plan level monitoring. Specific elements are focused on determining whether the ARCS is being implemented, restoration objectives are being attained, and water quality BMPs and other standards and guidelines are being implemented and are effective at the site-scale. Other elements are designed to assess the status and trend of watershed conditions and aquatic ecosystems, determine changes in the distribution of ESA-listed aquatic species and species of conservation concern, and track the status and trend of stream temperatures (Section 12).

Importantly, ARCS defines the types of management decisions that will be informed by monitoring information at various spatial and administrative scales. Linkages between monitoring and other components of the ARCS (e.g., watershed analysis) are also clearly defined.

Implementation

ARCS applies to an extremely large and diverse landscape, with highly variable and dynamic ecological conditions. Annual precipitation rates, for example, vary substantially across the area, ranging from less than 10 inches per year east of the Cascade Mountains to over 100 inches per year on the western mountain faces nearest the ocean (Daly et al. 2008, Safeeq et al. 2015). In turn, mean annual runoff varies dramatically, from 0-25mm on some NFS lands in eastern OR to >1200mm on some NFS lands in the Cascade, Olympic, and Klamath Mountains (Figure 7, Brown et al. 2008). These patterns of precipitation and runoff, together with other broad-scale influences such as topography, elevation, and geology create large differences in stream density, streamflow, and forest vegetation types and densities (Figure 8, Mildrexler et al. 2015). These precipitation and runoff patterns also strongly influence dominant disturbance regimes. Fires, for example, are much more common in eastern WA, eastern and southern OR, and northwest CA than in western OR and WA (Figure 9). Flood magnitudes and the frequencies of landslides vary as well. For instance, the magnitudes of floods in western WA and OR with a recurrence interval of 50-years are, on average, almost twice as large as those in eastern OR and WA (Figure 10, Sumioka 1998, Cooper RM. 2005a, Cooper RM. 2005b, and Safeeq et al. 2015). These and other fundamental differences in landscape patterns and processes strongly influence the types of aquatic and riparian species and habitats present in different areas, species' life histories and habitat requirements, and their sensitivities to different types of disturbance. These patterns and processes, along with diverse social and economic conditions, also strongly influence the types of activities (e.g., timber harvest, recreation, grazing, minerals management, fuels management, water management, hydropower) that are most common in a given area and the ways in which those activities are implemented.

Given this diversity, some elements of ARCS are necessarily general. It is recognized that highly-variable landscape conditions will influence how ARCS is implemented on a particular National Forest, through Forest planning and ultimately through project planning and implementation. As described in Section 1, in the Forest planning process, Forests should add specificity and local detail as needed to tailor ARCS to best meet local ecological, social, and economic systems and conditions and the broader set of issues and opportunities on a particular forest. There will be, for example, different issues associated with forest vegetation on different Forests and thus potentially different vegetation management strategies (e.g., Franklin and Johnson 2012). Needs and opportunities to address local context will be defined, in part, through the assessment process (Section 7).



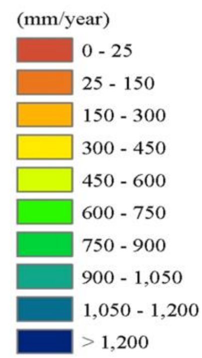


Figure 7. Mean annual runoff for Oregon, Washington, and northern California (Brown et al. 2008).

Extreme variability in precipitation rates and other factors create highly variable resource conditions and disturbance regimes in the ARCS area. See Figures 8-10.

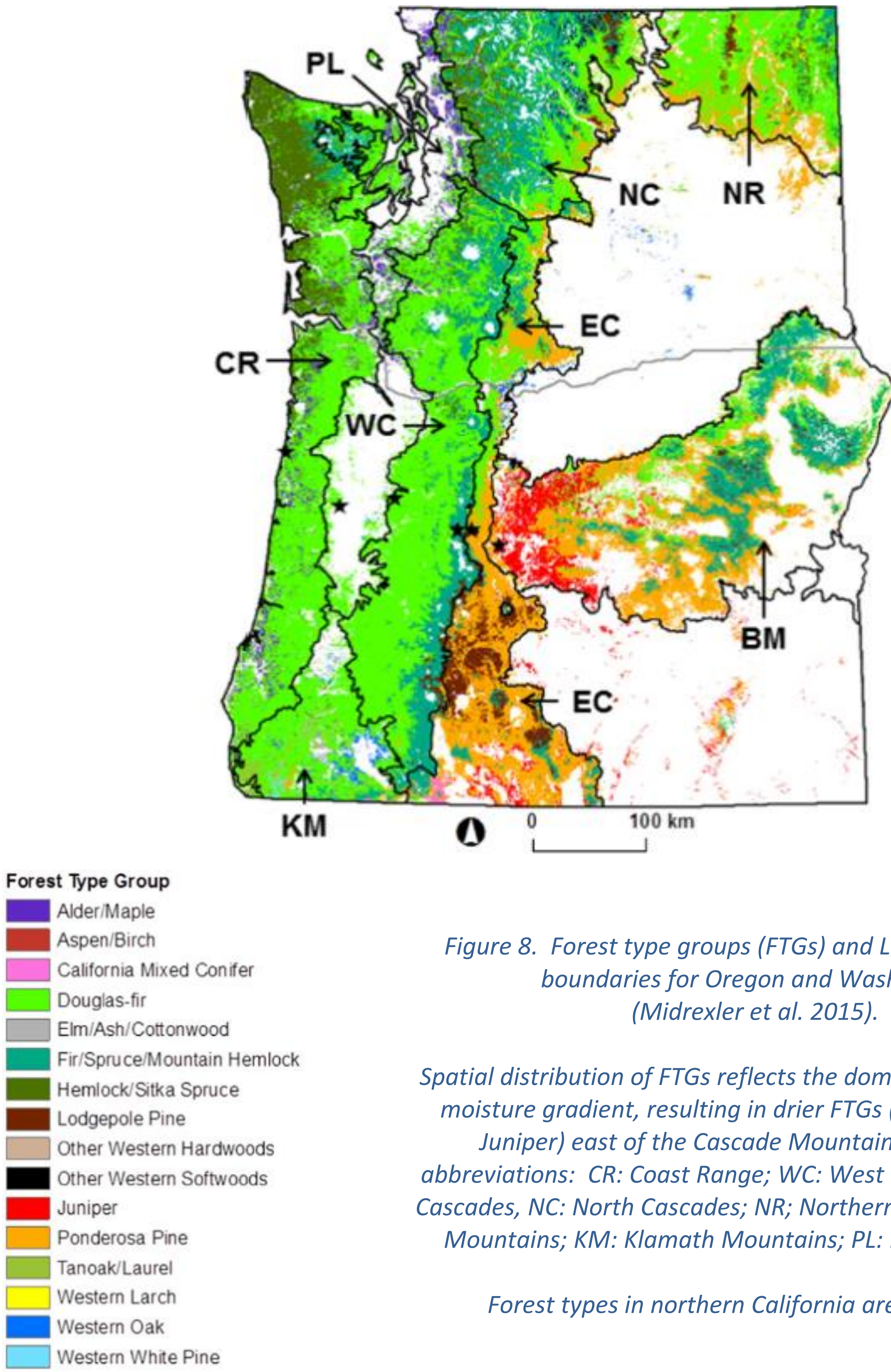


Figure 8. Forest type groups (FTGs) and Level 3 Ecoregion boundaries for Oregon and Washington (Midrexler et al. 2015).

Spatial distribution of FTGs reflects the dominant west-to-east moisture gradient, resulting in drier FTGs (Ponderosa Pine, Juniper) east of the Cascade Mountains. Ecoregion abbreviations: CR: Coast Range; WC: West Cascades; EC: East Cascades, NC: North Cascades; NR; Northern Rockies; BM: Blue Mountains; KM: Klamath Mountains; PL: Puget Lowlands.

Forest types in northern California are not shown.

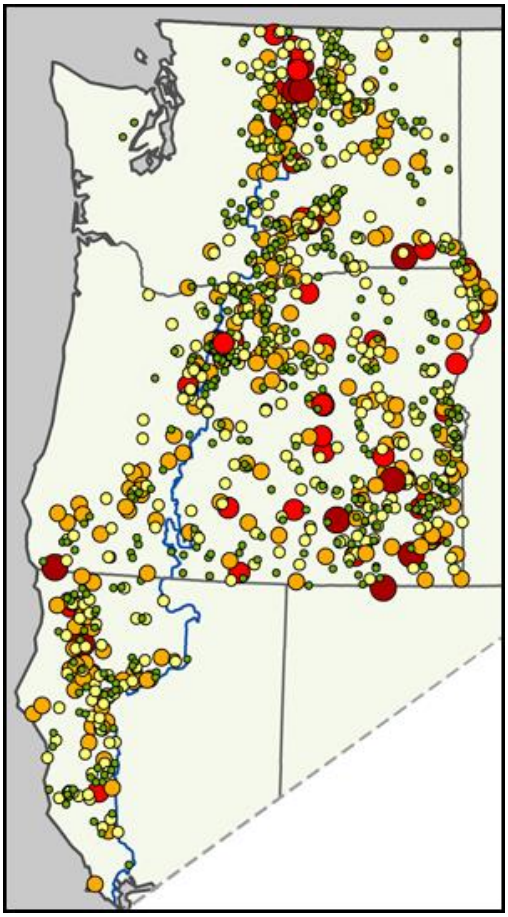
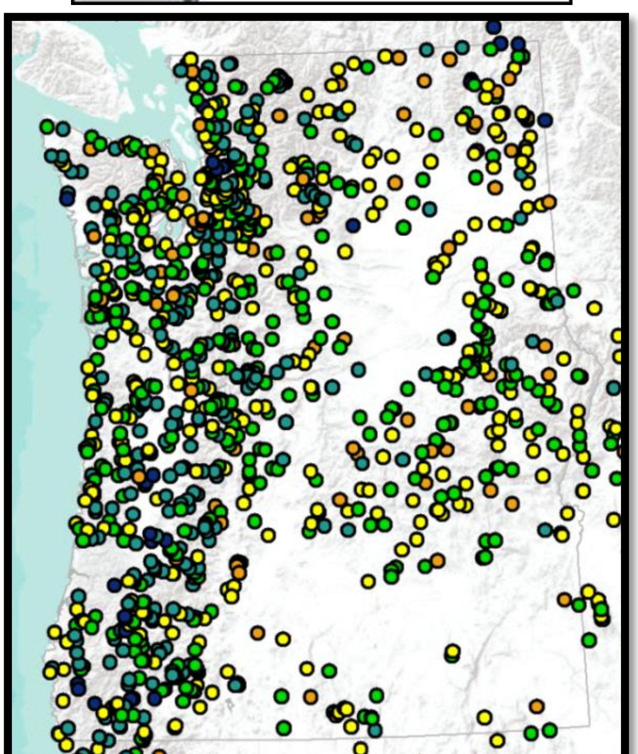


Figure 9. Spatial distribution and relative size of large (>1000 acres) fires in Oregon, Washington, and northern California from 1992-2014 (USDA Forest Service, 2016a).

Areas west of the blue line are currently managed under the NWFP-ACS. Areas to the east are currently implementing the PACFISH and INFISH strategies.



Discharge (cubic feet per second, cfs)

<10 cfs

10-100 cfs

100-1,000 cfs

1,000-10,000 cfs

10,000-100,000 cfs

100,000-1,000,000 cfs

Figure 10. Magnitudes of floods with a 50-year recurrence interval in Oregon and Washington.

Data are based on 1,000 sites with 10-98 years of record (from Sumioka 1998, Cooper RM. 2005a, Cooper RM. 2005b, and Safeeq et al. 2015). Flood magnitudes in northern California are not shown.

Expectations and Limitations

ARCS is intended to prevent degradation of aquatic and riparian ecosystems and to restore the ecological processes responsible for creating those ecosystems and providing high-quality water over broad landscapes (USDA and USDI 1994a and 1994b). The strategy is built upon knowledge that periodic disturbances are necessary to maintain ecological structure and function. Consequently, it is not expected that all watersheds will be in good condition at any point in time, nor will any particular watershed remain in a certain condition through time. Instead, when ARCS is successful, there will be watersheds in various levels of recovery from disturbance and the distribution of watersheds in good condition will increase. We would have successfully increased the resiliency of watersheds to respond to natural disturbances (Reeves 2006, Reeves et al. 2006).

Like the NWFP-ACS, in the short term (10-20 years), the ARCS is intended to protect watersheds that currently contain good habitat, support healthy populations of fish and provide high-quality water. However, it will likely take several decades to possibly more than a century to attain all of the desired conditions. In particular, it will likely take an extended period of time for the condition of watersheds that have been extensively degraded from past management activities to markedly improve (FEMAT 1993, USDA and USDI 1994a and 1994b).

Implementation of ARCS builds on the strategies outlined in FEMAT (1993) and is therefore is expected to substantially contribute to the recovery of ESA-listed aquatic organisms, by increasing the quantity and quality of freshwater habitat. It is also expected to significantly contribute towards attainment of CWA goals of protecting and restoring water quality. By itself, however, it is not expected to prevent the listing of species or distinct population segments or enable their full recovery, primarily because factors off Federal land often strongly influence populations, particularly those that are migratory and use habitat off of the National Forests (Reeves et al. 2017). For Federally-listed migratory fish, factors outside the responsibility of Federal land managers contribute to the status and trends of populations. These include the condition of freshwater and estuarine habitats, commercial and recreational fisheries harvest, ocean conditions, management of mainstem dams, and the effects of hatchery practices and introductions (National Research Council 1996). Similar limitations apply to water quality.

Climate change is another factor beyond the direct control of Federal land managers. Nonetheless, those managers have a responsibility to address and respond to climate change through adaptation and mitigation as directed in the 2012 planning rule (219.12(a)(4)(vi)). Key adaptation actions relevant to water and aquatic resources are reflected in this ARCS.

5. Scientific Basis of ARCS

Aquatic and Riparian Ecosystems

Aquatic and riparian ecosystems are highly dynamic in space and time (Reeves et al. 1995, Reeves et al. 2017). Ecologically healthy watersheds are maintained by natural disturbances that create spatial heterogeneity and temporal variability in the physical components of the system (Naiman et al. 1992a, Bisson et al. 2003, Miller et al. 2003, Rieman et al. 2015). Natural disturbances have resulted in a mosaic of habitat conditions over time and native fish populations have adapted to this dynamic environment (Naiman et al. 1995, Reeves et al. 1995). Aquatic and riparian ecosystems are resilient to the types of disturbances under which they have developed. Recovery from disturbance may take decades or longer, depending upon its magnitude and extent, but some improvements can be expected in 10 to 20 years (Reeves 2006).

Naiman et al. (1992b) described different disturbance regimes based on the frequency and magnitude of disturbance and its location in a watershed (e.g., headwaters, middle, or lower reaches). Under natural disturbance regimes, a landscape would have watersheds exhibiting a range of conditions because of the asynchronous nature of large and infrequent disturbance events (Miller et al. 2003). Other studies describe stream systems as complex, branching networks rather than linear systems, providing a better understanding of the ecological processes that link riparian and aquatic and headwater and downstream ecosystems (Fisher 1997, Benda et al. 2004). These perspectives imply that aquatic ecosystems are not steady state. Rather, streams are invariably dynamic, and conditions vary in space and time because of periodic events such as wildfire, large storms and subsequent floods, hillslope failures, landslides, debris flows, and channel migration. An important implication is that streams and aquatic ecosystems are linked to the dynamics of both the riparian and upland natural communities and the watershed and physical processes that shape them.

Small streams[3] serve as critical source areas for high-quality water. Because the spatial extent of headwater streams comprise a major portion of the total catchment area (Sidle et al. 2000, Meyer and Wallace 2001), these and adjacent upland ecosystems are important sources of sediment, water, nutrients, energy, and organic matter for downstream systems (Furniss et al. 2005, Gomi et al. 2002, Meyer et al. 2003, Wipfli et al. 2007). These relationships are illustrated in Figure 11.

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[3] Small streams are also called headwater, intermittent, ephemeral, seasonal, low-order, and upper network streams (after Furniss and Colby 2005).

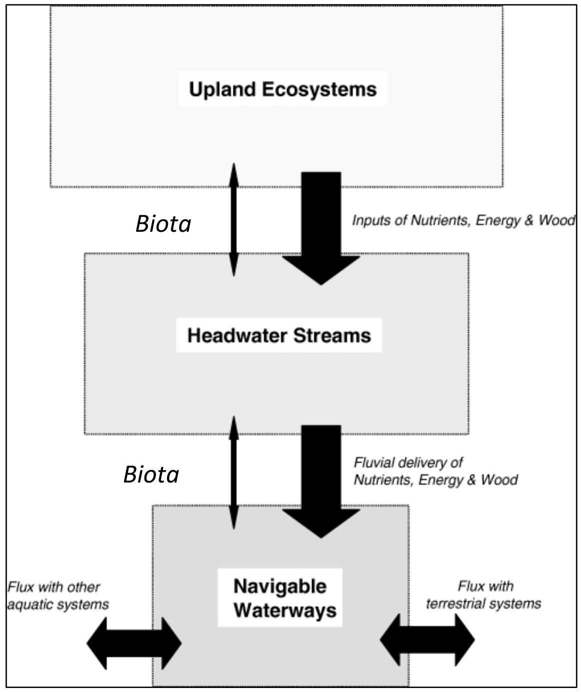

Figure 11. Natural connectivity model between uplands, headwater streams and larger streams and rivers.

Headwater streams are sources of energy and serve as conduits for fish, amphibians and other biota, nutrients, energy, and wood, linking upland ecosystems with larger navigable waters downstream (modified from Wipfli et al. 2007).

Riparian ecosystems are among the most diverse, dynamic and complex biophysical habitats on the landscape. They have many interfaces, edges, or ecotones and possess a relatively high diversity of resources. Riparian zones control energy and material flux, are sites of biological and physical interaction at the terrestrial/aquatic interface, support unique vegetation assemblages, provide critical habitats for rare species, and are refuges and source areas for a wide variety of species (Kaufman et al. 2001). Riparian zones also play a critical role in connectivity of watersheds by providing dispersal and travel habitat and corridors across the landscape for both terrestrial and riparian-dependent species. The functions of living and dead vegetation in riparian zones include regulating bank erosion, providing an adequate and continuous supply of coarse woody debris to streams, and providing shade and microclimate protection. Most vertebrates (e.g., 53% of wildlife species occurring in OR and WA) use riparian zones for at least part of their activities (Kaufman et al. 2001). Moreover, approximately 25-30% of plants in OR and WA, respectively, are facultative or obligate wetland species (USDA Natural Resource Conservation Service 2006, FEMAT 1993). These species play a critical role in the productivity, resiliency, and function of riparian zones.

Ecosystem Disturbance, Sensitivity, and Resilience

ARCS is intended to contribute to the sustainability of aquatic and riparian ecosystems and support the diversity of species which depend on them. The basic approach is to maintain and restore the ecological health of watersheds and to retain the ability of riparian and aquatic ecosystems to recover from natural disturbances. This approach stems from recent science suggesting that, to provide for resilient, productive, and persistent natural systems, it is important for management to: 1) conserve natural processes that influence the structure and variability in landscapes, 2) conserve natural variation or diversity, and 3) account for the influence of scale by identifying and conserving patterns and key processes at multiple spatial and temporal scales (Rieman et al. 2006, Rieman et al. 2015).

Stream habitats are heterogeneous and dynamic in longitudinal (headwaters to larger rivers), lateral (stream, floodplain, riparian area interactions), and vertical (stream channel-hyporheic interactions) dimensions (Stanford and Ward 1992). Stream and riparian habitats also vary in their response to disturbance (Reeves et al. 1995). Different physical processes may affect aquatic habitat at different spatial and temporal scales. Figure 12 displays the relative frequencies and scales of selected disturbances that may affect stream channels and watersheds, producing spatially and temporally variable habitats and water quality (Montgomery and Buffington 1998). Disturbance from storms, debris flows and/or fires, for example, are typically more frequent and occur at smaller spatial scales than climate change and tectonic processes. The probability that a particular location will be affected by disturbance at a particular time may be low, but it increases with increasing spatial scale.

The scale of biological response to disturbance will vary depending upon spatial requirements (e.g., home range, territory size, migratory patterns, life history characteristics) and temporal constraints (e.g., generation time, migration time) of different species (Rieman et al. 2006). Similarly, the relationship between recovery time and the relative sensitivity to disturbance will vary depending on the relative scale of various habitat and stream features (Figure 13). For example, individual sites have a relatively high sensitivity to disturbance, but relatively short recovery periods. Conversely, watersheds with relatively low sensitivities to disturbance may have relatively long recovery periods (Frissell et al. 1986, Naiman 1998, Naiman et al. 1992b.). Aquatic and riparian ecosystem management needs to account for these processes interacting at multiple scales to establish the context for aquatic resource conservation (Fausch et al. 2002).

Allen and Hoekstra (1992) suggest that to understand ecological processes, it is necessary to assess three scales of ecosystem organization concurrently: (1) the scale in question, (2) the scale below that provides mechanisms (dominant processes), and (3) the scale above that gives broader context, role, or relative significance. The relationship between the finest spatial or temporal resolution studied or of interest (grain) and the size of the study area or study duration (extent) determines the scale of processes that can be understood (Wiens 1989). To understand and maintain or restore ecological processes, it is necessary to consider their role and influences upon them at varying spatial and temporal scales.

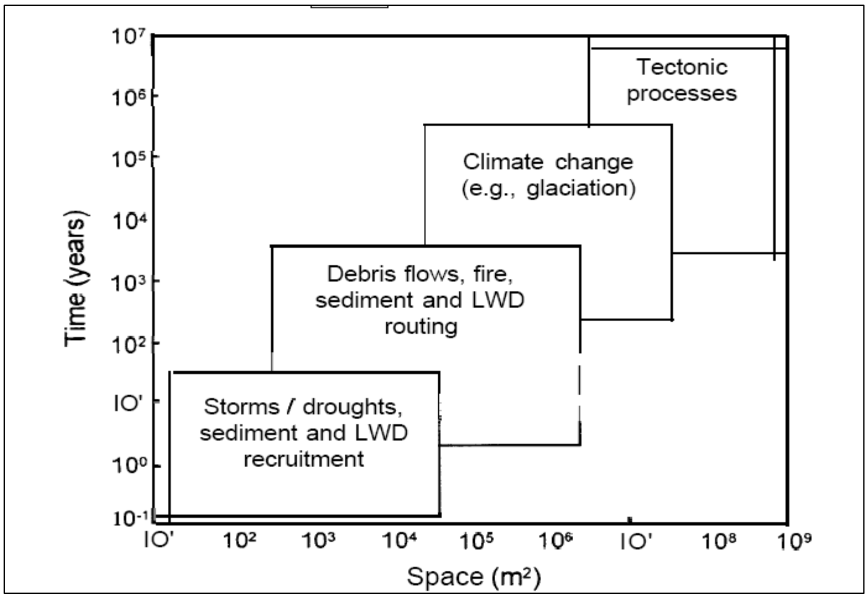

Figure 12. Influences on stream channels at a range of spatial and temporal scales (Montgomery and Buffington, 1998).

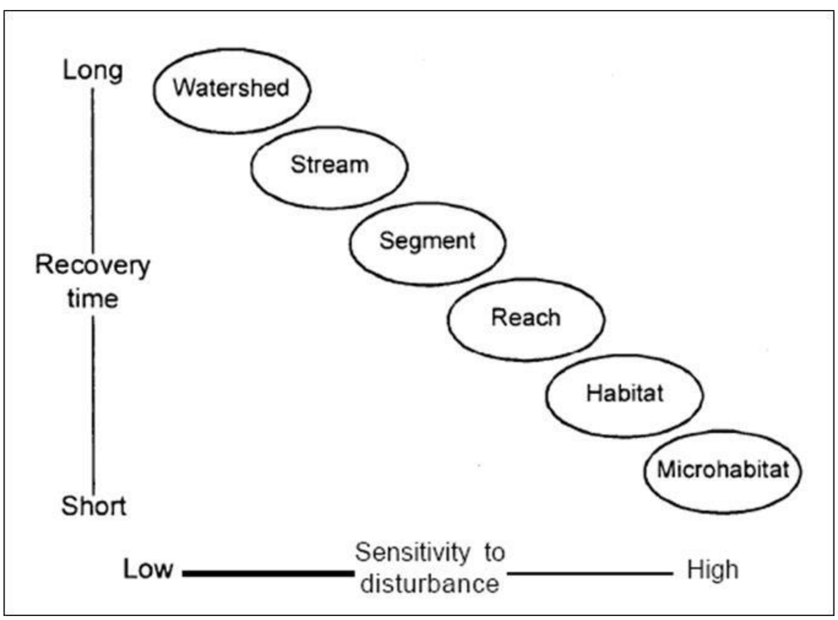

Figure 13. Relationship between sensitivity to and recovery from disturbance at different spatial scales
(Frissell et al. 1986, Naiman 1998, Naiman et al. 1992b).

Ecosystem Management

Management and conservation strategies (Holling and Meffe 1996, Dale et al. 2000), including those involving aquatic and riparian organisms (National Research Council 1996, Independent Multidisciplinary Scientific Team 1999), require consideration of large spatial and temporal extents and the conservation of biophysical processes rather than just the consideration of individual biological and physical elements (Rieman et al. 2015). In the case of many Federally-listed fish, this necessitates a continued transition from a focus on relatively small spatial scales with little or no consideration of temporal dimensions, to larger spatial extents (ecosystems and landscapes) over longer (i.e., 10 – 100 years) periods of time (Reeves et al. 1995, Poff et al. 1997, Naiman and Latterell 2005). Williams et al. (1989), for example, suggested better progress would be made on the delisting of ESA-listed fish species if recovery efforts would focus on restoration and conservation of ecosystem processes rather than individual habitat attributes. This view is supported by recent work of Rieman et al. (2015).

Factors to be considered in developing ecosystem management plans and policies include the frequency, magnitude, extent, duration (Pickett and White 1985, Hobbs and Huenneke 1992), and context of interacting disturbance regimes (including legacy effects) in managed ecosystems (Hobbs and Huenneke 1992, Reeves et al. 1995, Lindenmayer and Franklin 2002). The resilience of an ecosystem can be reduced if any of these factors are modified. Reduced resilience can lead to a decrease in the range of conditions that an ecosystem can experience, extirpation of some species, increases in species favored by available habitats, and an invasion of exotic species (Lugo et al. 1999, Levin 1974, Harrison and Quinn 1989, Hansen and Urban 1992). The effects of land management on the ecosystem depend on how closely the management disturbance regime resembles the natural disturbance regime with regard to these factors.

The focus of the ARCS on ecological processes and dynamics is well supported in the scientific literature. Ecosystems constantly change through time. They are not steady state and periodic disturbance is necessary to maintain the long-term productivity and integrity of an ecosystem (Lugo et al. 1999, Reeves et al. 2017). Based on recognition of ecosystem dynamics, a key focus of ecosystem management and the ARCS is maintaining or restoring ecological processes and resilience as opposed to attempting to maintain a desired set of static conditions through time (Dale et al. 2000). Ecosystem management also strives to maintain a variety of ecological states or patches in a desired spatial and temporal distribution (Gosz et al. 1999, Concannon et al. 1999).

Ehrenfeld (1992) supports these perspectives, noting that conditions in many ecological communities are in flux because of disturbance. This makes it difficult to determine a normal state. Applying fixed standards developed for ecological conditions at small spatial extents with the expectation of achieving constant conditions over large areas is likely to compromise or decrease the long-term productivity of ecosystems and can create false or unrealistic expectations about the outcomes of policies or regulations (Holling and Meffe 1996, Bisson et al.

1997, Caraher et al. 1999, Dale et al. 2000, Poole et al. 2003). As such, like the NWFP-ACS, the ARCS does not include relatively uniform and static quantitative management objectives for stream habitat attributes (e.g., pools per mile), known as Riparian Management Objectives, which were incorporated into the PACFISH and INFISH strategies. Instead, it includes a new Desired Condition (DC-4) for the dynamic distribution of aquatic habitat conditions in the population of watersheds on the Forests in the ARCS area to be similar to the changing distribution of conditions in comparable, reference condition watersheds or to other ecologically-relevant benchmarks. As described in Section 12, progress towards this Desired Condition will be assessed via broad-scale and Forest-scale monitoring programs. Moreover, those data along with other information can be used in watershed analysis as a diagnostic tool for assessing conditions in particular watersheds and their potential causes. Lastly, they can be used to more specifically describe desired conditions for individual watersheds (Section 10).

A variety of sources, including interested citizens, interest groups, scientific review and evaluation groups (e.g., the Independent Multidisciplinary Scientific Team 1999, National Research Council 1996), regulatory agencies, and policy- and decision-makers have called for development of policies and practices to manage the freshwater habitats of at-risk fish at ecosystem and landscape extents. ARCS responds to this need by improving on previous conservation strategies including focusing on broader and more varied spatial extents and longer timeframes.

Specifically, the ARCS combines “coarse filter” (ecosystem diversity) and “fine filter” (species diversity) approaches to the management, conservation, and restoration of aquatic and riparian ecosystems over a continuum of spatial scales (Groves 2003, Poiani et al. 2000). Since the inception of the coarse/fine filter concept for conserving biological diversity (The Nature Conservancy 1982), there has been an evolution in its interpretation and application. Originally, reserves were viewed as an efficient coarse filter approach to conserving biodiversity by protecting 85-90% of all plant and animal species. The complementary fine filter approach focused on conserving individual rare or specialized species that “slip” through the coarse filter and are not necessarily protected in reserves (Noss 1987, Hunter 1991).

The coarse filter has evolved to a concept of conserving species diversity by providing adequate representation (distribution and abundance) of ecological land units, considering the historical range of variability based upon an understanding of natural disturbance regimes (Haufler et al. 1996). This coarse filter approach does not necessarily prescribe reserves, but rather recognizes ecological processes and provides for a dynamic distribution of ecological units across the landscape over time. Fine-filter assessments of individual species (e.g., species of conservation concern) are conducted to evaluate whether a sufficient amount and distribution of habitat is provided under the coarse filter strategy. Thus, a coarse filter strategy has been viewed both as a reserve system and as an approach to managing dynamic landscapes, considering natural disturbance regimes. **ARCS INCORPORATES BOTH OF THESE COMPONENTS TO ENSURE THAT MANAGEMENT ACTIVITIES HELP TO MOVE THE LANDSCAPE TOWARD DESIRED CONDITIONS AT MULTIPLE SCALES.**

Spatial Scales for Watershed and Aquatic Ecosystem Management

Effective watershed and aquatic ecosystem management requires analysis, planning and action across a range of spatial scales. The national Watershed Boundary Dataset[4] provides a consistent hierarchal basis for this. The spatial scales most relevant to the ARCS are: river basin (6-digit hydrologic unit, HU), subbasin (8-digit HU), watershed (10-digit HU), subwatershed (12-digit HU), drainage, and site (Figure 14). These terms are used throughout ARCS.

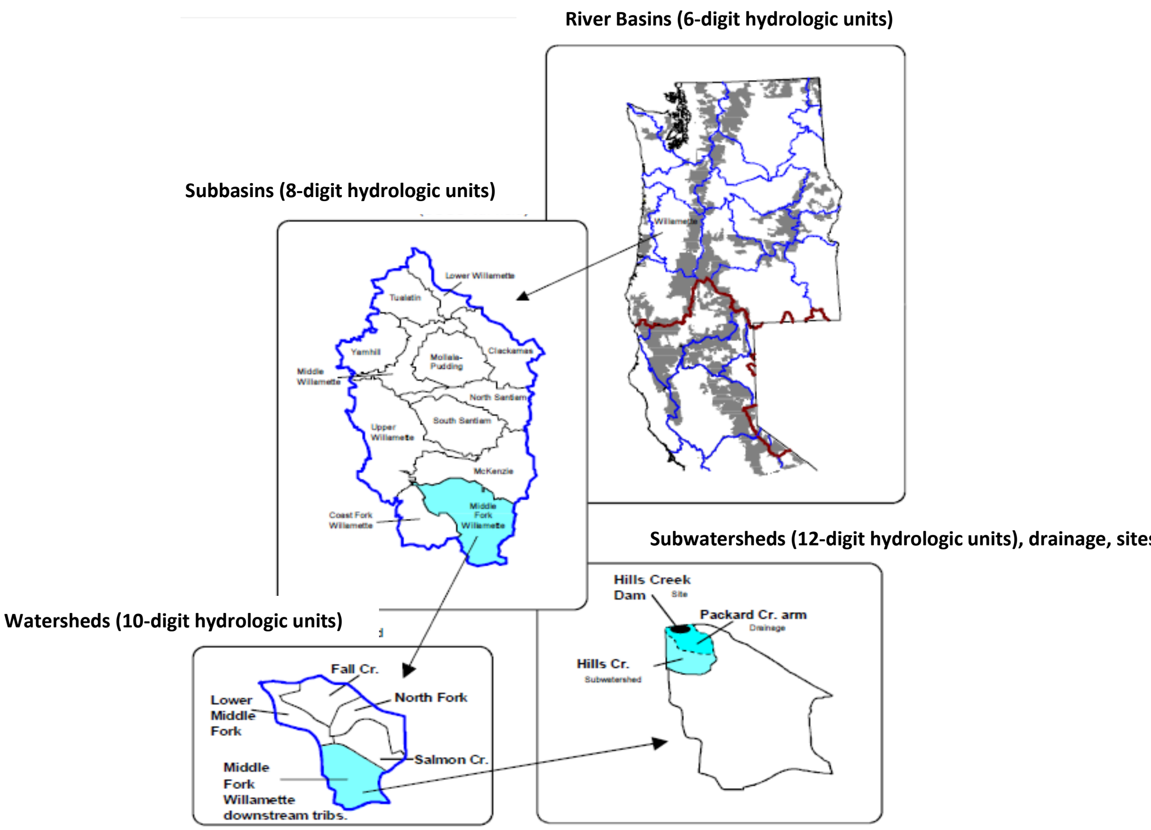

Figure 14. A hierarchy of spatial scales and terms for managing watersheds and aquatic and riparian resources.

Aquatic populations have been classified in a manner consistent with the watershed-scale definitions. Bull Trout core populations (Whitsell et al. 2004) and anadromous fish populations, for example, have been generally identified at subbasin scales. In addition, Bull Trout local populations and anadromous fish major and minor spawning areas are generally defined by watersheds or subwatersheds.

[4] http://nhd.usgs.gov/wbd.html

Riparian Area Management

Protection and restoration of riparian areas is central to achieving ARCS goals and objectives. Riparian management strategies differ substantially across the United States and within the Pacific Coastal region (Lee et al. 2004, Everest and Reeves 2007). Key differences include the type and size of riparian areas identified for protection or restoration, management goals for them, the kinds of activities that are or are not permissible, and the nature of management direction used to guide or constrain those activities.

The ARCS approach to riparian area management involves designation of relatively large default RMAs to protect and restore water quality, a wide range of aquatic and terrestrial habitats and species, and critical ecological processes (Section 8). **Watershed analysis can be used to adjust these default RMA widths in particular watersheds (Section 10).** The scientific basis for this approach was originally provided in FEMAT (1993) and later supported by Everest and Reeves (2007), who concluded that there was no scientific evidence that either the default prescriptions or the options for watershed analysis in the NWFP provide more protection than necessary to meet stated riparian management goals.

Importantly, RMAs are not "no-touch" reserves. Instead, management activities designed to benefit aquatic and riparian-dependent resources and move watersheds toward desired conditions are allowed and encouraged within them. Furthermore, while ARCS default RMA widths are uniform, the management of them is not intended to be. Instead, a wide range of management activities, that may involve highly-varied prescriptions, are expected to occur within RMAs. Activities within and influencing RMAs are to be planned and implemented based on watershed and/or site-scale analyses that lead to project-specific plans that prescribe the types, locations, spatial extent, and timing of the activities. Prescriptions must meet applicable standards and guidelines. This approach recognizes that effective project designs, including identification of both treated and untreated areas, depend upon objectives and local landscape context (Richardson et al. 2012).

Advances in science continue to provide new insights to help inform watershed and project-level plans for activities in RMAs. Recent scientific syntheses related to ESA-consultation in western OR (USDA Forest Service et al. 2013), for example, provide information about the potential effects of forest thinning on stream temperature, large woody debris, and terrestrial wildlife species. Other recent work (e.g., Benda et al. 2015, Olson et al. 2014, and Olson and Burton 2014, Reeves et al. 2016) provides additional science that can be used to plan and implement management activities in RMAs to help achieve desired conditions.

The management approach adopted in ARCS differs substantially from other strategies (e.g., state riparian protection laws) that often have different management goals, specify smaller riparian management areas, and/or contain more prescriptive and uniform regulatory standards across broad, diverse areas. It is consistent, however, with recent trends away from simple, uniform standards and prescriptions, towards more complex guidelines that are planned and implemented at larger, watershed scales (Lee et al. 2004).

New Threats

Two threats, climate change and invasive species, have emerged as major issues since NWFP-ACS, INFISH, and PACFISH were first developed in the early to mid-1990s (Reeves et al. 2017). The following section describes these threats and the ways in which ARCS addresses them.

IMPORTANTLY, THESE RISKS AND UNCERTAINTIES DO NOT SUGGEST A NEED TO CHANGE THE BASIC STRUCTURE AND COMPONENTS OF THE ARCS. Instead, they reinforce and amplify the need for this landscape scale, process-based strategy and it's associated monitoring and adaptive management (Seavey et al. 2009, Furniss et al. 2010, Reeves et al. 2017). As described below, these threats will also influence the details of the implementation of ARCS at subbasin, watershed, and site scales (Furniss et al. 2010, Rieman and Isaak 2010, Perry et al. 2015).

CLIMATE CHANGE

Science conducted since the existing strategies were developed has greatly advanced understanding of the potential ecological effects of climate change. As described below, it will likely have major implications for water resources, native fish, and aquatic ecosystems. Importantly, however, the magnitude of likely effects and the sensitivity of affected resources varies substantially across the landscape and not all anticipated effects are negative. In addition, the magnitude of other anthropogenic impacts (including legacy impacts) may be much greater than climate impacts (ISAB 2007).

Climate change will likely diminish winter snowpacks and cause runoff to occur earlier in the spring (Mote et al. 2003a and 2003b). This could impact species whose migration to the ocean is timed to coincide with plankton blooms (Pearcy 1997). Winter floods are also likely to increase, but the degree of change will vary substantially between different areas. Safeeq et al. (2015), for example, concluded that temperature-induced changes in snowpack dynamics may result in large (>30–40%) increases in peak flow magnitude in some locations, principally the Cascade, Olympic, and Blue Mountains and parts of the western edge of the Rocky Mountains. Smaller effects, however, are expected in lower elevation areas and in the rain-dominated Oregon Coast Range.

More frequent severe floods may increase fish egg mortality in the bed of streams due to gravel scour. These effects, however, are unlikely to extirpate entire populations of salmonids because, while scour magnitude may increase, the frequency of these events relative to typical salmonid life cycles is relatively low (Goode et al. 2013). In addition, not all streams are particularly sensitive to these effects. Unconfined portions of the stream network, for example, are less susceptible to increased scour than those in confined valleys because overbank flows can spread across floodplains (Goode et al. 2013, Sloat et al. 2016).

Summer base flows will likely decline as a result of smaller snowpacks, earlier and faster runoff, and increased summer evapotranspiration (Wenger et al. 2010, Safeeq et al. 2014). This may shrink the network of perennially flowing streams and thus force fish into smaller channels and less diverse habitats (Battin et al. 2006, ISAB 2007). Summer water temperatures may increase as a result of these lower flows and increasing downwelling radiation resulting from warmer air temperatures and increased atmospheric emissivity (Luce et al. 2014). Warmer water temperatures could increase physiological stresses and potentially lower growth rates. Summer peak temperatures may approach or exceed lethal levels for salmon and trout (Crozier and Zabel 2006, ISAB 2007, Crozier et al. 2008, Isaak et al. 2012). Higher temperatures will also favor species that are better adapted to warmer water, including potential predators and competitors (Reeves et al. 1987, Reese and Harvey 2002). The thermal sensitivity of different streams and rivers to climate warming varies, however. As such, the magnitude and consequences of stream temperature warming may differ substantially across the region (Luce et al. 2014, Isaak et al. 2015). Moreover, recent studies of long-term data in the Pacific Northwest show variable trends. Isaak et al. (2011), for example, observed increases in autumn, summer and winter stream temperatures. Arismendi et al. (2012), in contrast, examined stream data from a larger number of sites and different periods of record and found variable trends in stream temperature. They concluded that stream temperatures have increased at some minimally-altered sites in the Pacific Northwest (28-44%), decreased at others (22-33%) and showed no detectable trends at the remaining sites.

The frequency and extent of wildfires and forest pathogen and parasitic insect outbreaks is expected to increase in a changing climate. This, combined with larger floods, may improve habitat complexity in some ways, as a result of large wood recruitment and subsequent floodplain reconnection (ISAB 2007). These losses of forest cover, however, may further exacerbate the increases in stream temperature described previously (Luce et al. 2014).

Collectively, these effects have the potential to influence the distribution of fish populations. They could, for example, reduce population resilience to natural disturbances, particularly drought (Battin et al. 2006, ISAB 2007). Streams located high in watersheds that historically provided some of the best habitat may no longer be accessible to migratory fishes if snowpack is reduced, thus limiting available rearing areas and access to thermal refugia in summer. Even moderate climate-induced changes may significantly increase the risk of extirpating local populations of some salmonids (Rieman et al. 2007, ISAB 2007, Crozier et al. 2008). These problems will likely be exacerbated by remaining migration barriers found at surface water diversions and road crossings.

Because climate change will affect habitat in different ways and at different time scales, a diversity of conditions and habitat resiliency is needed for population stability (Crozier and Zabel 2006, ISAB 2007). Existing well-connected, high-elevation habitats on public lands will be important to supporting cold water fisheries as the climate continues to warm (Martin and Glick 2008). Isaak et al. (2015), for example, found that cold-water habitats in mountain streams are highly resistant to temperature increases and that many populations of cold-water species exist where they are well-buffered from climate change. As a result, there is hope that many native species dependent on cold water can persist this century and that mountain landscapes will play an important role in that preservation.

Maintaining and restoring these areas are a fundamental goals of the ARCS. The strategy incorporates numerous adaptive actions relevant to climate change. These include maintaining instream flows, reducing flood peaks by enhancing floodplain connectivity and disconnecting roads from streams, reconnecting isolated habitats by removing anthropogenic barriers, managing riparian forests to provide shade and other functions, and improving waters where aquatic habitats and water quality have been degraded (Seavy et al. 2009, Furniss et al. 2010). Importantly, some of these actions can reduce and, in some situations, more than offset the effects of climate change (Diabat et. al. 2016, Justice et al. 2017). Actual climate change impacts to aquatic ecosystems will be highly dependent on the degree to which these adaptation actions are strategically identified and implemented, now and in the future. Without them, aquatic habitats may become increasingly isolated, simplified, and less likely to recover after significant disturbance events.

These climate change impacts will be addressed in local Forest plans by tailoring the plan components and other plan content to reflect results of Forest-level climate change vulnerability assessments and adaptation strategies (e.g., Halofsky and Peterson, 2017). This may include selection of Key and Priority Watersheds, development of Forest plan objectives, and/or generation of standards and guidelines. Vulnerability assessments will utilize best available science to assess the impacts of changes in streamflows, stream temperatures, and disturbance regimes on water and aquatic resources. The map-based products summarized by Staab et al. (2015), for example, provide a basis for characterizing the relative magnitude and spatial and temporal variability of these effects across the landscape.

Invasive Species

Climate change effects will be compounded by those associated with the distribution of aquatic and terrestrial invasive species, which are likely to intensify in the future. For example, non-native species have invaded many water bodies on and off National Forest lands, dominating and, often replacing native fish populations. In some rivers downstream of NFS lands, nonnative predators such as Small Mouth Bass have been introduced and their presence has affected the abundance and distribution of native fish. Less developed areas have also been invaded by nonnative species. Introduced Brook Trout, for example, have replaced native trout populations in Wilderness headwater lakes and streams. With the increasing documentation of non-native aquatic and riparian plants on and off NFS lands, concerns are not limited to invasive animals. Japanese Knotweed, for example, can displace other riparian vegetation chemically and physically (crowding and shading). It then dies back with the first frost, exposing stream banks to erosive winter streamflow forces until they emerge again in the spring (Urgenson 2009).

The magnitude of these effects will depend on the particular invasive species, effectiveness of invasive species prevention and eradication programs, reinvasion rate of invasives after control actions are taken, and the speed with which native species reoccupy habitats previously dominated by the non-native species. Effective aquatic invasive species prevention and control will depend heavily on successful public awareness programs to prevent spread of new invasives on both public and adjacent private lands.

ARCS addresses these issues through inventory and monitoring, specific standards and guidelines focused on preventing or reducing the spread of invasive species, and watershed restoration. The Forests and Regions will continue to collaborate with the States and other partners in aquatic invasive species prevention and control.

6. ARCS and Forest Plans

ARCS will be implemented through its integration into Forest plans via plan components and other plan content. Specifically, elements of ARCS will be incorporated into a suite of five plan components to set goals **(desired conditions)**, identify areas where certain activities are or are not generally appropriate **(suitability of lands)**, provide a means of measuring progress towards achieving or maintaining desired conditions **(objectives)**, and constrain activities **(standards, guidelines)** to ensure protection of physical and biological resources. **Other plan content will be equally important in implementing ARCS. It will summarize results of a pre-revision assessment, identify management areas, outline a process for watershed analysis, describe a comprehensive watershed restoration strategy, and establish a framework for monitoring and adaptive management.**

Each part of the ARCS and its means of implementation are important. However, these individual elements should not be viewed in isolation. All parts of ARCS, the plan, and other plan content work together to guide and constrain management to achieve desired conditions.

Definitions for plan components and other plan content, as defined by 36 CFR 219.7, are provided below. Details regarding how they will be used to implement ARCS are provided in Sections 7-12.

Desired Conditions

Desired conditions are descriptions of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates.

Objectives

Objectives are concise, measurable, and time-specific statements of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets. They are what can be realistically achieved, not just a vision of what could be accomplished.

Standards

STANDARDS are mandatory constraints on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Guidelines

GUIDELINES are constraints on project and activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met (36 CFR 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Suitability of Lands

Specific lands within a plan area will be identified as suitable for various uses or activities based on the desired conditions applicable to those lands. The plan will also identify lands within the plan area as not suitable for uses that are not compatible with desired conditions for those lands. For example, some lands are not suitable for timber or livestock production and some rivers are not suitable for hydroelectric generation. The suitability of lands need not be identified for every use or activity. Suitability identifications may be made after consideration of historic uses and issues that have arisen in the planning process. Every plan must identify those lands that are not suitable for timber production (36 CFR 219.11).

Management Areas and Geographic Areas

Management areas are lands identified within the planning area that have the same set of applicable plan components. A management area does not have to be spatially contiguous.

Geographic areas are spatially contiguous lands identified within the planning area. A geographic area may overlap with a management area.

Other Plan Content

Besides plan components, other content must be included in plans. This **REQUIRED "OTHER PLAN CONTENT"** is specified at 36 CFR 219.7.

7. Pre-Revision Assessment

Background

36 CFR 219.6 requires an assessment for the development of a new plan or for a plan revision. **In addition, the Interior Columbia Basin Strategy (2014) and RIEC Framework (2011) recommends that results of multi-scale analyses, recovery plans for listed aquatic/riparian species, and restoration plans for impaired waters be used in plan amendments or revisions.** The Interior Columbia Basin Strategy further recommends that they be used to inform subsequent project-level decisions. A plan's set of documents is to describe how this was and will be done. Collectively, this section on assessment and Section 10 focused on watershed analysis, describe how the ARCS and Forest plans built upon it address these requirements.

Content and Use

The first phase of planning for a national forest or other comparable administrative unit of the NFS is assessment, followed by development, amendment, or revision of a plan, and monitoring (36 CFR 219.6). Assessments rapidly evaluate existing information about relevant ecological, economic, and social conditions, trends, and sustainability and their relationship to the land management plan within the context of the broader landscape. Responsible officials are to consider and evaluate existing and possible future conditions and trends of the plan area, and assess the sustainability of social, economic, and ecological systems within the plan area, in the context of the broader landscape.

The assessment phase should contribute to the planning phase by providing information to:

- identify the need for change in the plan development, amendment, or revision process; and
- develop potential plan components responsive to the need for change including desired conditions, objectives, standards, guidelines, suitability of lands, and other plan content.

Responsible officials are to identify and evaluate existing information relevant to the plan area for the following 15 topics, most of which are relevant to aquatic and riparian resources (36 CFR 219.6):

- terrestrial ecosystems, aquatic ecosystems, and watersheds
- air, soil, and water resources and quality
- system drivers, including dominant ecological processes, disturbance regimes, and stressors and the ability of terrestrial and aquatic ecosystems in the plan area to adapt to change
- baseline assessment of carbon stocks
- threatened, endangered, proposed, and candidate species, and potential species of conservation concern present in the plan area

- social, cultural, and economic conditions
- benefits people obtain from the NFS planning area (ecosystem services)
- multiple uses and their contributions to local, regional, and national economies
- recreation settings, opportunities, access, and scenic character
- renewable and nonrenewable energy and mineral resource
- infrastructure, such as recreational facilities and transportation and utility corridors
- areas of tribal importance
- cultural and historic resources and uses
- land status/ownership, use, and access patterns
- existing designated areas located in the plan area, including wilderness and wild and scenic rivers, and potential need and opportunity for additional designated areas.

Available Information

For Forests implementing ARCS, there are several key sources of information for aquatic and riparian resources that should be utilized in the assessment phase. These include, at minimum: (1) results of Step A (Assessment) of the National Watershed Condition Framework (WCF[5]), (2) existing watershed analyses, (3) status reviews/assessments and recovery plans for threatened, endangered, or sensitive species, (4) State assessments and management plans associated with water quantity and quality, (5) other Federal and State conservation assessments, strategies, and plans, (6) results of broad-scale monitoring programs (e.g., AREMP, PIBO), (7) transportation analyses, and (8) climate change vulnerability assessments and adaptation strategies.

In addition, as part of the assessment process, the contribution of NFS lands to the viability of a suite of aquatic and riparian species of conservation concern will be evaluated. As plan development progresses, this viability evaluation will be applied for the appropriate action alternatives during the environmental analysis phase of the NEPA process. For more information, refer to *Guidance for Evaluating Fish Viability on National Forest System Lands in the PNW Region* (USDA Forest Service, 2016b).

The assessment should be highly integrated, wherein findings associated with specific topics are synthesized with those associated with other relevant topics. For example, issues associated with riparian areas should address water quality and both terrestrial and aquatic ecosystems and species.

Additional Direction

More details regarding the assessment are provided in FSH FS1909.12, Chapter 10. Additional direction is under development.

[5] http://www.fs.fed.us/biology/watershed/condition_framework.html

8. Management and Other Areas

Forest plans will include the following management areas as part of other plan content: (1) Riparian Management Areas, and (2) Key Watersheds. In addition, other plan content will include a current list of Priority Watersheds. These areas are critical elements of the ARCS, as they are used to provide important direction for watershed and aquatic resource management. Each of these is described in detail in the following sections.

Riparian Management Areas

Consistent with 2012 Planning Rule requirements (36 CFR 219.8), RMAs will be identified for the plan area, as described in this section.

Definition and Purpose

RMAs are management areas and include portions of watersheds where water quality and aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies. RMAs are designated for all permanently flowing streams, lakes, wetlands, seeps, springs and intermittent streams, and unstable sites that may influence these areas. The emphasis of management is to maintain and restore the structure and function of these areas for the benefit of aquatic and riparian-dependent plant and animal species, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, and provide for greater connectivity within and between watersheds for both riparian and upland species. Management is also intended to maintain and restore water quality.

RMAs are used as the primary framework (coarse filter) that provides for ecosystem diversity by conserving biophysical processes at the landscape and watershed scales. RMAs provide travel and dispersal corridors for many riparian-dependent animals and plants and provide connectivity between geographically significant areas for both riparian and upland species. Management activities within RMAs maintain or enhance existing functional conditions or restore degraded conditions for aquatic and riparian-dependent species.

RMAs occur at the margins of standing and flowing water, intermittent stream channels, lakes, ponds, springs, and wetlands. They generally parallel the stream network and include areas necessary for maintaining hydrologic, geomorphic, and ecologic processes that influence riparian and aquatic systems. Unstable and potentially unstable areas in headwaters and along streams are primary source areas for coarse wood, fine and coarse particulate organic matter, and sediment (FEMAT 1993).

Management of RMAs focuses on ecological processes and conditions within and contributing to the physical and ecological health, function, and resiliency of these areas. Management activities within them contribute to moving toward, meeting, or maintaining desired conditions.

Designating RMAs

The following RMA widths will be specified in the Management/Geographic Area section of each Forest plan. These widths are identical to those in the NWFP-ACS. The scientific basis for them was originally provided in FEMAT (1993) and later supported by a review by Everest and Reeves (2007).

Fish-bearing streams - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.

Permanently flowing non-fish-bearing streams - RMAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Constructed ponds and reservoirs, and wetlands greater than 1 acre – RMAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.

Lakes and natural ponds - RMAs consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.

Seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre, and unstable and potentially unstable areas ***- This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RMAs will include:***

- ***The extent of unstable and potentially unstable areas (including earthflows).***
- ***The stream channel and extend to the top of the inner gorge.***
- ***The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class. Intermittent streams are defined as any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Including intermittent streams, springs, and wetlands within RMAs is important for full implementation of the ARCS.***

  Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. The extent of intermittent channels are also difficult to identify due to lack of continuity in bedform features. Fish-bearing intermittent streams are distinguished from non-fish-bearing intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams, or travel routes for fish emigrating from lakes. In these instances, the guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.

Key Watersheds

Reflecting the Interior Columbia Basin Strategy (2014) and RIEC Framework (2011), Key Watersheds will be identified for the plan area, as described in this section.

Definition and Purpose

Key Watersheds are management areas that either provide, or are expected to provide, high-quality habitat for aquatic and riparian species and/or provide high-quality drinking water to communities that depend upon USFS watersheds as their municipal water sources. Key Watersheds comprise a protected network of refugia and readily restorable watersheds throughout the ARCS area. They complement other protective land designations such as Wilderness, Wild and Scenic Rivers, Roadless, and older forest type designations.

Key Watersheds contribute to broad-scale ecosystem integrity and diversity (coarse-filter) by providing the ecological conditions needed to maintain diverse aquatic and riparian-dependent plant and animal communities and key ecological processes that sustain them. They also contribute to the protection of specific aquatic and riparian species (fine-filter). A network of Key Watersheds, managed to serve as refugia is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. In this case, at-risk stocks include threatened or endangered species or species of conservation concern. Refugia include areas of high-quality habitat as well as areas of degraded habitat that have high potential to develop into productive habitat. In the short term, they provide centers of fully functioning, high-quality, aquatic and riparian habitat and a starting point for longer term expansion of such habitats. Key Watershed networks should complement and support fish and water quality recovery plans. While Key Watersheds are designed primarily to provide high-quality habitat for fish species, other aquatic or riparian and upland species also benefit from the Key Watershed network. Management direction in Key Watersheds is intended to provide the highest relative level of protection and the lowest relative level of risk from activities potentially threatening their integrity and resiliency.

Research supports managing important watersheds more conservatively in terms of future risk and restoration (Buttrick et al. 2015). Conservation of meta-populations requires numerous patches of suitable habitat over time and the potential for dispersal among the patches (Harrison 1994). Where there is currently an insufficient number of high-quality habitat patches, it is important to protect existing high-quality patches in the near term (Frissell 1997). Minimizing or eliminating external threats increases the likelihood of persistence of these patches (Carroll and Meffe 1997). These areas will serve as sources of individuals to colonize new patches as they develop favorable habitat. Development of future patches of favorable habitat requires the protection or restoration of critical ecological processes creating favorable habitat over time (Carroll and Meffe 1997).

Key Watersheds provide a network of refugia at the population, ESU (Evolutionary Significant Unit), or Recovery Unit scale. The network is designed to provide species level conservation and restoration of habitat conditions to retain populations of valued aquatic and riparian plant and animal species in the short term, and contribute to recovery in the long term. The relative contribution to long-term conservation and recovery provided by the Key Watershed network will vary depending on species, habitat, and life history requirements and the quality and extent of habitat provided on NFS lands. Key Watersheds with high-quality habitat will serve as anchors for the potential, near-term recovery of depressed species. Those of lower quality habitat with high potential for restoration are expected to become future sources of high-quality habitat with the implementation of a comprehensive restoration program (see Section 11). Key Watersheds with readily restorable habitat contain Priority Watersheds for restoration action.

Designating Key Watersheds

Key Watersheds will be designated based upon their condition and their importance to aquatic and riparian species and/or for providing water for human communities. Key Watershed networks will be established at the ESU/Recovery unit scale for specific threatened or endangered or other valued aquatic and riparian-dependent species, and/or areas that provide high-quality water important to these populations and/or their habitats downstream, in order of relative priority.

Identification of Key Watersheds will consider proximity to other protective designations, connectivity between protective designations, potential investment of resources required to restore the watershed and habitat integrity, and biological diversity within the watershed. Other protective designations include Wilderness, Inventoried Roadless Areas, Natural Areas, old forest conservation areas, and Wild and Scenic Rivers. Together, they are intended to form a multi-designation network of areas with a protection and restoration emphasis established by Federal law and policy. Thoughtful designation of Key Watersheds relative to the location of these areas can aid the resiliency of valued species if they are able to migrate to and from the refugia established by the protective designations as a system across the landscape (Rieman and McIntyre 1995, Keppel et al. 2012). If these protective areas are sufficiently replicated, thoughtfully positioned across the landscape, and connected, they contribute to the resiliency of populations of aquatic, terrestrial, and riparian-dependent species as stochastic events impact populations and communities in various patches of the landscape through time.

A basic premise of restoration ecology is protecting and restoring the best first (Reeves et al. 1995, Frissel and Bayles 1996, USFS 2005, Beechie et al. 2008). Consideration should be given to the degree of investment required to restore a candidate watershed. The intent is to invest limited resources where they will make the most difference. In most cases, that would be restoring the best condition watersheds first, especially considering limited financial resources (FEMAT 1993, Roni et al. 2002). Habitat integrity (including a consideration of climate change effects) and biological diversity enhance the resiliency of the watershed and the species that live there (Pressey 2004, Keppel et al. 2012, Isaak et al. 2015). For example, a species such as Bull Trout will more likely persist in a watershed with quality habitat available now and under future climate change scenarios and with multiple life history patterns (resident and migratory patterns) exhibited in the population.

Viability assessments of aquatic species should be used to inform Key Watershed designations. In the USFS-Pacific Northwest Region, this process should be directed by Guidance for Evaluating Fish Viability on National Forest System Lands in the PNW Region (USDA Forest Service 2016b). Other tools, such as intrinsic potential models (Burnett et al. 2007) can also be used as part of the Key Watershed selection process. In addition, the

potential effects of climate change on streamflows, habitats and species will be considered when selecting Key Watersheds. This information will generally be developed through climate change vulnerability assessments and other available literature. Regional tools to support climate change vulnerability assessments are described in Staab et al. (2015).

Key Watersheds are to be positioned such that over time they can form the centers of a broadly connected network of high-quality watersheds that reduces the currently fragmented condition of many habitats for threatened or endangered animals and plants and other aquatic and riparian-dependent species. They are also selected to provide high-quality water important to aquatic biota or human communities downstream. Generally, the networks are expected to remain relatively unchanged for the life of the Forest plan. Adjustments may be necessary based on substantial, new information (e.g. populations and trends, life history characteristics and needs, distribution and use/nonuse of habitats) or new listings of species.

When Key Watersheds are designated because they are important to communities for their water source, their designation can be prioritized based upon the size of the community, the relative role NFS lands play in supporting that use, the location of the watershed in relation to other watershed conservation designations, and the presence of rare aquatic and riparian species.

Priority Watersheds for Restoration

Consistent with 2012 Planning Rule requirements (36 CFR 219.7), watersheds that are a priority for maintenance or restoration ("Priority Watersheds") will be identified for the plan area. Forests will use the Watershed Condition Framework (WCF), to develop and implement their watershed restoration programs in a structured, efficient and effective manner. The framework, which includes identification of Priority Watersheds, is summarized in Figure 15 and described in detail in Section 11.

Definition and Purpose

Priority Watersheds are the 12-digit hydrologic units (subwatersheds) in which near-term (e.g., 5-7 years) restoration programs and resources will be focused. Selection of these Priority Watersheds will be based on several criteria, as described in the following sections. Priority Watersheds will generally be a subset of the broader, longer-term Key Watershed network. Unlike Key Watersheds, Priority Watersheds will regularly change over time as essential restoration actions are completed in some watersheds and new Priority Watersheds are designated.

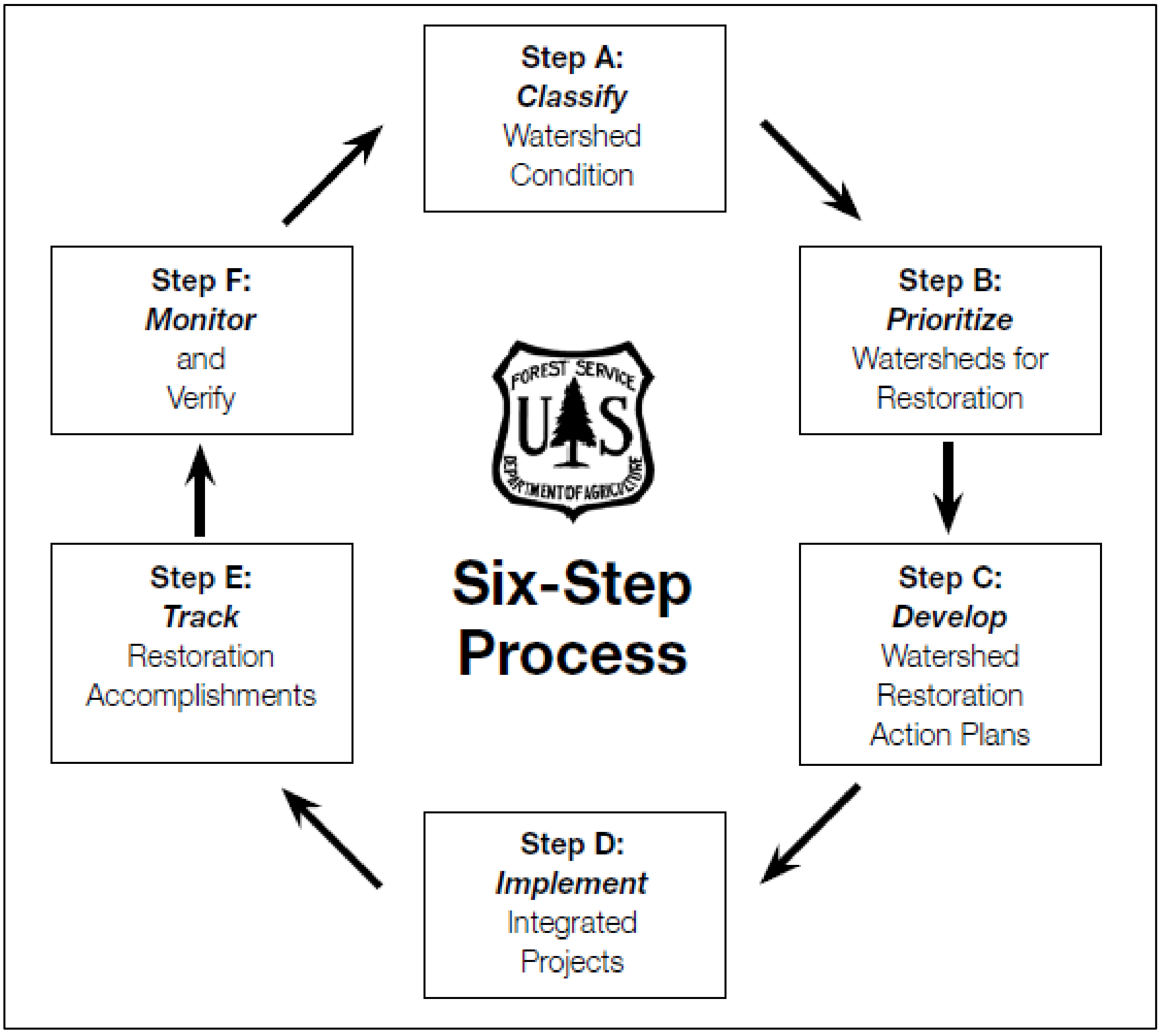

Figure 15. Watershed Condition Framework, a 6-step process for watershed restoration.

Designating Priority Watersheds

Forest plans will incorporate by reference the information contained on the WCF map viewer website[6]. That website will contain the current WCF Priority Watersheds and associated information.

The responsible official will select Priority Watersheds based on an interdisciplinary analysis and evaluation. In addition, the responsible official will reach out to local, State, Tribal, other Federal agencies, and interest groups when identifying priority watersheds (FSH 1909.12, chapter 20, section 22.31).

Criteria for selection include:

- ***the value of the watershed from a water/aquatic resource perspective;***
- ***existing watershed, water quality, and aquatic habitat conditions;***
- ***Key Watershed status;***
- ***alignment with other strategic objectives or priorities at National, Regional, or local levels;***
- ***alignment with priorities of other agencies and potential partners;***
- ***estimated costs and unit work capacity; and***
- ***technical, financial, and social opportunities and constraints.***

Priorities will generally focus on those watersheds that are in good to fair condition, but still require some restoration. Priority work includes actions to address immediate and long-term threats to the integrity and health of those watersheds. This approach, consistent with principles of conservation biology (FEMAT 1993, Roni et al. 2002), will enable watersheds to be restored with reasonable investments of time and funding. As with Key Watersheds, the potential effects of climate change and the efficacy of restoration treatments in ameliorating those and other effects (e.g., Diabat et al. 2016, Justice et al. 2017) should be considered in the selection of Priority Watersheds and subsequent identification of the scope and scale of needed restoration work.

[6] http://apps.fs.usda.gov/WCFmapviewer/

RELATIONSHIP WITH KEY WATERSHED NETWORK

Through WCF implementation since 2011, Forests in OR, WA and northwestern CA have already selected dozens of Priority Watersheds and planned and implemented restoration work in those areas (Figure 16). Consistent with their current Forest plans, Forests in the NWFP area have generally identified portions of the Key Watershed network as Priority Watersheds for restoration. ***As such, the Key Watershed network serves as a broad-scale, long-term (multiple decades or more) strategic network of watersheds focused on the conservation and restoration of aquatic and riparian ecosystems and water quality. Priority Watersheds are generally a subset of that broader network, wherein near-term (e.g., 5-7 years) restoration actions are focused. The Key Watershed network is expected to remain relatively unchanged during the life of the Forest plan, whereas the list of Priority Watersheds are expected to change fairly frequently (e.g., perhaps as frequently as every couple of years), depending on the scope of needed restoration work and the pace of its implementation.***

Forests will continue using this approach to achieve the long-term strategic goals (desired conditions) of the Forest plan, while facilitating near-term restoration planning and implementation at a finer spatial scale. Importantly, there are and may continue to be exceptions to this general principle. That is, responsible officials may identify Priority Watersheds outside of the Key Watershed network due to unique social, economic, or environmental conditions or opportunities.

CHANGING PRIORITY WATERSHEDS

As part of plan implementation, updates to a plan's Priority Watersheds may be made by administrative change at any time (FSH 1909.12, chapter 20, section 21.5). The responsible official shall give public notice before issuing an administrative change (36 CFR 219.13(c)(2)). The public notice may be made in any way the responsible official deems appropriate, except that at a minimum, the notice must be posted online on the administrative unit's planning website. After reviewing any comments on the proposed change, the responsible official may make the change effective by posting it online and at the WCF map viewer. Administrative changes are not subject to the objection process (36 CFR 219.50).

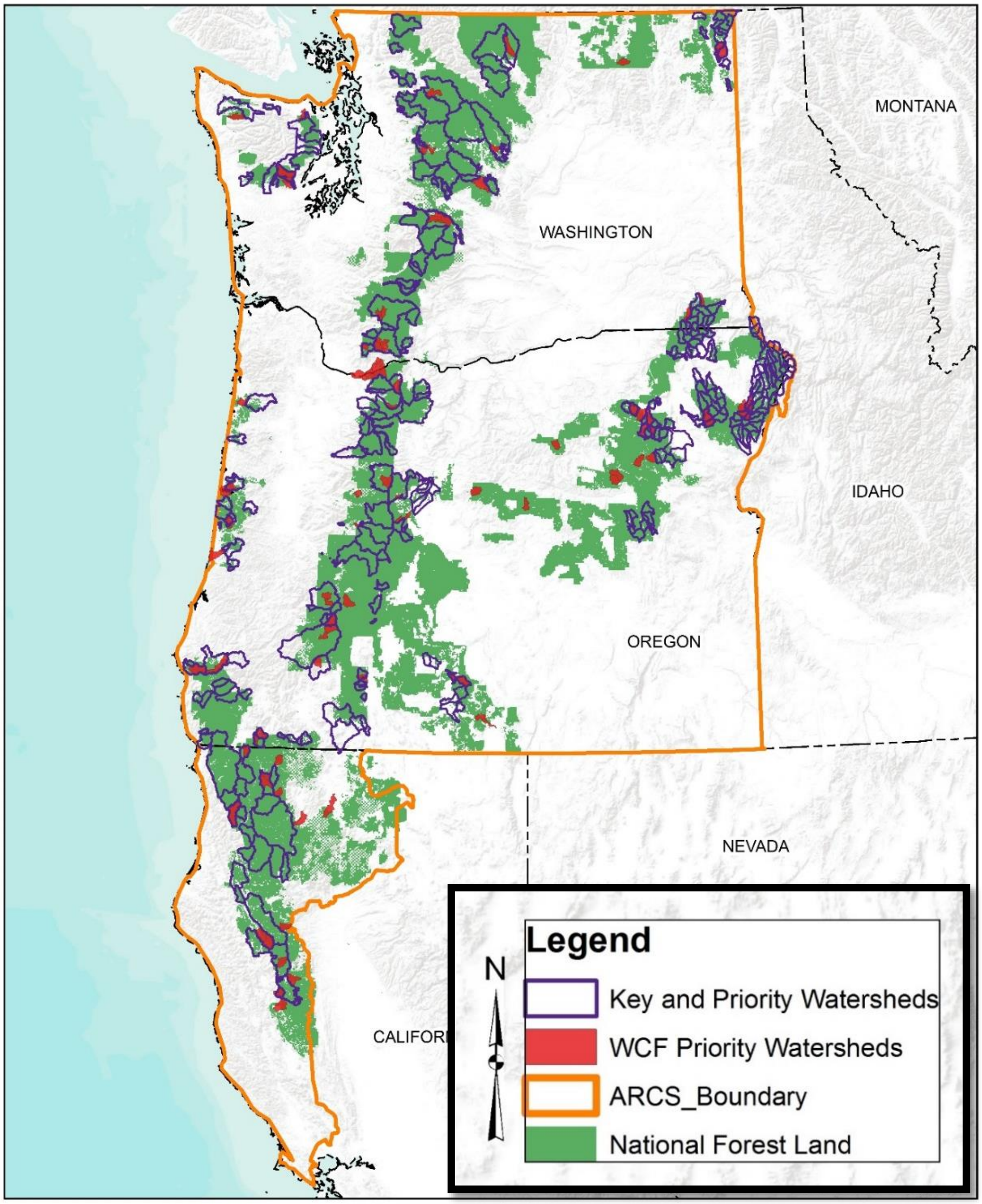

Figure 16. Existing Key Watershed network for the NWFP-ACS and PACFISH strategies and Priority Watershed network for INFISH. Existing Priority Watersheds for WCF are also shown.

The Key and Priority Watershed networks identified in NWFP-ACS, PACFISH and INFISH are the long-term focus for watershed and aquatic resource protection and restoration. WCF Priority Watersheds are the near-term (e.g., 5-7 years) focus for active restoration. Through Forest plan revision and implementation, an integrated network of Key Watersheds and WCF Priority Watersheds will be developed and/or refined throughout the area to which ARCS applies. As such, like areas under NWFP and PACFISH direction, areas currently implementing INFISH will eventually have both Key Watersheds and WCF Priority Watersheds.

9. Plan Components

MULTIPLE PLAN COMPONENTS WILL BE USED TO IMPLEMENT ARCS VIA FOREST PLANS, AS DESCRIBED IN THIS SECTION. These plan components include desired conditions, suitability, objectives, and standards and guidelines, as defined in Section 6. **OTHER PLAN CONTENT (E.G., WATERSHED ANALYSIS, RESTORATION, MONITORING AND ADAPTIVE MANAGEMENT) WILL BE EQUALLY IMPORTANT IN IMPLEMENTING ARCS.**

Desired Conditions

The desired conditions described in this section apply at larger (e.g., watershed) scales, not at the site scale. The national hydrologic unit (HU) is the basis for defining the specific scales at which the general Forest-wide desired conditions apply. The three watershed scales most relevant to implementation of the Forest plan are: subbasin (8-digit HU), watershed (10-digit HU), and subwatershed (12-digit HU). Individual project assessments often use data collected at finer scales such as the subwatershed, drainage, valley segment, stream reach, or site scale (Figure 14).

During Forest plan revision, more detailed desired conditions may be developed, as needed, using information from existing watershed analyses, broad-scale assessments and other analyses.

FOREST-WIDE DESIRED CONDITIONS FOR ECOSYSTEMS, WATERSHEDS, AND RMAS

Desired conditions for all National Forest System lands are described below. The scale(s) at which these generally apply to Forest planning and project planning are identified after each desired condition.

Consistent with the inherent capability of the plan area (36 CFR 219.8), National Forest System lands provide:

DC-1. the distribution, diversity, and complexity of watershed and landscape-scale features, including natural disturbance regimes, that support the aquatic and riparian ecosystems to which species, populations, and communities are uniquely adapted. (Subbasin scale for Forest planning and watershed or subwatershed scale for project planning.)

DC-2. spatial connectivity within or between watersheds where appropriate. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals. They also provide access to refugia in some areas within the landscape while

other areas are disturbed by stochastic events such as floods, landslides, and fires. (Subbasin scale for Forest planning, watershed and subwatershed for project planning)

DC-3. ecological conditions capable of supporting self-sustaining populations of native and desired non-native aquatic and riparian-dependent plant and animal species, including species listed as threatened or endangered under the Endangered Species Act. (Subbasin scale for Forest planning and watershed or subwatershed scale for project planning.)

DC-4. aquatic habitats in which the dynamic distribution of conditions (e.g., bank stability, substrate size, pool depths and frequencies, channel morphology, large woody debris size and frequency) in the population of watersheds on the Forest is similar to the dynamic distribution of conditions in the population of comparable, reference condition (least human disturbance) watersheds or to other ecologically-relevant benchmarks. (Subbasin, Basin, aquatic province or other appropriate scale for both Forest and project planning.)

DC-5. water quality necessary to support healthy riparian, aquatic, and wetland ecosystems and other State-designated beneficial uses of water. Water quality maintains the biological, physical, and chemical integrity of the system and benefits the survival, growth, reproduction, and migration of species composing aquatic and riparian communities. (Subbasin or watershed scale for both Forest planning and project planning.)

DC-6. a sediment regime under which aquatic and riparian ecosystems evolved. The sediment regime (including the timing, volume, rate, and character of sediment input, storage, and transport) supports healthy watershed functions. (Subbasin or watershed scale for both Forest planning and project planning.)

DC-7. in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, heat, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of high and low flows are retained. (Subbasin or watershed scale for forest and project planning.)

DC-8. the timing, variability, and duration of floodplain inundation within the natural range of variation. (Watershed or subwatershed scale for both Forest planning and project planning.)

DC-9. flow regimes and water elevations in wetlands, seeps, springs and other groundwater-dependent ecosystems that support the structure and function of those systems. (Watershed or subwatershed scale for both Forest planning and project planning.)

DC-10. the species composition and structural diversity of native plant communities in riparian management areas, including wetlands, that provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and supply amounts and distributions of coarse woody debris and fine particulate organic matter sufficient to sustain physical complexity and stability. (Subbasin or watershed scale for Forest planning and watershed or subwatershed scale for project planning.)

DC-11. native assemblages of riparian-dependent plants and animals free of persistent noxious and undesirable non-native species, disease, and pathogens. (Watershed scale for both Forest and project planning.)

DC-12. aquatic and riparian ecosystems resilient to the effects of climate change and other major disturbances. (Subbasin scale for Forest planning and watershed scale for project planning.)

DC-13. key riparian processes and conditions, including slope stability and associated vegetative root strength, wood delivery to streams and within the RMAs, input of leaf and organic matter to aquatic and terrestrial systems, solar shading, microclimate, and water quality, operating consistently with local disturbance regimes. (Subbasin scale for Forest planning and watershed or subwatershed scale for project planning.)

DC-14. road networks posing limited risk to riparian and aquatic resources. (Watershed scale for both Forest and project planning).

Desired Conditions for Key Watersheds

Consistent with the inherent capability of the plan area (36 CFR 219.8), Key Watersheds:

DC-15. serve as a network of watersheds with high-quality habitat and functionally intact ecosystems contributing to and enhancing recovery of threatened or endangered aquatic species and aquatic and riparian-dependent species of conservation concern and the provision of large volumes of high-quality water. The networks contribute to short-term conservation and long-term recovery of at-risk species at the appropriate population scales. (Subbasin or watershed scale, dependent upon species or population of interest)

DC-16. produce high-quality water for downstream ecological communities (including human communities) dependent upon them. (Watershed scale for both Forest and project planning).

DC-17. have high watershed integrity and have aquatic and riparian ecosystems resilient to stochastic disturbance events such as wildfires, floods, and landslides. (Watershed scale for both Forest and project planning).

Suitability

Riparian Management Areas

One objective of land management plans is to identify land areas that are generally suitable and unsuitable for various uses. The identification of areas generally suitable for various land uses involves social, economic, and ecological considerations. Suitability of areas must be consistent with their desired conditions.

RMAs are unsuitable for:

- **new facilities, except those needed for resource protection or those that inherently must be in RMA's;**
- **new designated motorized use areas, except at road or trail stream crossings;**
- **scheduled timber production; and**
- **waste and disposal areas.**

Objectives

Watershed Restoration

Forests will establish watershed restoration objectives for conditions that pose substantial risk and consequence to the maintenance or attainment of aquatic and riparian desired conditions. These restoration objectives should be informed by existing watershed analyses and ESA recovery plans and water quality restoration plans, including those associated with waters listed as impaired under the Clean Water Act. The management actions to meet these objectives should be achievable within the life of the plan (e.g., 10 -15 years) and should include necessary changes to management actions that have caused the impacts to be addressed.

Specifically, Forest Plan objectives for individual restoration treatments should be developed that outline the general scope/magnitude, general location, timing, sequencing, and integration needs of projected treatments. Treatments could include, but are not limited to, the following:

- **soil and water resource improvements**
- **fish passage improvements**
- **instream habitat improvements**
- **riparian/floodplain treatments**
- **road and trail improvements focused on watershed and aquatic resources**
- **road storage treatments and road decommissioning**
- **improvements at developed or dispersed recreation and other administrative facilities**
- **rangeland improvements**

- **invasive species treatment**
- **reconnection of side channels and floodplain environments**

These objectives for individual restoration treatments should be specified at the Forest-wide scale and at the Key Watershed network scale. In addition, Forests should develop objectives for the number of watersheds to be improved, per the WCF process (Section 11), during the life of the plan.

In developing objectives, the highest priorities for restoration include the removal of major factors impairing and posing risks to the integrity/resiliency of watersheds and riparian and aquatic ecosystems.

Standards and Guidelines

This section outlines ARCS Standards and Guidelines, as defined in Section 6. They are organized into groups of similar activities. Many of these are based on those contained in the NWFP, PACFISH and INFISH. However, for the reasons described in Section 4, ARCS also contains some modified and new Standards and Guidelines.

Many of these standards and guidelines include phrases such as "maintain", "restore", "move towards", "contribute to" and "not retard or prevent attainment of" ARCS aquatic and riparian desired conditions. These important phrases define the context for agency development, review and implementation of management activities. Implementing ARCS-related plan direction means that the agency is managing aquatic and riparian-dependent resources to maintain the existing condition or implementing actions to restore conditions.

The standards and guidelines are designed to focus the development and review of proposed and certain existing projects to determine compatibility with ARCS aquatic and riparian desired conditions. The intent is to ensure that a decision-maker makes a finding that proposed management activities are consistent with these desired conditions. This finding will be based on project analysis, available watershed analysis, and other relevant analysis and information at multiple scales. The analysis must include a description of the existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability. Management actions that do not maintain the existing condition or lead to improved conditions in the long term would not "meet" the intent of the ARCS and thus, should not be implemented. Improvement relates to restoring biological and physical processes within their ranges of natural variability.

General Watershed Management

Standard WM-1[7]. When aquatic and riparian desired conditions are being achieved and watersheds are functioning properly, projects shall maintain[8] those conditions. When aquatic and riparian desired conditions are not yet achieved or watersheds are not functioning properly and to the degree that project activities would contribute to those conditions, projects shall restore or not retard attainment of desired conditions. Short-term adverse effects from project activities may be acceptable when they maintain or do not retard attainment of aquatic and riparian desired conditions. Exceptions to this standard include situations where Forest Service authorities are limited (examples include Alaska National Interest Lands Conservation Act {ANILCA}, 1872 Mining law, valid state water right, etc.). In those cases, project effects that retard attainment of desired conditions shall be minimized to the extent possible.

Standard WM-2. All projects shall be implemented in accordance with Best Management Practices, as described in National and/or Regional Technical Guides.

Guideline WM-3. Prevent the spread of botanical and aquatic invasive species when withdrawing, transporting, and using equipment. Inspect equipment with the potential of coming into contact with invasive species and, if necessary, clean it of organic and inorganic debris prior to use.

General Riparian Management

Standard RA-1. Riparian Management Areas include portions of watersheds where aquatic and riparian-dependent resources receive primary management emphasis. When aquatic and riparian desired conditions are being achieved and RMAs are functioning properly, projects shall maintain[8] those conditions. When aquatic and riparian desired conditions are not yet achieved and/or RMAs are not functioning properly, and to the degree that project activities would contribute to those conditions, projects shall restore or not retard attainment of aquatic and riparian desired conditions. Short-term adverse effects from project activities may be acceptable when they maintain or do not retard attainment of aquatic and riparian desired conditions. Exceptions to this standard include situations where Forest Service authorities are limited (examples include Alaska National Interest Lands Conservation Act {ANILCA}, 1872 Mining law, valid state water right, etc.). In those cases, project effects that retard attainment of RMA desired conditions shall be minimized to the extent possible.

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[7] Watershed Condition Framework Technical Guide (USDA Forest Service, 2011b), subsequent versions and/or comparable methods can be used to assist in guiding implementation of this standard. This information can be refined with other broad-scale or local inventory, assessment and monitoring data and most importantly, project-level analysis.

[8] See glossary for definitions of the terms “maintain”, “restore”, and “retard attainment”.

Standard RA-2. **Apply herbicides, insecticides, piscicides, other toxicants, and other chemicals only to maintain, protect, or enhance aquatic and riparian resources or to restore native plant communities.**

Standard RA-3. **Trees felled for safety shall be retained onsite unless in excess of what is needed to achieve aquatic and riparian desired conditions. If the desired quantity and size distribution of large wood has been met on site, the wood can be transported to other aquatic and riparian restoration projects.**

Standard RA-4. **Water drafting sites for forest management activities including road maintenance and fire management shall be located and managed to minimize adverse effects on stream channel stability, sedimentation, temperature, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat. To prevent the spread of invasive species, drafted water should not be discharged into other water bodies.**

Standard RA-5. **Fish habitat and water quality shall be protected when withdrawing water for administrative purposes. When drafting, pumps shall be screened at drafting sites to prevent entrainment of aquatic species, screen area shall be sized to prevent impingement on the screens, and pumps shall have one-way valves to prevent back-flow into streams. Use appropriate screening criteria where listed fish or critical habitat are present.**

Standard RA-6. **Wherever possible, storage of petroleum products and refueling will occur outside of RMAs. If refueling or storage of petroleum products is necessary within RMAs, these operations will be conducted no closer than 100 feet from waterways. Refueling shall occur with appropriate containment equipment and a spill response plan in place.**

TIMBER MANAGEMENT

Standard TM-1. **Timber harvest and other silvicultural practices shall occur in RMAs only as necessary to attain desired conditions for aquatic and riparian resources. Vegetation in RMAs will not be subject to programmed timber harvest.**

Standard TM-2. **Fuelwood cutting shall not be authorized in RMAs unless specifically designed to attain aquatic and riparian desired conditions.**

Guideline TM-3. **New landings, designated skid trails, staging, and decking shall not occur in RMAs, unless they are associated with projects designed to improve RMA conditions. These features shall be of minimum size, be located outside the active floodplain, and minimize negative effects to large wood recruitment, bank integrity, stream shade, and sediment levels.**

Standard TM-4. **Yarding activities shall achieve full suspension over wet and dry stream channels.**

Guideline RF-1. Avoid new permanent road construction in RMAs except where:

a) **necessary for stream crossings.**
b) **a road relocation contributes to attainment of aquatic and riparian desired conditions.**
c) **reconstruction of an existing road cannot avoid areas with high risk for shallow rapid landslides. In those situations, road reconstruction shall include mitigation measures that reduce risk (e.g., retaining wall construction, improved drainage, vegetative improvements).**
d) **avoidance of deep-seated earthflows is not possible. In those situations, avoid overloading the terrain with additional weight (e.g., fill), undercutting toe-slopes, or altering surface and groundwater flows in ways that can destabilize or accelerate movement of the area.**
e) **Forest Service authorities are limited by law or regulation.**

Standard RF-2. Temporary roads in RMAs shall be minimized. Temporary roads shall be managed to protect and restore aquatic and riparian desired conditions.

Guideline RF-3. Locate roads to minimize delivery of water and sediment from roads to streams.

Guideline RF-4. Avoid or minimize disruption of natural hydrologic flow paths, including interception of surface and subsurface flow when constructing or reconstructing roads or landings.

Guideline RF-5. Avoid routing road drainage onto potentially unstable channels, fills, and hillslopes.

Standard RF-6. Prohibit side-casting unconsolidated earthen waste materials associated with road construction or maintenance into RMAs.

Guideline RF-7. Except where needed to construct or replace stream crossings, avoid placing fill material or organic debris in RMAs unless it is intended to benefit aquatic and riparian-dependent species.

Standard RF-8. At a minimum, all new or replaced permanent stream crossings shall accommodate at least the 100-year flood and its bedload and debris. 100-year flood estimates will reflect the best available science regarding potential effects of climate change.

Standard RF-9. Where physically feasible, construction or reconstruction of stream crossings shall be designed to prevent the diversion of streamflow out of the channel and down the road in the event of crossing failure. Where avoidance is not possible, minimize the potential effects of crossing failure.

Standard RF-10. Construction or reconstruction of stream crossings shall provide and maintain passage for all life stages of all native and desired non-native aquatic species and for riparian-dependent organisms where connectivity has been identified as an issue. Crossing designs shall reflect the best available science regarding potential effects of climate change on peak flows and low flows.

Standard RF-11. Fish passage barriers shall be retained where they restrict undesirable non-native species access.

Standard RF-12. In Key Watersheds and in subwatersheds with ESA critical habitat for aquatic species that are functioning properly[9] with respect to roads, there will be no net increase (at least one mile of road-related risk reduction for every new mile of road construction) in system roads that affect hydrologic function. In Key Watersheds and in subwatersheds with ESA critical habitat for aquatic species that are functioning-at-risk or have impaired function with respect to roads, there will be a net decrease (two miles of road-related risk reduction for every new mile of road construction) in system roads that affect hydrologic function. Treatment priority shall be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems. Road-related risk reduction will occur prior to new road construction unless logistical restrictions require post-construction risk reduction.

Grazing Management

Standard GM-1. Manage livestock grazing to attain aquatic and riparian desired conditions. Where livestock grazing is found to prevent or retard attainment of aquatic and riparian desired conditions, modify grazing practices (such as number of livestock, timing, and physical structures). If adjusting practices is not effective, remove livestock from that area using appropriate administrative authorities and procedures.

Standard GM-2. New and replaced livestock handling and/or management facilities and livestock trailing, salting, and bedding are prohibited in RMAs unless they do not prevent or retard attainment of aquatic and riparian desired conditions.

[9] Per definitions for “functioning properly”, “functioning-at-risk”, and “impaired function” in Watershed Condition Framework Technical Guide (USDA Forest Service 2011b) and/or subsequent versions. Other broad-scale and local inventory, assessment and monitoring data and information can be used to refine initial classifications made per WCF.

Guideline GM-3. The purpose of this guideline is to manage livestock grazing to help attain and maintain aquatic and riparian desired conditions over time. Specifically, it is intended to maintain or improve vegetative and stream conditions, help ensure the viability of aquatic species, provide important contributions to the recovery of ESA-listed species, and facilitate attainment of State water quality standards.

The annual livestock use and disturbance indicators described below should be applied to help achieve, over longer timeframes, conditions at site and watershed scales that enable attainment and maintenance of desired conditions. The values specified below are starting points for management. Only those indicators and numeric values that are appropriate to the site and necessary for maintaining or moving towards desired conditions should be applied.[10] Specific indicators and indicator values should be prescribed and adjusted, if needed, in a manner that reflects existing and desired conditions and the natural potential of the specific geo-climatic, hydrologic and vegetative setting in which they are being applied[11]. Indicators and indicator values should be adapted over time based on long-term monitoring and evaluation of conditions and trends. Alternative use and disturbance indicators and values, including those in current ESA consultation documents or non-ESA allotment management plans or allotment NEPA decisions, may be used if they are based on best available science and monitoring data and meet the purpose of this guideline.

1. **Where desired conditions for water quality, aquatic habitat, and riparian vegetation have been attained[12] and riparian vegetation is in late-seral conditions[13], protect or maintain those conditions by managing annual livestock grazing use and disturbance as follows [14]:**

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[10] Not all indicators may apply to a particular site. For example, stubble height is a meaningful indicator for lower gradient streams where herbaceous vegetation plays an important role in stabilizing streambanks. It is generally less useful for steeper channels, where channel morphology is controlled by coarse substrates. Moreover, not all numeric values may apply to a particular site (e.g., sites with short graminoids).

[11] Indicator values for specific sites should be determined based on consideration of local conditions including, but not limited to, the degree of departure between existing and desired conditions, the current and desired rate of improvement, site sensitivity to grazing, grazing season, the presence of special status species (e.g., ESA-listed species, Regional Forester's sensitive species) that are sensitive to grazing, whether or not water quality standards and related requirements (e.g., TMDLs for impaired waters) are being met, and the site's importance in maintaining or attaining those standards and requirements. Consideration of these conditions is especially important in prescribing specific stubble height values within the 4-inch to 6-inch range and streambank alteration values within the 15-20% range. The more conservative stubble height and streambank alteration values should be applied in locations where these conditions are a primary consideration.

[12] Assessment of conditions and trends should be based on best available information at a variety of spatial and temporal scales. Site-specific information is particularly important.

[13] Late seral conditions means the existing riparian vegetation community is similar to the potential natural community composition (per Winward 2000).

[14] Per Pacfish/Infish Monitoring, Multiple Indicator Monitoring (BLM Technical Reference 1737-23) protocols or comparable methods for stubble height, streambank alteration, and use of woody species. Per Bureau of Land Management protocols (BLM/RS/ST-96/004+1730) or comparable methods for herbaceous utilization.

- **maintain a minimum of 4-inch residual stubble height [15] of key herbaceous species on the greenline;**
- **utilize no more than 30-45 percent of deep-rooted herbaceous vegetation in the active floodplain[16] and, as needed, in other critical portions of the riparian management area;**
- **limit streambank alteration[17] to no more than 20-25 percent; and**
- **limit use of woody species to no more than 30-40 percent of current year's leaders along streambanks and, as needed, in other critical portions of the riparian management area.**

2. **Where desired conditions for water quality, aquatic habitat, and/or riparian vegetation have not yet been attained, but conditions are moving towards those desired conditions[14], enable continued recovery by managing annual livestock grazing use and disturbance as follows:**
   - **maintain a minimum of 4-inch to 6-inch residual stubble height of key herbaceous species on the greenline[11];**
   - **follow the criteria for utilization of deep-rooted herbaceous vegetation, streambank alteration, and use of woody species described in (1).**

3. **Where desired conditions for water quality, aquatic habitat, and/or riparian vegetation have not been attained and conditions are not moving towards those desired conditions[12], enable recovery by managing annual livestock grazing use and disturbance as follows:**
   - **maintain a minimum of 6-inch residual stubble height of key herbaceous species on the greenline;**
   - **utilize no more than 30-35 percent of deep-rooted herbaceous vegetation in the active floodplain and, as needed, in other critical portions of the riparian management area;**
   - **limit streambank alteration to no more than 15-20 percent[11]; and**
   - **limit use of woody species to no more than 20-30 percent of current year's leaders along streambanks and, as needed, in other critical portions of the riparian management area.**

Guideline GM-4. Avoid livestock trampling of Federally-listed threatened or endangered fish redds.

[15] Stubble height criteria apply at the end of the grazing period, when that period ends after the growing season. When the grazing period ends before the growing season does, stubble height criteria can be applied at the end of the grazing period or the end of the growing season.

[16] Active floodplain is defined as the area bordering a stream inundated by flows at a surface elevation that is two times the maximum bankfull depth (measured at the thalweg).

[17] Streambank alteration criteria apply within 1-2 weeks of removal of livestock from each pasture.

Recreation Management

Standard RM-1. Do not place new facilities or infrastructure within expected long-term channel migration zone if it has the potential to impact channel or floodplain function. If some facilities must occur in RMAs (e.g. road stream crossings, trailheads, boat ramps, docks, interpretive trails), locate and design them to minimize impacts on floodplains and aquatic and riparian-dependent resources (e.g., within geologically-stable areas, away from areas with high potential for channel migration, away from major spawning sites).

Guideline RM-2. Adjust dispersed and developed recreation facilities and practices that retard or prevent attainment of aquatic and riparian desired conditions. Where adjustments (e.g. education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures) are not effective and are causing unacceptable impacts, eliminate the facility or use to the extent practical and mitigate residual impacts.

Minerals Management

Standard MM-1. For operations in RMAs, ensure operators take all practicable measures to maintain, protect, and rehabilitate water quality and habitat for fish and wildlife and other aquatic and riparian-dependent resources affected by the operations. Ensure operations do not retard or prevent attainment of aquatic and riparian desired conditions. Exceptions to this standard include situations where Forest Service has limited discretionary authorities. In those cases, project effects shall be minimized and shall not prevent or retard attainment of aquatic and riparian desired conditions to the extent possible within those authorities.

Standard MM-2. Work with operators to adjust their mineral operations to minimize adverse effects to aquatic and riparian-dependent resources in RMAs. Require BMPs and other appropriate conservation measures to mitigate potential mine operation effects.

Standard MM-3. Work with operators to locate structures, support facilities, and roads outside RMAs. Where no alternative exists, work with operators to locate and manage them to minimize effects upon aquatic and riparian desired conditions. When structures, support facilities, and roads are no longer required for mineral activities, they will be restored or reclaimed to achieve aquatic and riparian desired conditions.

Standard MM-4. Do not locate mine waste with the potential to generate hazardous material (as defined by CERCLA) within RMAs and/or areas where groundwater contamination is possible. The exception is temporary staging of waste during abandoned mine cleanup.

Standard MM-5. For leasable oil, gas, and geothermal exploration and development activities, coordinate with the Bureau of Land Management and recommend the application of BMPs and mitigation as Conditions of Approval to support attainment and maintenance of aquatic and riparian desired conditions.

Standard MM-6. Prohibit saleable mineral activities such as sand and gravel mining and extraction within RMAs unless no alternatives exist and if the action(s) will not retard or prevent attainment of aquatic and riparian desired conditions.

Standard MM-7. Conduct inspections, monitor, and annually review required monitoring for mineral plans, leases, and permits. Evaluate inspection and monitoring results and require mitigations for mineral plans, leases, and permits as needed to eliminate impacts that retard or prevent attainment of aquatic and riparian desired conditions.

Standard MM-8. Mineral activities on NFS lands shall avoid or minimize adverse effects to aquatic threatened or endangered species/populations and their designated critical habitat.

a) **All suction dredge mining activities in occupied habitat for aquatic threatened or endangered species/populations and in their designated critical habitat shall be evaluated by the District Ranger to determine if the mining activity is causing or "will likely cause significant disturbance of surface resources"[18]. A likelihood that a threatened or endangered species "take" and/or "harm" (significant habitat modification or degradation that results in death or injury to listed species) (defined in Section 3[18] of the ESA of 1973 as amended) incidental to the mining activity are examples of a significant resource disturbance. Other significant disturbances that do not involve incidental take might involve effects on channel stability or stream hydraulics.**

b) **If the District Ranger determines that placer mining operations are causing or will likely cause significant disturbance to surface resources, the District Ranger shall contact and inform the operator to seek voluntary compliance with 36 CFR 228 mining regulations and to cease operations until compliance.**

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[18] The phrase ''will likely cause significant disturbance of surface resources'' means that, based on past experience, direct evidence, or sound scientific projection, the District Ranger reasonably expects that the proposed operations would result in impacts to NFS lands and resources which more probably than not need to be avoided or ameliorated by means such as reclamation, bonding, timing restrictions, and other mitigation measures to minimize adverse environmental impacts on NFS resources.

Fire/Fuels Management

Guideline FM-1. Locate temporary fire facilities (e.g. incident bases, camps, wheelbases, staging areas, helispots, fueling stations, and other centers) for incident activities outside RMAs. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian-dependent resources should be used. If the only suitable location for such activities is within a RMA, use may be granted following review by a resource advisor and discussion with the agency administrator. The resource advisor will work the incident management team to prescribe the location, use conditions, and rehabilitation requirements. Use an interdisciplinary team to predetermine suitable incident base and helibase locations.

Guideline FM-2. Locate and configure firelines to minimize sedimentation to waterbodies, capture of overland and streamflows, and development of unauthorized roads and trails. Restore firelines following suppression or prescribed fire activities.

Standard FM-3. Ensure prescribed burn projects contribute to and do not retard the attainment of the aquatic and riparian desired conditions.

Guideline FM-4. Direct ignition in RMAs should not be used unless it would not retard attainment of aquatic and riparian desired conditions.

Standard FM-5. Prevent the potential spread of aquatic invasive species when withdrawing, transporting, and using water for firefighting. When changing locations, all fire equipment that contacted surface water shall be cleaned. Clean equipment and vehicles prior to post-fire release.

Standard FM-6. Aerial application of chemical retardant, foam, or other fire chemicals is prohibited within 300 feet (slope distance) of perennial and intermittent waterways. Waterways are defined as any body of water (including lakes, rivers, streams, and ponds) whether or not it contains aquatic life. This includes open water that may not be mapped as such on avoidance area maps and intermittent streams with surface water at the time of retardant use. Exception include cases where human life or public safety is threatened and chemical use could be reasonably expected to alleviate that threat.

Guideline FM-7. Whenever practical, as determined by the fire incident commander, use water or other less toxic wildland fire chemical suppressants for direct attack or less toxic approved fire retardants in areas occupied by threatened, endangered, proposed, candidate, or sensitive species, or their habitats.

Lands and Special Uses, including Hydropower

Standard LH-1. Authorizations for all new and existing special uses that result in adverse effects to habitat conditions and ecological processes essential to aquatic and riparian-dependent resources shall require actions that result in re-establishment, restoration, mitigation, or improvement of those conditions and processes. These authorizations include, but are not limited to, water diversion or transmission facilities (e.g, pipelines, ditches), energy transmission lines, roads, hydroelectric, and other surface water development proposals.

Guideline LH-2. Identify instream flow regimes needed to maintain or restore aquatic and riparian resources, channel conditions, and fish passage and coordinate with the State to secure the flows, as feasible.

Standard LH-3. Locate new hydropower support facilities outside of RMAs. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas) not directly integral to its operation or necessary for the implementation of prescribed protection, mitigation, or enhancement measures.

Guideline LH-4. Operate and maintain existing hydropower support facilities located within the RMAs to achieve aquatic and riparian desired conditions. At the time of permit reissuance, relocate or remove support facilities where feasible when they prevent or retard attainment of aquatic and riparian desired conditions. When not feasible, projects effects shall be minimized and shall not prevent or retard attainment of aquatic and riparian desired conditions to the extent possible within Forest Service authorities.

Standard LH-5. Issue leases, permits, rights-of-way, and easements with conditions to avoid adverse effects that retard or prevent attainment of aquatic and riparian desired conditions. Adjust existing leases, permits, rights-of-way, and easements to eliminate adverse effects retarding or preventing attainment of aquatic and riparian desired conditions. If adjustments are not effective, eliminate the activity within legal authorities. Prioritize modification of existing leases, permits, rights-of-way, and easements based on the actual or potential impact and the ecological value of the riparian resources affected.

Standard LH-6. New hydroelectric facilities and water developments shall not be located in a Key Watershed and in subwatersheds with ESA critical habitat for aquatic species unless it can be demonstrated they will not retard the attainment of riparian and aquatic desired conditions.

Standard LH-7. Hydroelectric and other water development authorizations shall include requirements for in-stream flow regimes and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian-dependent resources, favorable channel conditions, and aquatic connectivity. Tools to help achieve or ensure implementation may include headgates, screens, diversion monitoring devices, fish bypass systems, etc.

Guideline LH-8. Use Key Watersheds as a criterion for prioritizing land acquisition, exchange, and conservation easements to enhance or enlarge the existing network.

WATERSHED RESTORATION

Standard RE-1. Watershed restoration projects shall promote long-term ecological integrity and resilience, conserve the genetic integrity of native species, and facilitate attainment of aquatic and riparian desired conditions.

Standard RE-2. Watershed restoration projects shall be designed to use natural ecological processes to achieve restoration long-term objectives and shall minimize the need for long-term maintenance.

Standard RE-3. Watershed restoration projects shall be based on best available science regarding potential effects of climate change, including changes in stream flows, stream temperatures, and disturbance regimes.

Standard RE-4. After restoration actions, provide sufficient time from resource use to facilitate recovery.

10. Watershed Analysis

Watershed analysis is an essential component of the ARCS. ***This content of this section will be included in Forest plans as other plan content.***

This section, combined with assessment (Section 7) addresses the direction for multi-scale analysis collectively provided by the 2012 Planning Rule, the Interior Columbia Basin Strategy (2014), and RIEC Framework (2011).

Background

Assessments, which generally cover one or more Forests or large areas of a Forest, are conducted before plans are developed or revised to identify the need to change plan direction and to inform the development of plan components. This section pertains to watershed analysis, which is conducted at finer spatial scales (generally subbasins to subwatersheds, 8-12 digit HUs) to inform implementation of plans, after they have been developed, amended, or revised. This historical focus will continue. However, existing watershed analyses can also be used as part of the pre-plan assessment process.

Through implementation of the existing aquatic strategies in the 1990s and early 2000s, watershed analyses have been completed for the majority of NFS lands within the ARCS area. Consequently, future work will largely focus on efficiently updating, as needed, a portion of those existing analyses to better reflect current watershed conditions and trends, new issues (e.g., climate change, invasive species), latest science and policy, and current opportunities.

Purpose

Watershed analysis is an interdisciplinary analysis of the status and trends of watershed and aquatic ecosystem conditions, key State-designated beneficial uses of water (e.g., municipal water supply), and the hydrologic, geomorphic, and biological processes that strongly influence them. **This important component of the ARCS provides consistent, mid-scale information that serves as a foundation for plan implementation** through the development of strategic and integrated programs and projects that protect and restore aquatic resources, while enabling informed and sustainable resource use and management. **These analyses, together with assessment (Section 7) and monitoring and evaluation (Section 12), provide context and information to adaptively execute the other components of the ARCS.** These include management of RMAs and Key Watersheds, implementation of Watershed Restoration, and compliance with Standards and Guidelines.

Watershed analysis is intended to guide plan implementation by providing decision-makers and others: 1) information to identify activities that would maintain watershed and aquatic and riparian ecological conditions or move them towards desired conditions; and 2) the context for developing projects and evaluating their consistency, via the NEPA process, with plan direction (i.e., desired conditions, objectives, standards, and guidelines associated with watershed and aquatic resources). This includes ensuring that management activities in Key Watersheds and RMAs maintain, restore, or enhance aquatic and riparian resources.

THROUGH IDENTIFICATION OF ACTIONS NEEDED TO AVOID OR MINIMIZE ADVERSE EFFECTS AND/OR RESTORE ECOSYSTEM CONDITIONS AND PROCESSES, WATERSHED ANALYSIS IS ALSO INTENDED TO ENABLE PROTECTION AND RECOVERY OF LISTED SPECIES AND THEIR HABITATS AND TO FACILITATE EFFICIENT PROJECT-LEVEL CONFERENCING AND CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT. SIMILARLY, IT SHOULD ENABLE PROTECTION AND RESTORATION OF WATER QUALITY AND THE FULL RANGE OF BENEFICIAL USES OF WATER IDENTIFIED UNDER THE CLEAN WATER ACT.

Watersheds to be Analyzed

In other plan content, Forests will estimate the number of new or updated watershed analyses expected to be completed during the life of the Forest plan and identify a set of potential watersheds for which this work will be a priority. Criteria for selecting potential watersheds for analysis should include: (1) Key Watersheds; (2) watersheds that have been or likely will be identified as Priority Watersheds during the life of the Plan; (3) watersheds that support listed species or contain designated critical habitat; and (4) watersheds wherein management activities are likely to occur that may substantially affect aquatic resources (e.g., due to their inherent nature, location, timing or scale).

Watershed analyses should generally be conducted or updated prior to developing and implementing Watershed Restoration Action Plans for Priority Watersheds (Section 11).

In addition, watershed analyses shall be conducted or updated prior to:

- ***proposing changes to RMA widths***
- ***timber salvage or construction of facilities in RMAs***
- ***construction of permanent system roads in RMAs***

Line Officer Role

The desired outcome is an efficient, effective analysis that provides a better understanding of watershed structure and function and a set of recommendations that help inform future management actions within and around the watershed. **To achieve this goal, line officers should guide analysis teams throughout the analysis process, ensuring that the analysis focuses on the most critical issues and questions and the scope, type and level of analysis is aligned with management needs and available financial resources and staff. This is critical to avoiding common pitfalls observed in previous analyses, which included unconstrained scope and level of detail.**

Analysis Process

The watershed analysis process (*Regional Ecosystem Office, 1995*) includes 6 steps to be conducted via an interdisciplinary process: 1) characterizing the study watershed; 2) identifying important water and aquatic resources and key management issues and questions associated with them; 3) describing current resource conditions and trends and the dominant biophysical processes (natural and human-caused) responsible for them; 4) comparing and contrasting those conditions with applicable reference conditions; 5) synthesizing and interpreting that information; and 6) identifying opportunities and making management recommendations to maintain or restore watershed and aquatic resources when those conditions are consistent with or trending towards desired conditions or otherwise to improve those resource conditions. It is generally based on existing information, although new information may be needed in some situations.

The watershed (10-digit HU, Figure 14) is the primary scale of the analysis. However, since relevant issues, ecological conditions, and dominant biophysical processes often occur at both broader and finer scales, components of the analysis may need to be conducted at a subbasin scale, while others may need to be addressed at a subwatershed or finer scale. Still others (e.g., habitat connectivity between and within watersheds) may need to be evaluated at multiple scales. The challenge is to efficiently analyze the interaction of multiple processes operating at multiple spatial and temporal scales and incorporate relevant findings into a concrete watershed conservation and management strategy.

The topics to be covered in a watershed analysis generally include: 1) hydrologic and geomorphic processes; 2) vegetation; 3) disturbance regimes; 4) transportation systems; 5) water quality; 6) aquatic and riparian species and habitats; and 7) human uses.

Updating Existing Watershed Analyses

As previously described, most future work will involve updating existing analyses rather than conducting entirely new ones. **THE PROCESS FOR UPDATES IS SIMILAR TO THE ANALYSIS PROCESS DESCRIBED ABOVE, EXCEPT THAT UPDATES SHOULD BE NARROWLY FOCUSED ON REFRESHING, REFINING OR AUGMENTING ONLY THOSE CRITICAL COMPONENTS OF THE EXISTING DOCUMENTS THAT DO NOT REASONABLY ADDRESS CURRENT ISSUES AND QUESTIONS, ADEQUATELY CHARACTERIZE CURRENT RESOURCE CONDITIONS AND TRENDS, ALIGN WITH CURRENT SCIENCE AND POLICY, OR REFLECT CONTEMPORARY MANAGEMENT NEEDS AND OPPORTUNITIES.**

LINE OFFICERS SHOULD DEFINE THE SCOPE OF THESE UPDATES AND THE FINANCIAL AND STAFF RESOURCES AVAILABLE TO SUPPORT THEM, AFTER CONSIDERING THE RECOMMENDATIONS OF AN INTERDISCIPLINARY TEAM THAT HAS CRITICALLY REVIEWED THE EXISTING ANALYSES.

General Products

The products of a watershed analysis generally include all or a subset of the following, depending on the scope of the analysis:

- a summary of the current status and trajectory of watershed conditions, aquatic and riparian-dependent resources and their habitat, water quality, and key State-designated beneficial uses of water
- a description of the key historic and ongoing processes (natural and human-caused) responsible for those conditions and trends
- an assessment of the status and trends of the watershed with respect to general Forest-wide desired conditions (DCs) at applicable scales (subbasin and/or watershed) and any specific DCs for Key Watersheds and/or Riparian Management Areas (RMAs)
- any recommended adjustments to the default, forest-wide widths for RMAs, as necessary
- a recommendation for retaining or changing the status of the watershed with respect to the Key Watershed network (e.g., adding or removing the watershed from the network)
- specific opportunities for managing, protecting, and restoring the watershed and its important resource values. This includes identification of areas within the watershed that are particularly important and activities that could be taken or avoided to protect and restore watershed conditions while achieving other socioeconomic objectives
- a strategic framework for implementing restoration opportunities. This includes, if applicable, a ranked list of potential Priority Subwatersheds (12-digit HU) to consider restoring via the FS National Watershed Condition Framework (WCF) process, the type and scope of critical restoration treatments, their location and priority, and any major considerations for timing/completion of restoration work
- a completed Watershed Restoration Action Plan (WRAP) for WCF Priority Subwatersheds per the national template, as appropriate

- significant information gaps and the inventories, monitoring, and/or analyses needed to address those gaps, and their relative priority
- a list of important monitoring questions and indicators.

THESE PRODUCTS SHOULD BE INFORMED BY AND ALIGNED WITH THE MAJOR GOALS, OBJECTIVES, STRATEGIES, AND TACTICS INCLUDED IN OTHER RELEVANT RESTORATION/RECOVERY PLANS (E.G., ESA-RECOVERY PLANS, STATE RESTORATION PLANS FOR IMPAIRED WATERS).

Specific map and tabular products may include all or a subset of the following, depending on the scope of the analysis:

- perennial and intermittent streams, fish habitats (including key spawning and rearing areas, critical habitat, etc.), and any major barriers to fish passage
- other special aquatic habitats (side channels, ponds, wetlands, etc.) of particular importance
- groundwater-dependent ecosystems (including springs) and important groundwater recharge zones
- key beneficial uses of water
- major water rights and uses
- the quality, quantity, and timing of streamflows and areas and processes that strongly influence them
- any water-quality limited stream segments
- available stream and water quality inventory and monitoring results, including those from AREMP, PIBO, applicable stream temperature monitoring and assessment programs, the Regional stream survey program, and other relevant programs
- Key and/or Priority Watersheds in the analysis area
- RMAs, including unstable areas
- key geomorphic features and processes strongly influencing watershed conditions and resources
- current and historic forest and rangeland vegetative conditions
- wildfire risks relevant to aquatic and riparian resources
- potential impacts/risks that the road network poses to watershed conditions and aquatic resources
- known and high-risk sites for aquatic and riparian invasive species
- projected climatic changes (e.g., streamflows, stream temperatures, aquatic biota, vegetative conditions) relevant to aquatic resources
- a listing of priority restoration treatments, including the location or general area and relative priority and any major considerations for timing/completion of restoration work.

Relationship with Project and Watershed Planning and Landscape Analysis

Watershed analysis is best conducted separate from project-level planning and the NEPA process. Its results are used to identify projects ripe for implementation and facilitate preparation of NEPA analyses, particularly Purpose and Need statements and descriptions of Existing Conditions. A watershed analysis more thoroughly informs decisions. New analyses or significant updates may be appropriate when a unit is contemplating complex projects covering a wide range of activities over large areas and multiple years. Large scale vegetation management projects spanning multiple watersheds may require an analysis to understand resources and their interaction with a broader perspective. The watershed analysis approach described here can be applied at broader scales if needed.

Where feasible, watershed analysis should inform the watershed restoration process, as specified in Section 11. Specifically, these analyses can guide selection of Priority Watersheds and development of Watershed Restoration Action Plans via the Watershed Condition Framework process (Figure 15).

Documentation

Watershed analyses should be a concise synthesis of key information about resource conditions and trends and the recommended management strategies and actions to address them. **Line officers should define their scope and review and approve final products.** These analyses should be kept in the record and be readily available for use. Supporting geospatial data should also be retained as part of the record. Watershed analyses are not Federal actions leading to a decision and do not require NEPA analysis, public outreach, and documentation.

Analysis Resources

Many resources, as described below, are available to support watershed analysis.

Existing Analyses

Much of the watershed analysis process involves the integration and synthesis of existing information. Therefore, identification and review of existing analyses is a critical step in the process. Similar to the assessment phase of plan development or revision (Section 7), information from the following documents should be reviewed and synthesized during the analysis process and be used to guide other components of the analysis, as appropriate given the scope of the analysis: 1) results of Step A (Assessment) of the National Watershed Condition Framework, 2) existing watershed analyses, 3) status reviews/assessments and recovery plans for threatened, endangered, or sensitive species, 4) State assessments and management plans associated with water quantity and quality, 5) results of broad-scale status and trend monitoring programs (e.g., AREMP and PIBO), 6) transportation analyses, and 7) climate change vulnerability assessments and adaptation strategies. In addition, relevant broad-scale environmental analyses for the area may be useful.

A key difference between the assessment phase of plan revision and watershed analysis is the spatial scale at which this and other information is considered. The assessment is intended to broadly characterize conditions across a whole Forest or several Forests. In contrast, watershed analysis is intended to address issues at finer scales, primarily at the watershed scale. Consequently, some of the existing information may only provide context for how conditions in a subbasin or watershed compare with other subbasins or watersheds. Other existing data and reports, however, may provide information about specific conditions within the analysis watershed. Some other sources may do both.

Analysis Guides

Existing guidebooks, such as *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis (Regional Ecosystem Office, 1995),* provide a logical, structured and organized approach to conducting watershed analyses. **Analysis teams are thus encouraged to use relevant components of those guidebooks to direct their work. Components of these guidebooks that are beyond the scope or level of detail decided by the line officer should be disregarded.**

Datasets and Analysis Tools

Numerous datasets, models, and other analysis tools are available to assist in conducting watershed analysis. Each has different capabilities and strengths and limitations, which need to be critically evaluated prior to their application. **Use of these tools should be focused on filling important information gaps needed to address the key management questions identified and approved by the line officer early in the analysis process.**

Available models can simulate a variety of watershed processes, including surface erosion and mass wasting, stream shade and/or heat loading to streams, large woody debris recruitment, and fluvial and floodplain processes. In addition, existing models can be used to characterize a variety of road-related impacts to watersheds and aquatic ecosystems.

The following datasets are generally available across the Region and can be used in the analysis process, as needed.

- National Hydrography Dataset and Watershed Boundary Dataset
- Fish Distribution and Fish Passage databases
- USGS streamflow monitoring
- streamflow modeling (e.g., Variable Infiltration Capacity model)
- physical and biological stream survey data and reports
- historic surveys and photos
- National Watershed Condition Assessment
- AREMP and PIBO data and analyses
- stream temperature monitoring and modeling (e.g., NorWeST products)
- State and Federal habitat and population monitoring programs
- State and Federal water quality monitoring
- State lists of water-quality limited streams (303-d list)
- Water Rights and Uses database
- Surface Water Diversion database
- Terrestrial Ecological Unit Inventory
- topographic data (e.g., digital elevation models)
- aerial photographs
- existing and potential vegetation
- Fire Regime Condition Class maps
- Forest transportation systems and results of Travel Analyses
- rangeland condition assessments and monitoring
- aquatic and riparian invasive species databases
- climate change datasets (snow, flow regimes, stream temperatures, soil-drought)

Typically, these data sources can and should be complemented with local information for the analysis area (e.g., localized road condition inventory).

- **Broad-scale Status and Trend Monitoring**

THE PRODUCTS OF BROAD-SCALE STATUS AND TREND MONITORING (SECTION 12), IN PARTICULAR THE AREMP AND PIBO DATASETS, CAN BE USED TO INFORM ANALYSIS OF SPECIFIC WATERSHEDS. For example, as a starting point for watershed analysis, analysis teams can consider how upslope and in-channel conditions and trends for a particular watershed fit within the distribution of conditions and trends across all reference (least disturbed) and managed watersheds within a larger area (e.g., subbasin, basin, Forest. See Figure 17.) This, together with the watershed-specific information described below, can enable analysis teams to more completely and accurately assess watershed and aquatic habitat conditions, their likely trajectories, the reasons those conditions exist (e.g., natural disturbance or human impacts), what actions might be warranted in the watershed, and generally how and where they should be implemented. This two-tiered approach, involving broad-scale status and trend assessment and monitoring across many watersheds to identify spatial and temporal patterns, coupled with more detailed, process-based analysis of specific watersheds to identify the causes of these patterns and management needs and opportunities, is consistent with the recommendations of Lisle et al. (2014).

IT IS IMPORTANT TO RECOGNIZE THAT WHILE "REFERENCE CONDITIONS" ARE USEFUL IN DESCRIBING POTENTIAL ENVIRONMENTAL CONDITIONS AND PROVIDING A TOOL FOR DIAGNOSING CURRENT STATUS AND TRENDS, THEY MAY NOT ALWAYS EQUATE TO DESIRED CONDITIONS. First, while they may sometimes characterize the "best available" and perhaps the "best attainable" conditions based on current data and information, they do not necessarily represent "natural" or "pristine" conditions because all watersheds have been impacted by human activities to some degree (e.g., fire suppression). As such, understanding of the range of true "natural conditions" is limited. In addition, these conditions need to be assessed in the context of the species, issue, or process of interest to holistically understand whether deviation from reference condition is ecologically meaningful.

As described by Montgomery and MacDonald (2002), in-channel data are best viewed as one set of diagnostic indicators of watershed and aquatic habitat condition. **TO INFORM MANAGEMENT DECISIONS, IT IS IMPORTANT TO UNDERSTAND THE REASONS FOR THESE CONDITIONS AND WHAT, IF ANY, MANAGEMENT ACTIONS ARE NEEDED TO ADDRESS THEM.** This is a challenge because channel conditions are highly variable over space and time and can result from multiple pathways and processes influenced by both natural conditions and human impacts (Lisle et al. 2014). Thus evaluation of reach-level channel data requires more than simple comparisons with data from reference sites. Such evaluations should characterize the current state of the system and the dominant natural and human-caused processes that control key variables of interest. This will generally involve consideration of the location of the reaches in the channel network, regional and local biogeomorphic context, controlling influences such as sediment supply and transport capacity, riparian vegetation, in-channel flow obstructions, and disturbance history (Montgomery and MacDonald, 2002).

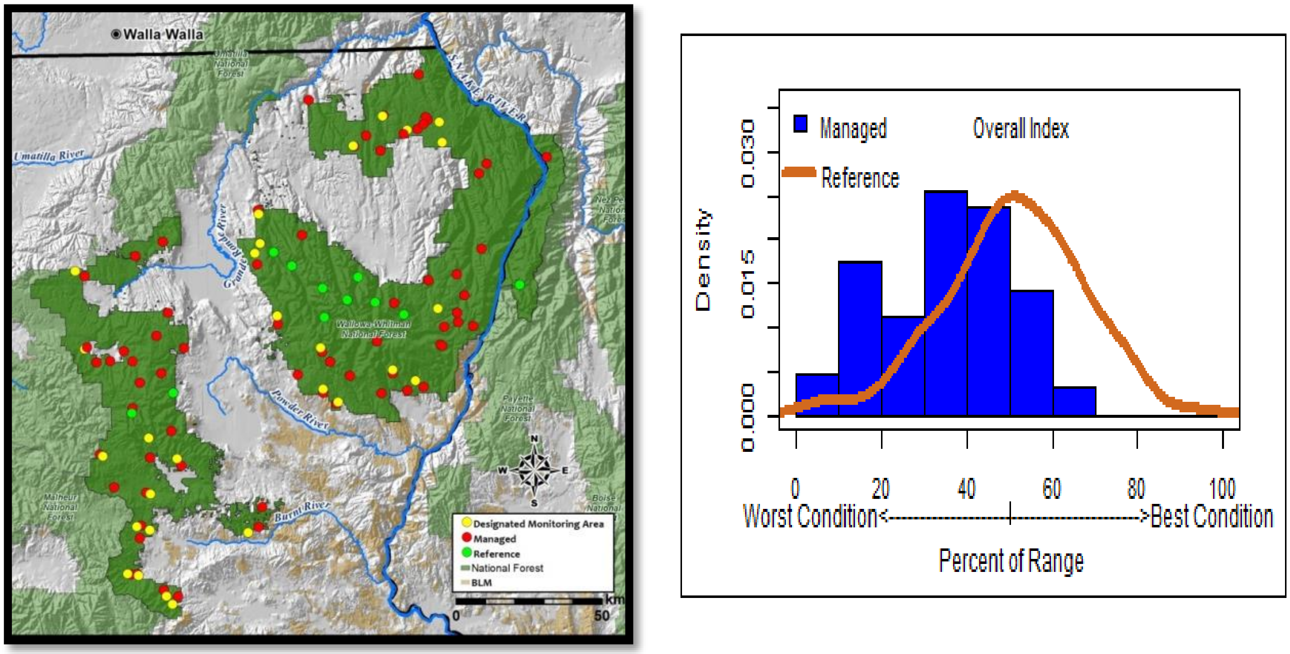


Figure 17. The distribution of stream habitat condition index scores for sites on the Wallowa-Whitman National Forest
(*Archer and Ojala, 2015*).

The distributions of conditions for streams in managed watersheds (blue histogram) indicate that they are not as good as expected reference conditions, as determined from data from minimally-managed watersheds (brown line). The habitat index is an integrated score comprised of scores from multiple habitat parameters, such as substrate composition, fine sediment in pools, large wood frequency, % pool habitat, and macroinvertebrate community composition (Al-Chokhachy et al. 2010). Scores are also available for individual habitat parameters. Reference conditions can be used to help assess how habitat conditions in a particular watershed or watersheds compare with those in the least disturbed watersheds. Consideration of natural watershed processes and human alterations of those processes is necessary to understand the reasons that those habitat conditions exist and what, if any, management actions are needed to address them.

11. Watershed Restoration Strategy

This entire section will be included in Forest plans as other plan content.

Background

Watershed restoration to benefit aquatic and riparian-dependent resources and water quality is an integral element of the ARCS. Restoration, in concert with other ARCS elements, contributes to protection and recovery of those resources. Collectively, the goal of restoration and the ARCS as a whole is to provide for ecologically healthy watersheds and aquatic and riparian ecosystems, as defined by ARCS desired conditions (Section 9). The phrase “ecologically healthy” refers to functions affecting biodiversity, productivity, biochemical, and evolutionary processes that are adapted to the environmental conditions in a given region (Karr et al. 1986; Karr 1991).

Watershed restoration is designed to enable recovery of the composition and structure of aquatic and riparian ecosystems by restoring critical watershed processes (physical, biological and chemical) needed to sustain them. Restoring the health and resiliency of selected watersheds will help ensure that the network of Key Watersheds serves intended purpose over time and space.

Watershed restoration is a catalyst for initiating ecological recovery (FEMAT 1993). Restoration efforts will be comprehensive, addressing both protection of existing functioning aspects of a watershed and restoration of degraded or compromised aspects. It may not be possible to restore every watershed and some restoration actions may only have limited success because of an extensive level of degradation and/or legal, social, economic, or technical constraints on the ability to address that degradation. The effectiveness of restoration efforts is not likely to be visible for some time. At the watershed scale, for example, it may take an extended period (decades or longer) to observe the full effects of treatments. Even longer timeframes (many decades to a century or more) may be necessary for changes to be expressed at larger-scales (FEMAT 1993).

Restoration at the watershed scale is a complex undertaking. Restoration programs must properly assess watershed conditions and processes, identify primary disturbance regimes (past, present and future), and locate, design, and implement integrated treatments to achieve the desired, watershed-scale response. To be effective, these programs need to: 1) target root causes of water quality, habitat and ecosystem change; 2) tailor restoration actions to local potential of the systems; 3) match the scale of restoration to the scale of the problem; and 4) be explicit about expected outcomes (Beechie et al. 2010). They also need to effectively prioritize and schedule restoration projects.

IMPLEMENTATION OF THE RESTORATION COMPONENT OF ARCS IS TO BE ACCOMPLISHED THROUGH PASSIVE AND ACTIVE RESTORATION, IMPLEMENTED WITH PARTNERS ACROSS WHOLE WATERSHEDS. USE OF THE STRATEGIC, PROGRAMMATIC FRAMEWORK DESCRIBED BELOW WILL MAXIMIZE THE EFFECTIVENESS OF THIS WORK.

Passive and Active Restoration

Both passive and active restoration are needed to successfully restore watersheds (Roni et al. 2002). Passive restoration involves the protection and/or natural recovery of watersheds and aquatic and riparian ecosystems. It is applied at the landscape scale to enable ecosystems to resist and recover from large-scale disturbances, such as fire, floods, and debris flows as well as chronic disturbances. Passive restoration involves planning and implementing various resource management programs and activities (e.g., fuels and timber management, recreation) in ways that maintain watershed and habitat conditions when they are in good condition and facilitate their recovery when they are not.

Active restoration involves implementation of integrated projects specifically designed to restore or accelerate recovery of specific ecosystem processes or to minimize threats to those processes. Active restoration is generally applied using integrated treatments (e.g., fish passage, road decommissioning and stabilization, riparian and upslope vegetation treatment, instream habitat improvement, restoration of streamflows) that are strategically applied at multiple, priority sites within a watershed. It is focused and applied on a more limited scale (e.g., specific sites in Key and Priority watersheds) than passive restoration.

Active restoration should be prioritized to emphasize the protection and/or retention of existing high-quality habitat and water and naturally functioning watersheds and ecosystems. This is accomplished by identifying and treating major risk factors (e.g., unstable roads or poorly located and/or drained roads, certain invasive plants and animals, major obstructions to physical and biological connectivity) threatening ecosystem integrity and likely to adversely influence existing or future conditions. Identification, prioritization, and integrated treatment of watersheds with limited loss of function and condition are also a priority. These watersheds will likely serve as the next generation of refugia for fish and provide high-quality water in the future. Their selection should consider the extent of habitat degradation and the degree to which their natural diversity and ecological processes are retained (Reeves et al. 1995). **ACTIVE RESTORATION PROGRAMS SHOULD CONSIDER AND COMPLEMENT RECOVERY PLANS FOR FISH, WATER QUALITY, AND OTHER RIPARIAN-DEPENDENT SPECIES. WATERSHED ANALYSES WILL BE CRITICAL TO IDENTIFY KEY ECOLOGICAL PROCESSES INFLUENCING WATERSHED CONDITION AND FUNCTION AND WILL BE IMPORTANT IN IDENTIFYING SPECIFIC PROTECTION AND/OR TREATMENT OBJECTIVES.**

In cases where the full recovery of watershed functions and processes is not possible (e.g., mixed ownerships without coordinated restoration opportunities, major dams/diversions for hydropower or other developments that influence large and/or important portions of the floodplain or stream channel), mitigation treatments may be needed. These should incorporate design features to benefit aquatic and riparian-dependent resources.

Whole Watershed Approach and Partnerships

Water resources such as high-quality water and healthy fish populations know no jurisdictional boundaries. To successfully meet agency responsibilities to maintain and restore these resources, work should be implemented across boundaries with willing neighbors and other partners in restoration. Whole watershed restoration considers opportunities from the ridgetop to the valley bottom. **RESTORATION SHOULD BE PLANNED AND IMPLEMENTED AT THE WATERSHED SCALE. TREATMENT OBJECTIVES AND ACTIVITIES ON NFS LANDS SHOULD BE COORDINATED WITH OTHER RESOURCE PROGRAMS AND WITH RESTORATION ON OTHER OWNERSHIPS.** Watershed-scale restoration is an interdisciplinary effort requiring close coordination and working partnerships among multiple resource programs, other agencies, Tribal governments, watershed councils, adjacent landowners, collaborative groups, and other stakeholders and partners. Interdisciplinary skills provide both operational and technical capacity for implementing comprehensive watershed restoration programs. Coordination and partnerships are essential to effectively address community and watershed-scale restoration needs and opportunities. Coordination also enhances skill and funding sources needed to sustain multi-year programs.

Programmatic Framework

IN 2005, THE PACIFIC NORTHWEST REGION BEGAN IMPLEMENTING A REGIONAL AQUATIC RESTORATION STRATEGY (ARS, USDA FOREST SERVICE 2005), PROVIDING A FRAMEWORK FOR THE ORGANIZATION AND IMPLEMENTATION OF RESTORATION ACTIVITIES FOR THE REGION. The goal of the ARS is to improve watershed and aquatic and riparian habitat conditions at the Regional scale, through both passive and active restoration. The ARS consists of three parts: 1) Goals/Objectives/Actions, 2) Program Framework, and 3) Restoration Components. The Goals/Objectives/Actions section identifies restoration goals and actions needed to achieve them. The Program Framework is the foundation of the strategy. It is a comprehensive, integrated restoration plan for the Region, enhancing teamwork, coordination, and consistency across the program. The Restoration Components are groups of activities used to implement various program elements, including resource support activities, aquatic and riparian resource assessment, cooperation between State and Federal salmon and watershed recovery programs, and technical support to the field.

Implementation of the Regional ARS has since been refined through the National Watershed Condition Framework (WCF). As shown in Figure 18, WCF is a 6-step process for restoration, including:

1. classifying watershed condition at the subwatershed scale;
2. prioritizing watersheds for restoration;
3. developing Watershed Restoration Action Plans based on watershed analysis;
4. implementing integrated projects;
5. tracking restoration accomplishments; and
6. monitoring and verifying the WCF process and its outcomes.

Classifying Watershed Condition

Classification of watershed condition is the first step of the WCF process. This classification is based on a standardized assessment of subwatersheds (12-digit HUs) across an entire national forest, using 12 different condition indicators (Figure 18). Additional details are provided in the Watershed Condition Classification Technical Guide (USDA Forest Service, 2011b)[19]. Results of broad-scale monitoring (e.g., AREMP and PIBO) should inform these classifications.

Prioritizing Watersheds for Restoration

The next step in the restoration framework is prioritization. The purpose of prioritization is to maximize the efficiency and effectiveness of the restoration program by focusing resources towards work in the most important watersheds. As described in Section 8, prioritization is done in two phases. First, through the Forest planning process, Forests will identify a long-term Key Watershed network. These are Management Areas. This network is comprised of watersheds with the highest quality aquatic habitats and water and watersheds that can be most readily protected and/or restored. These watersheds, generally 10-digit HUs, are the priorities for aquatic conservation and restoration over long-timeframes (i.e., multiple decades to a century or more).

Due to capacity limitations, however, watershed-scale restoration work cannot be implemented across the entire Key Watershed network at one time or even during the life of a Forest plan. Thus, as described in Section 8, through the Forest planning process Forests will identify a smaller number of Priority Watersheds as the focus for near-term (e.g., 5-7 year timeframe) restoration. These Priority Watersheds are specified at the subwatershed (12-HU) scale. In general, they are a subset of the broader, longer-term Key Watershed network. Exceptions include situations where unique issues and restoration opportunities occur in areas outside of the Key Watershed network (e.g., unique partnerships, opportunities to address connectivity issues at larger scales). Priority Watersheds are expected to change during the life of the Forest

[19] http://www.fs.fed.us/biology/resources/pubs/watershed/maps/watershed_classification_guide2011FS978.pdf

plan as restoration objectives and actions are completed. Details about how to change the priority status of a watershed are provided in Section 8.

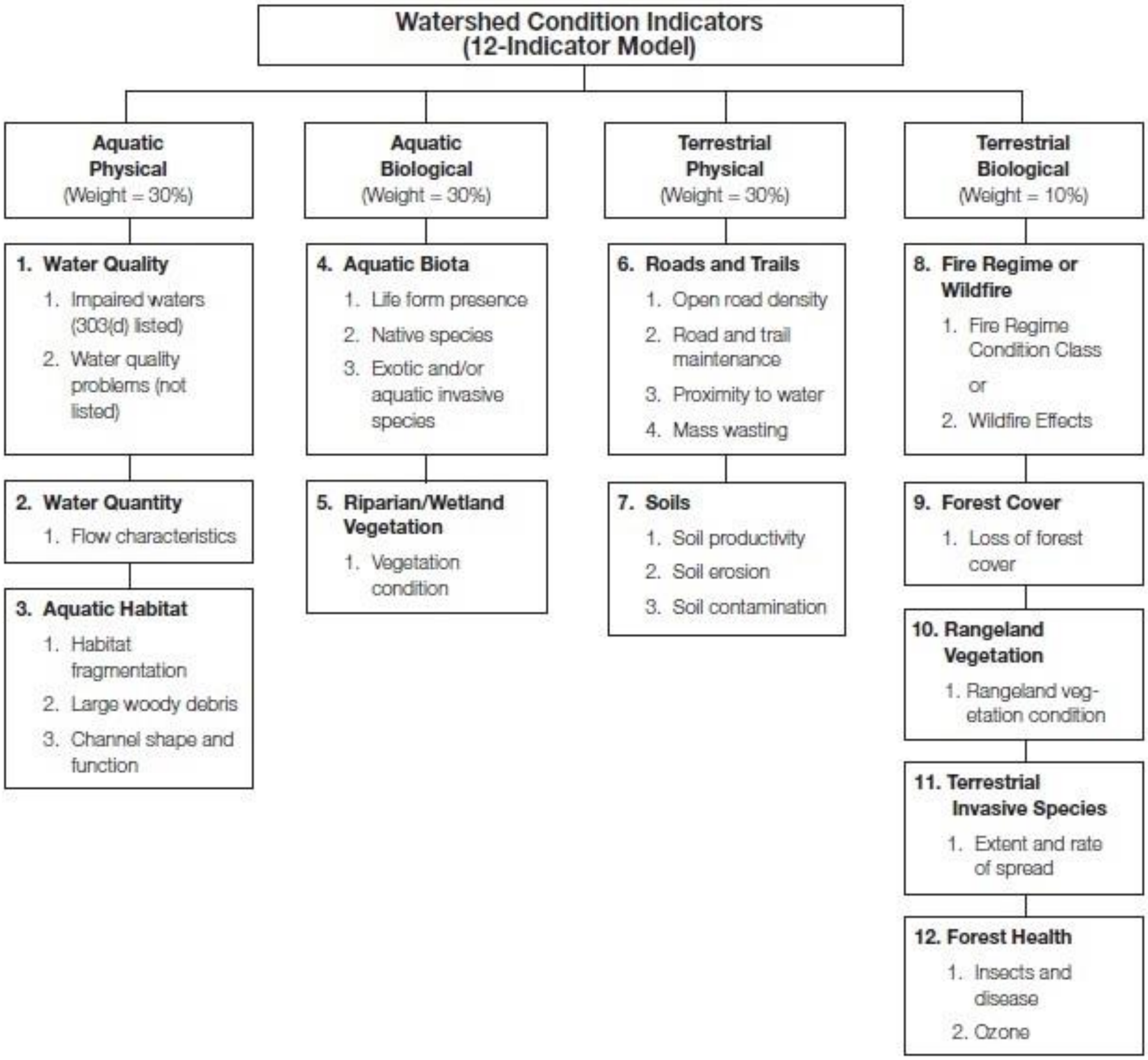


Figure 18. 12-indicator watershed condition model used in Watershed Condition Framework.

This model is used to classify watershed conditions across all subwatersheds on each national forest. Each indicator is classified as functioning properly, functioning-at-risk, or having impaired function based on standardized rulesets. These results are then aggregated into an overall condition score. Results of the 2010 assessment, for example, are shown in Figure 19.

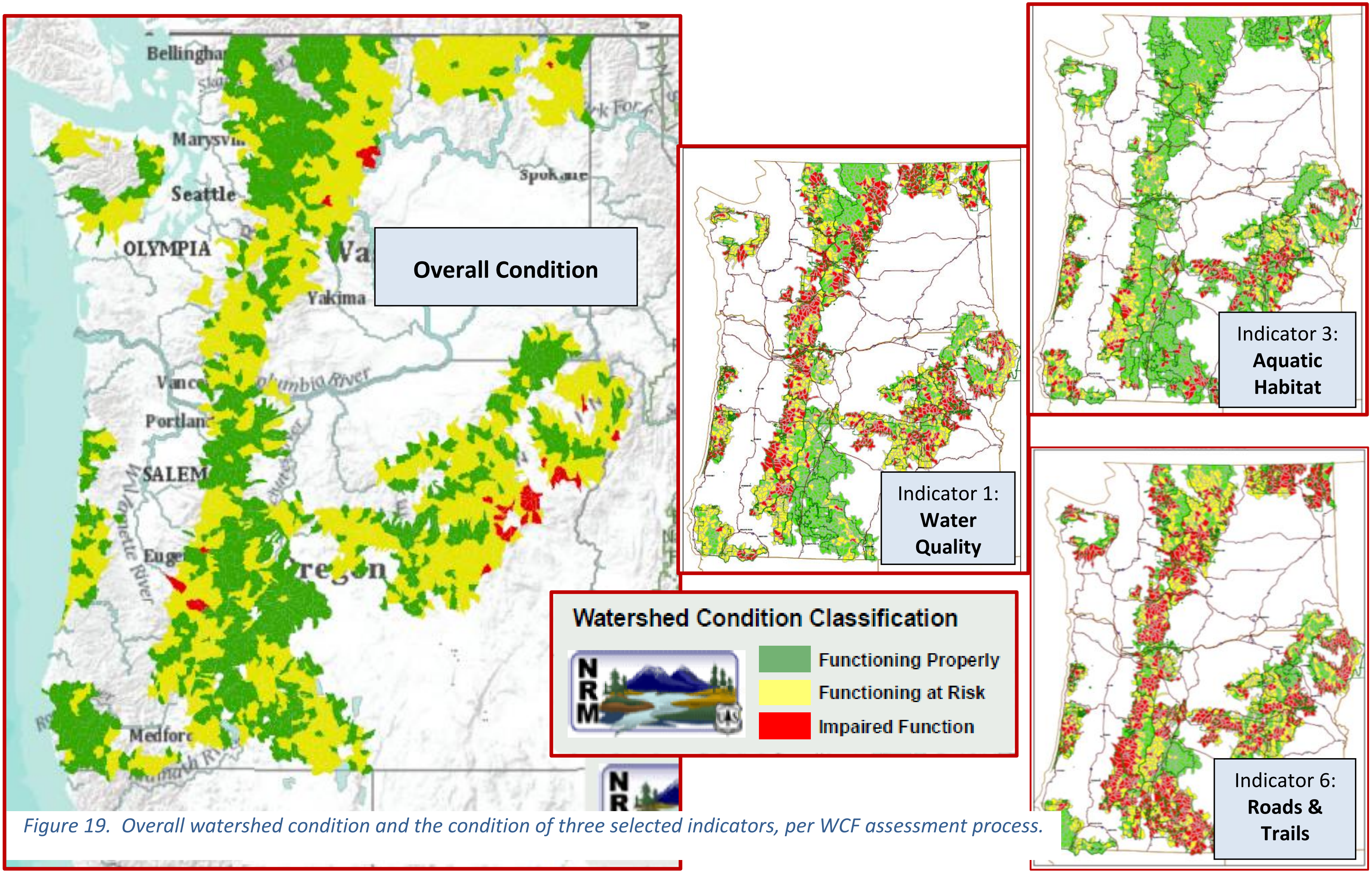


Figure 19. Overall watershed condition and the condition of three selected indicators, per WCF assessment process.

Developing Watershed Restoration Action Plans

Watershed restoration in the late 1980s and 1990s often focused on site-scale actions scattered across the landscape. As the practice evolved over the last few decades, it has become increasingly evident that, the most effective restoration programs implement a wide range of projects that address multiple impacts and threats at a watershed scale in a phased and coordinated manner (Roni et al. 2002). Thus, after identifying Priority Watersheds, Forests will use watershed analyses (Section 10) and other assessments to identify the full-suite of "essential" restoration projects needed to restore critical ecological conditions and processes in targeted areas at a whole watershed scale. This could include elimination of fish passage barriers, road improvements or decommissioning, stream and floodplain reconstruction, dam removal, restoration of instream flows, invasive species control, vegetation management and many other actions. This suite of essential projects should be designed to achieve specific and explicit restoration goals and objectives for the watershed, address the root causes (rather than symptoms) of degradation, be fit to the local ecological potential of the watershed and ecosystem, and be of sufficient scope and scale to address these problems (Beechie et al. 2010). Restoration plans and essential restoration projects should be based on a consideration of the potential effects of climate change and the ability of restoration actions to minimize them. **In particular, water availability, streamflows and stream temperature should be considered. Identified restoration project should also be informed by and generally consistent with any applicable recovery plans for ESA-listed aquatic species and/or any State water quality restoration plans.**

Per WCF, these projects, their general location, estimated costs, schedule for completion, interested partners, and other information will be documented in a Watershed Restoration Action Plan (WRAP) for each Priority Watershed. In the preparation of WRAPs, consideration shall be given to restoration actions located off NFS lands when those projects are essential to the restoration of the watershed and benefits national forest resources (e.g., facilitating the upstream passage of rare fish species from private land onto NFS lands by implementing a passage project on downstream private lands).

Implementing Integrated Projects

Once a WRAP is developed, essential restoration projects are implemented in a logical, phased, and coordinated way. For example, restoration of habitat connectivity is often one of the first restoration actions that should be completed in a watershed (Roni et al. 2002). Conversely, if road decommissioning is needed in a watershed, it should be conducted after any other critical work that is dependent on those particular roads is complete.

As described previously, restoration projects should be done in an interdisciplinary manner. Also, close coordination with other agencies, Tribal governments, watershed councils, adjacent landowners, collaboratives, and other stakeholders and partners is essential.

Tracking Restoration Accomplishments

Implementation of restoration actions will be tracked for individual essential restoration projects, as identified in a WRAPs for each Priority Watershed. These will be recorded in corporate databases. In addition, once all essential projects are completed, per WCF, the watershed is considered to have been "improved" or "restored". Similarly, this status is tracked in agency databases.

Restoration projects that occur in areas not specified as Priority Watersheds are also recorded in agency databases.

Monitoring, Verification and Adaptive Management in Restoration

Monitoring and adaptive management are essential to ensuring the success of restoration. As such, Forests will incorporate monitoring and adaptive management as fundamental components of their restoration programs, as described in this section. Specifically, Forests will implement WCF Monitoring as described below. In addition, implementation, effectiveness, and/or validation monitoring should be incorporated into project plans. Information gained from that monitoring should be shared to facilitate mutual learning and adaptive management.

- **WCF Monitoring**

The National WCF process includes two tiers of monitoring: Tier 1 monitoring is focused on performance accountability. That is, it is intended to assess whether the WCF process is being implemented properly. Tier 2 monitoring is a longer-term effort to develop relationships between focused restoration activities in a watershed and improvements in upland, channel, and aquatic habitat conditions.

Tier I monitoring guidance has recently been finalized (USDA Forest Service 2015c). It is designed to address the following questions to ensure that the WCF process has been correctly implemented:

- Were the watersheds properly classified?
- Were the indicator rule sets to classify the watersheds applied as described?
- Were the process and criteria used to select priority watersheds in alignment with WCF Step B recommendations?
- Is there a clear linkage between individual indicators and attributes and the restoration actions (essential projects) designed to improve watershed conditions.
- Has the suite of essential projects identified in the WRAP been completed?

- Is it reasonable to conclude that, with the completion of essential projects identified in the WRAP, the watershed is now on a trajectory to improve in overall condition?
- If applicable, were collaborators and partners involved in the implementation of the essential projects? What percentage of the work was accomplished using partnerships?
- Was the completion date of essential projects verified and documented in the appropriate database?
- Was the watershed condition class of the completed WRAP documented as improved in the database of record?
- Are improvements or changes to the Watershed Condition Framework or Tier 1 monitoring procedures needed?

Tier 2 monitoring guidance has not yet been finalized. Once completed, this monitoring direction will also guide Forest restoration monitoring programs.

- **Implementation, Effectiveness and Validation Monitoring**

Watershed restoration is based on best available science and practical experience. As such, there is a continuous stream of new knowledge that informs restoration planning and implementation. Restoration projects should be implemented, monitored, and subsequently modified to reflect what was learned through monitoring. Information from monitoring enters a feedback loop, improving future restoration actions (Roni et al. 2002). Reporting, publishing, and disseminating the success or failure of restoration projects will not only help a particular District or Forest learn, but will assist others within and outside the agency, adding to the restoration community's knowledge.

Implementation monitoring evaluates whether a project was conducted according to specific design criteria (e.g., best management practices). For example, this type of monitoring might involve an evaluation and documentation of whether an aquatic organism project was constructed according to the design specifications (e.g., 1.3x's bankfull width).

Effectiveness monitoring assesses whether a project met its intended goal. For example, when an aquatic organism project is implemented, effectiveness monitoring might evaluate whether the new stream crossing "simulates" a natural stream by evaluating stream channel and flow conditions at, above and below the structure. It might also directly monitor passage of different fish species and age classes.

Validation monitoring, generally the most expensive form of the three monitoring approaches, validates assumptions made in effectiveness monitoring. This type of monitoring might, for example, seek to test the hypothesis that simulating natural stream conditions under road crossings facilitates the upstream passage of aquatic organisms or improves fish populations. Because of its generally higher cost, validation monitoring is usually performed on a small subset of the overall number of individual restoration projects and/or whole watershed restoration programs that are implemented. This type of monitoring is generally implemented by research scientists.

12. Monitoring and Adaptive Management

Adaptive management is a continual process of adjusting actions in response to new information or knowledge (RIEC 2011). It is composed of an ongoing cycle of planning and implementing activities, monitoring through collection of data by observation or measurement, evaluation of those data and other relevant information, and subsequent adjustments in the overall process based on new knowledge (Figure 20). Scientists and policymakers generally recognize that adaptive management is necessary to effectively manage complex and poorly understood ecosystems (RIEC 2011, Bormann et al. 2007, Schreiber et al. 2004, McClain and Lee 1996, Walters 1986).

Figure 20. Adaptive management cycle, including planning, action, monitoring and evaluation.

Reflecting direction from the 2012 Planning Rule (36 CFR 219.12), this section outlines a consistent monitoring and adaptive management (MAM) framework for the ARCS and Forest plans built upon it, at the broad-scale and the Forest plan level. This framework is focused on enabling managers to make informed decisions by addressing key questions and reducing uncertainties at multiple scales. Some components of broad-scale monitoring will be implemented by the Regional Offices, whereas others will involve both Regional and Forest-level activities. ***The Forest plan monitoring components will be incorporated into local plans and/or plan documents as they are revised by individual Forests. If needed, Forests may add additional monitoring components to address additional or more specific questions needed to inform management of watershed and aquatic resources.*** Importantly, as described below, the broad-scale and Forest plan guidance of this framework are intended to efficiently work together and inform one another. Moreover, this monitoring is strongly linked with the assessment and watershed analysis components of the ARCS (Sections 7 and 10).

REFLECTING THE PRINCIPLES OF THE RIEC FRAMEWORK (2011) AND INTERIOR COLUMBIA BASIN STRATEGY (2014), THIS MAM FRAMEWORK FOCUSES ON USING MONITORING TO ANSWER THE FOLLOWING KEY QUESTIONS:

1) Are plans are being implemented correctly?
2) Are plans and activities effective in achieving desired results?

3) What is the status and trend of watersheds, water quality, and aquatic and riparian resources?
4) Are underlying assumptions of the plans valid?

In addition, this MAM framework provides a mechanism for accountability and oversight and provides a feedback loop, so that management direction and/or activities can be evaluated and modified at multiple spatial (project site to Region) and temporal scales (years to decades or more) by decision-makers at different levels of the agency (District Ranger to Regional Forester).

This framework uses a multi-scale approach because: 1) the ARCS and Forest plan components (e.g., desired conditions, objectives, standards and guidelines) cover a broad range of spatial and temporal scales, 2) the condition of watersheds and aquatic and riparian habitats is influenced by numerous processes operating at a similarly large range of scales (Figure 12), 3) the sensitivity to disturbance of different ecosystem components varies widely across those scales (Figure 13), and 4) adaptive management actions need to be taken by different people at different administrative levels over varying timeframes.

Broad-scale Monitoring

Monitoring Elements

- **ARCS Implementation**

This monitoring element is intended to answer the following question: *Are essential ARCS elements being implemented consistently and as intended across the region?*

This question will be addressed through Regional Office reviews of Forests, which may include representatives from other agencies (e.g., NOAA, USFWS, state agencies). The evaluations will include structured interviews of Forest staff and line officers, document reviews, and field visits. Key questions to be addressed include whether and how: 1) aquatic and riparian-dependent resources within RMAs are receiving primary emphasis through project analyses and implementation; (2) special management direction (standards and guidelines) are being implemented; (3) multi-scale analysis is being implemented and is being used to develop watershed-scale management/restoration strategies that refine desired conditions, management objectives and strategies; (4) restoration is being focused in Key Watersheds and WCF Priority Watersheds and, if passive/active restoration is being implemented to address the conservation of at risk species, important watershed conditions, and water quality issues; and (5) field units are using relevant monitoring to inform management activities.

Forest reviews will be conducted annually using existing regional (i.e. integrated forest program and NEPA/ESA, etc.) and interagency reviews (e.g., current PIBO reviews). Reviews would be focused on (1) evaluating whether essential ARCS elements are being implemented through forest programs and projects; (2) identify areas where Regional policies are unclear or challenging to implement; (3) review compliance with conservation measures associated with ESA consultation; and (4) identify Regional or Forest actions to improve implementation. All Forests will be evaluated approximately every 5-10 years. Forests with specific implementation issues based on annual monitoring could be reviewed more frequently.

- **Implementation and Effectiveness of ARCS Standards and Guidelines, including Water Quality Best Management Practices**

This monitoring element is intended to assess the following: *At a regional scale, are activities being implemented in a manner consistent with ARCS watershed/aquatic standards and guidelines, including water quality best management practices (BMPs), and other applicable policy and direction? Are they effective in protecting watershed conditions and aquatic habitats at project sites?*

THESE QUESTIONS WILL BE ADDRESSED THROUGH REGIONAL IMPLEMENTATION OF THE NATIONAL BMP AND BMP MONITORING PROGRAM.

Population of interest	activities associated with: aquatic ecosystems, chemical uses, facilities and non-recreation special uses, wildland fire, minerals, rangelands, recreation, roads, vegetation, and water uses.
Sampling methods	random sample of projects and activity sites, per National BMP monitoring protocols
Monitoring indicators	multiple field-based indicators, varying by activity type
Measurement scale	site-scale
Measurement protocol	National BMP monitoring protocols
Evaluation scale	site-scale
Evaluation methods	National BMP rating system
Analysis and reporting scale	Region and/or Province
Data Sources	FS database
Monitoring frequency	Annually
Evaluation and reporting frequency	Every 1-2 years
Responsibility	Regional Forester and Forest Supervisors

Beyond nationally standardized BMP monitoring, additional effectiveness monitoring will be conducted as needs and opportunities arise. Current broad-scale effectiveness monitoring activities are focused on evaluating the effectiveness of road restoration in reducing the hydrologic and geomorphic impacts of roads and improving habitat connectivity at road-stream crossings.

- **Status and Trend of Watersheds and Aquatic Habitat Conditions**

This monitoring element is intended to answer the following question: *What is status and trend of watershed and aquatic habitat conditions at provincial and regional scales?*

THE FOLLOWING REGIONAL MONITORING PROGRAMS WILL BE USED TO ADDRESS THIS QUESTION:

- Aquatic and Riparian Effectiveness Monitoring Program (AREMP), in western OR and WA and northern CA; and
- PACFISH/INFISH Biological Opinion Monitoring Program (PIBO), in the Interior Columbia River Basin

While the precise methods used by these programs differ somewhat, they generally involve the collection, gathering, and evaluation of data regarding upslope watershed conditions (AREMP only) and/or instream aquatic habitat conditions (AREMP and PIBO).

Upslope Watershed Conditions (AREMP only)

Population of interest	all 12-digit hydrologic units (HUs) in western OR, WA and northern CA (AREMP)
Sampling methods	complete census
Monitoring indicators	multiple GIS-based indicators, including roads and vegetative conditions
Measurement scale	multiple
Measurement protocols	various
Evaluation scale	12-digit HU
Evaluation methods	decision-support models (e.g., EMDS) that integrate multiple indicators into a watershed condition score; trends over time
Analysis and reporting scale	Region and Province
Data Sources	FS and other agency databases
Monitoring frequency	5-10 years
Evaluation and reporting frequency	5-10 years
Responsibility	Regional Forester

An example product of this type of monitoring is shown in Figure 21.

Aquatic Habitat Conditions

Population of interest	All 12-digit hydrologic units (HUs) in western OR and WA and northern CA (AREMP) and in the Interior Columbia River Basin (PIBO)
Sampling methods	random sample of 12-digit HUs (subwatersheds) and reaches within them, per AREMP and PIBO protocols
Monitoring indicators	multiple field-based indicators, including those pertaining to connectivity, pools, wood, substrate, macroinvertebrates, and stream temperature
Measurement scale	stream reach
Measurement protocols	applicable AREMP and PIBO field protocols
Evaluation scale	reach and/or 12-digit HU
Evaluation methods	departure from reference conditions (i.e., managed vs. reference watersheds) via habitat index models; departure from desired conditions or to other ecologically-relevant benchmarks; and/or trends over time
Analysis and reporting scale	Region and Province
Data Sources	FS and other agency databases
Monitoring frequency	annual sampling in selected watersheds and reaches, individual sites revisited every 5-10 years.
Evaluation and reporting frequency	5-10 years
Responsibility	Regional Forester

Example products of this type of monitoring are shown in Figures 22 and 23.

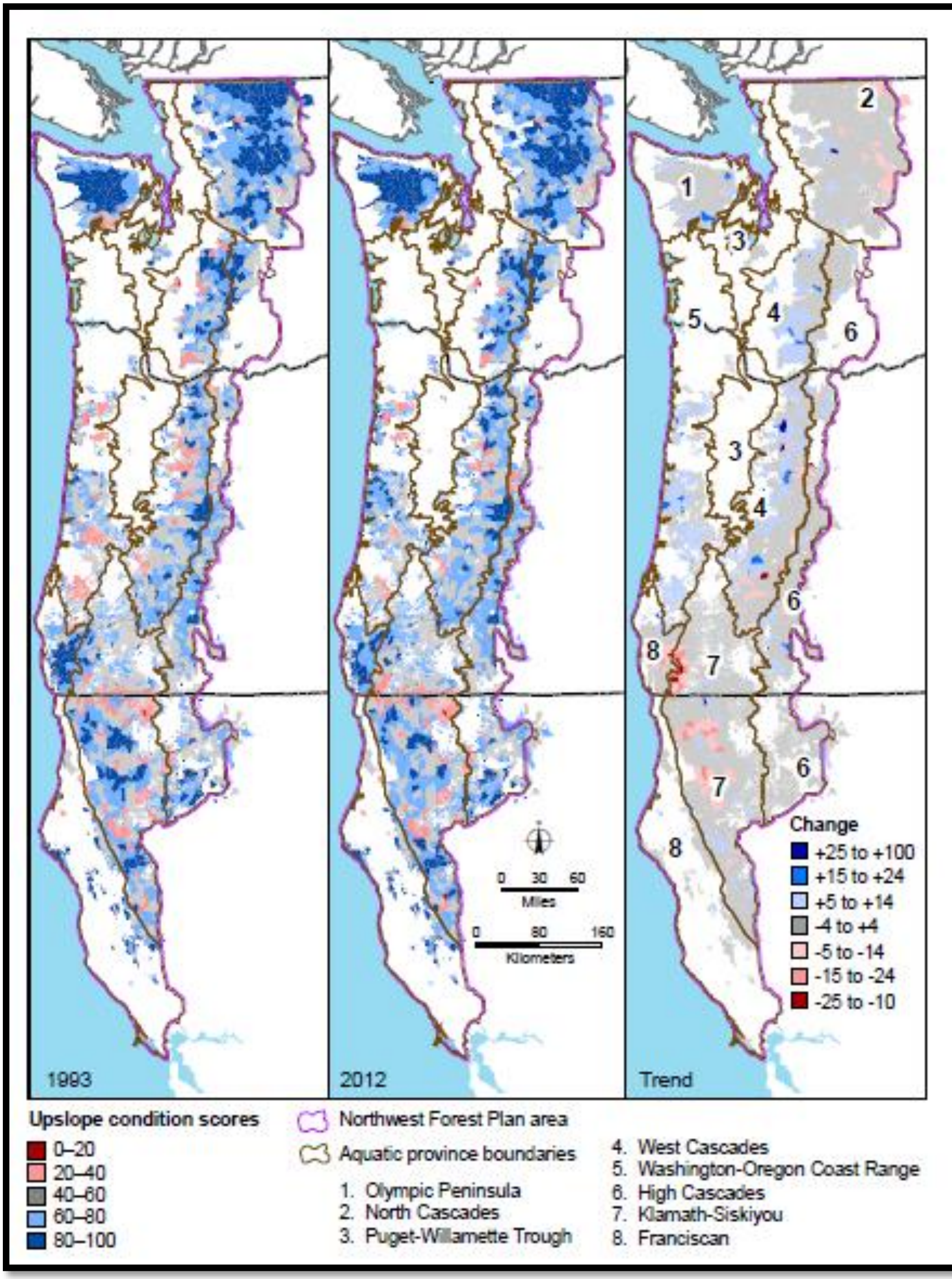


Figure 21. Status and trend of upslope watershed conditions in the Northwest Forest Plan area, 1993-2012
(Miller et al. 2017)

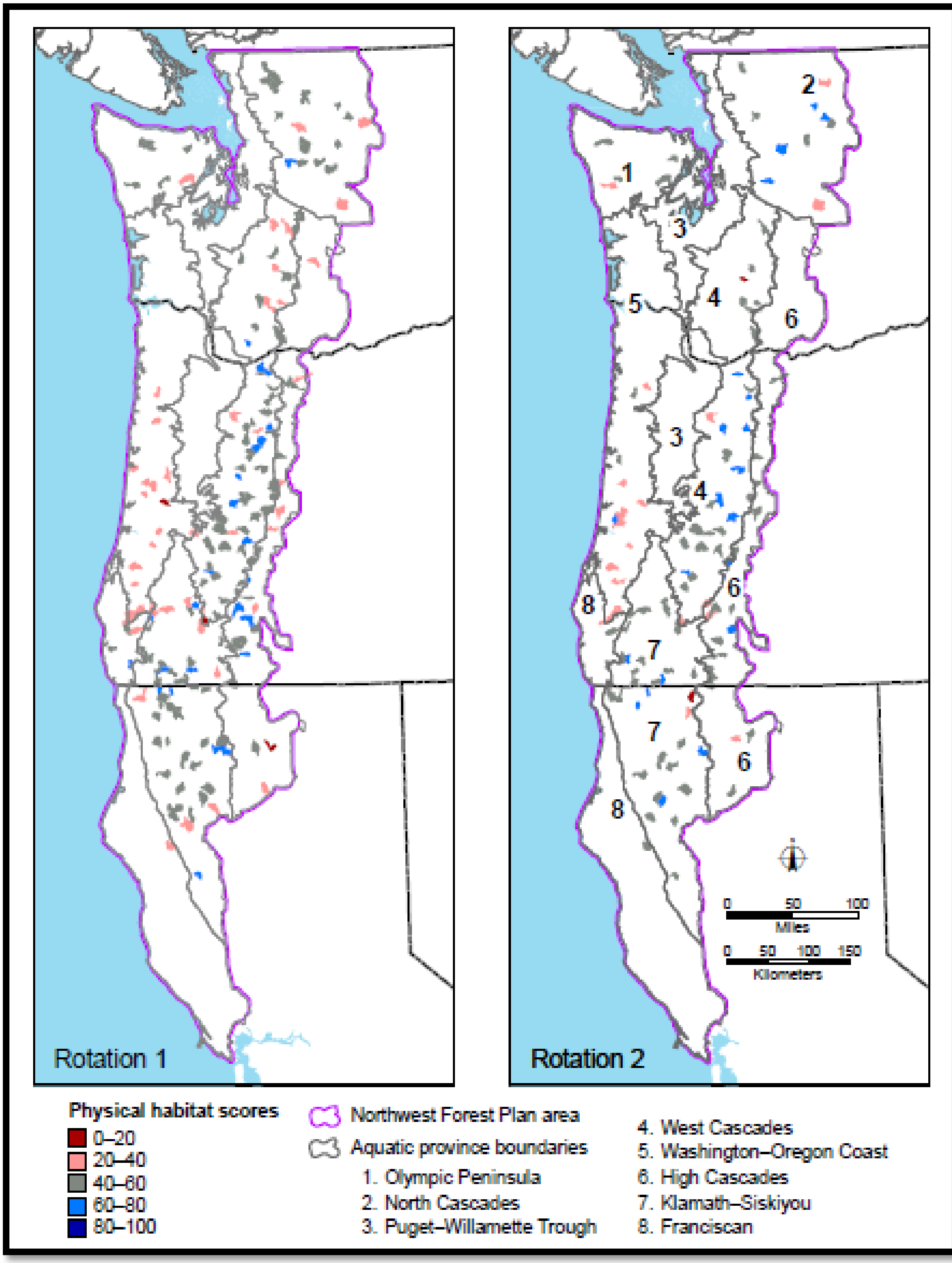


Figure 22. Spatial distribution of instream physical habitat scores for the Northwest Forest Plan area for two sampling rotations. (Miller et al. 2017)

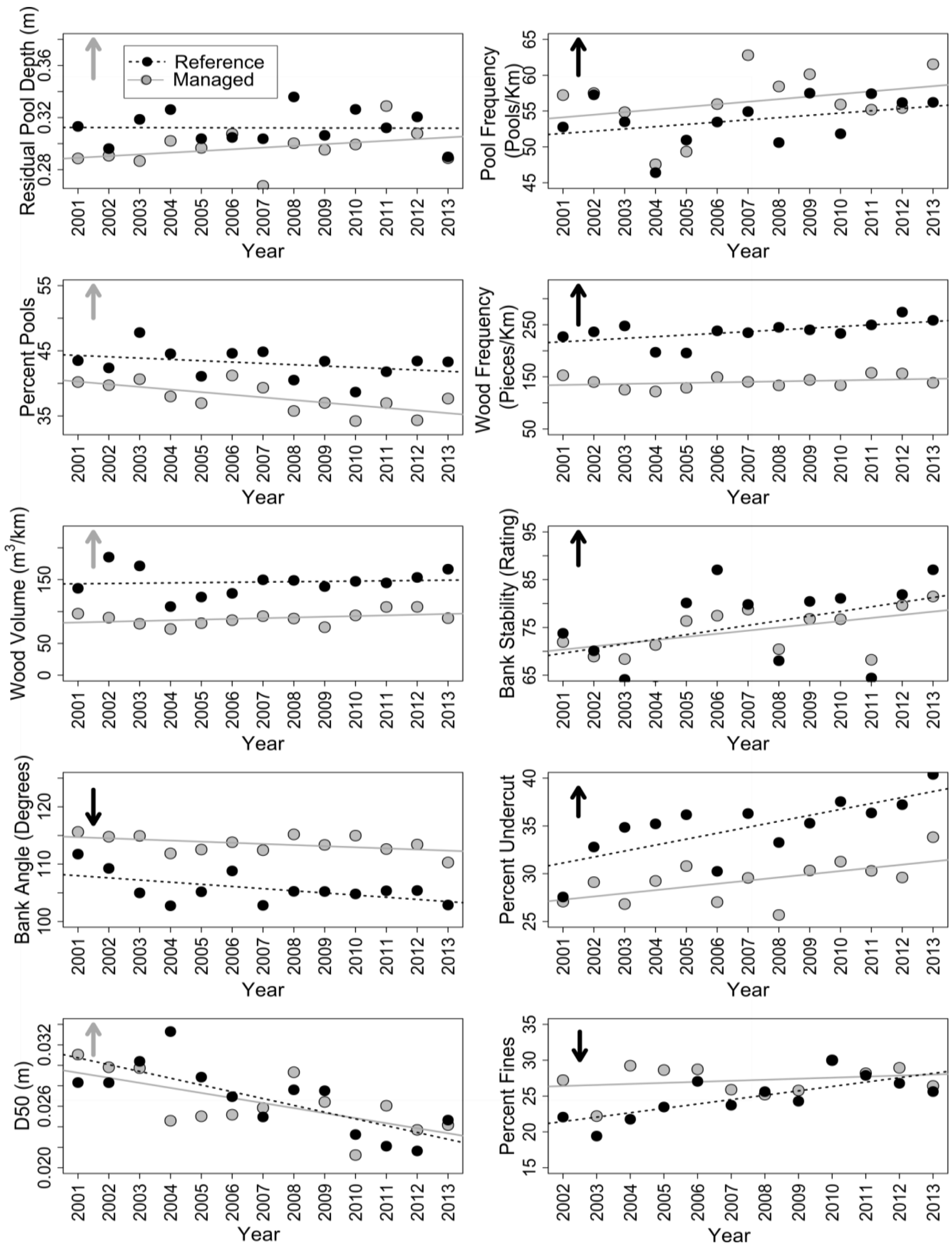


Figure 23. Trends in habitat conditions in reference and managed watersheds on Federal lands in the interior Columbia Basin, 2001-2012 (Roper 2014).

Arrows point to the direction of desired conditions based on PACFISH/INFISH Riparian Management Objectives (RMOs, black) or the literature (gray). As a whole, this data suggests that stream habitat conditions have been maintained or improved since PACFISH and INFISH were adopted.

- **Status and Trend of Stream Temperature**

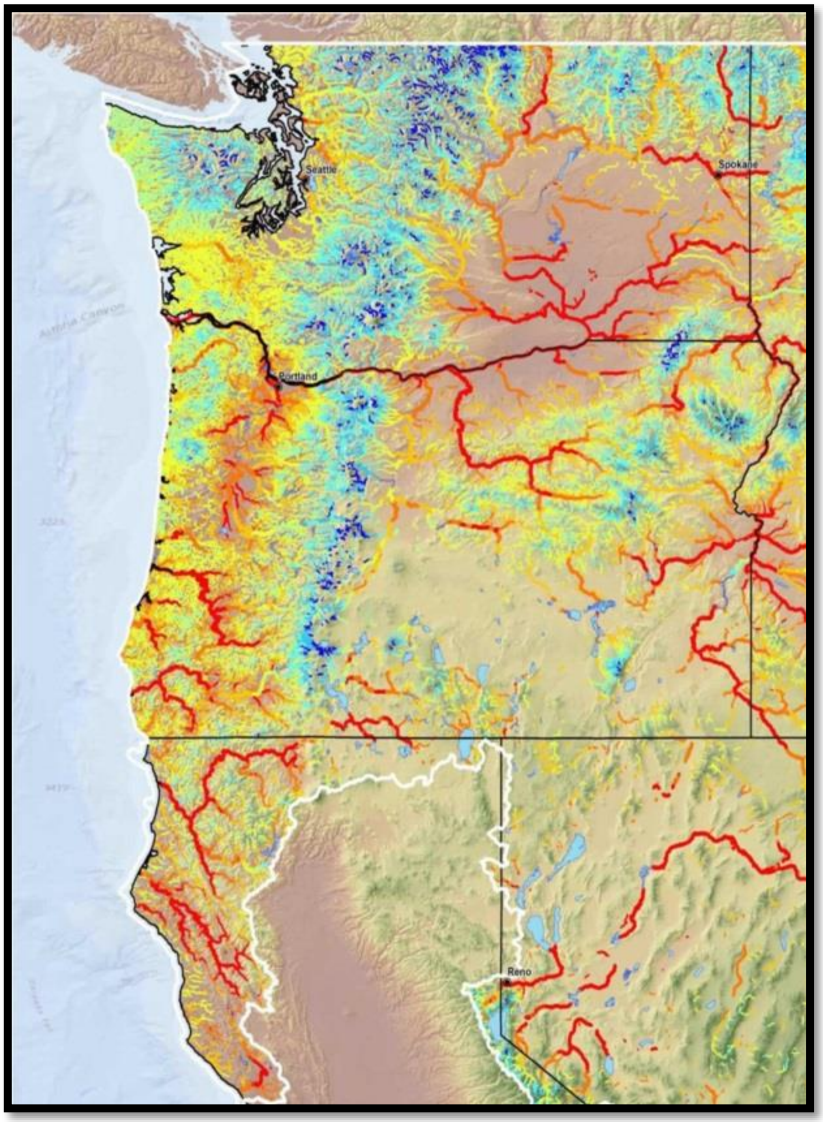
This monitoring element is intended to answer the following question: *What is status and trend of stream temperature at provincial and regional scales?*

This question will be answered through ongoing implementation of the NorWeST Regional Stream Temperature Database and Modeling Project[20]. This project uses data from extensive existing monitoring conducted by National Forests, other Federal agencies, States, Tribes, and other organizations. These data are integrated into a common dataset and used, together with empirical models, to develop basin-scale characterizations of stream temperature over different timeframes.

Population of interest	all perennial streams in OR and WA and northern CA
Sampling methods	combination of random and non-randomly selected stream reaches
Monitoring indicators	stream temperature
Measurement scale	point-scale
Measurement protocols	State-approved or comparable protocols
Evaluation scale	8-digit HU (river basin)
Evaluation methods	characterization of current status, past trends and potential future stream temperatures based on measured temperature and/or basin-scale empirical models and global circulation (climate) models
Analysis and reporting scale	Region to River Basin
Data Sources	FS and other agency databases
Monitoring frequency	Annual sampling in selected watersheds and reaches.
Evaluation and reporting frequency	5-10 years
Responsibility	Regional Forester and Forest Supervisors

An example product of this type of monitoring is shown in Figure 24.

[20] http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html



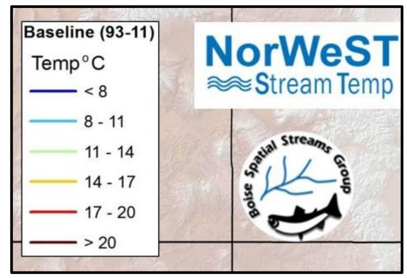


Figure 24. Spatial distribution of average August stream temperatures for the 1993-2001 baseline period.

Ongoing monitoring by National Forests, other Federal agencies, States, Tribes and non-governmental organizations will enable similar products to be developed in the future, so that temporal trends can be characterized.

- **Validation Monitoring**

This monitoring element is intended to answer the following question: *Are the foundational assumptions of ARCS and the associated Forest plans sound?* This type of monitoring is based on rigorous experimental designs and will thus generally be conducted with FS Research, universities, or other research organizations.

Validation monitoring will be conducted the least frequently of all monitoring activities, given the relatively large cost and long timeframes to address these types of questions. Currently, no specific validation monitoring questions have been identified as priorities to address via broad-scale or regional monitoring. Some potential questions could include:

- *Do current RMAs and associated Standards and Guidelines provide the same level of protection for water quality and aquatic and riparian species as was expected?*
- *Is the size and distribution of the Key Watershed network sufficient to achieve objectives?*
- *Do current watershed process models reasonably predict the parameters of interest (e.g., landslide risk, stream temperature, large wood debris loading)?*
- *Are current projections for climate change (e.g., snow, streamflows, stream temperatures) accurate?*
- *Does the focal species sustainability model/assessment reasonably reflect species status and trends and the influence that land management has on them?*
- *Does the current class of watershed condition indicators (e.g., near-stream roads) adequately characterize watershed conditions and their influence on water quality and aquatic habitat?*

Potential Adaptive Management Actions

Potential adaptive management actions associated with broad-scale monitoring would generally be taken by the Regional Forester(s). These would typically focus on significant issues occurring over broad areas (i.e., many Forests, millions of acres). Actions associated with ARCS implementation monitoring and BMP implementation and effectiveness monitoring would generally occur over short to medium time-scales (e.g., one to 5 years). Actions could include development or refinement of Regional policies and procedures, additional training and functional assistance trips to Forests, and direction to Forests to focus additional resources towards certain activities.

ARCS implementation monitoring might, for instance, show that Forests are not using multi-scale analyses to plan and implement projects on the ground. In response, the Regional Office could provide additional training and assistance in this and/or focus its reviews of future project plans and associated NEPA analyses to ensure that this is being done. In addition, BMP monitoring might indicate that road BMPs are being implemented at unacceptably low rates at a Regional scale. In response, the Region could provide direction to Forests to review relevant contracts to ensure that road BMPs are being properly incorporated and to increase oversight of this work on the ground (e.g., through contract administration).

If status and trend monitoring indicates that trends in watershed, aquatic habitat and/or stream temperatures are declining or are not improving at the desired rate, the Regional Forester(s) might direct Forests to: 1) emphasize existing plan direction, or 2) alter the type, scope, scale or location of different activities (e.g., watershed restoration, timber harvest, road building or decommissioning, fuels treatment) being implemented. Trend monitoring and/or validation monitoring results may also prompt Regional Foresters to refine or modify implementation of this strategy (ARCS), provide direction to Forests to develop new or revised Forest plan direction, or adjust approaches to implementing current plan direction. These actions would generally occur over medium to long time-scales (e.g., one to several decades).

Forest Plan Monitoring

Monitoring Elements

- **Plan Implementation**

This monitoring element is intended to assess the following: *Are watershed/aquatic restoration projects (e.g., road improvement and decommissioning, fish passage improvements, riparian and stream habitat improvements, aquatic invasive species treatments, etc.) being implemented at a rate consistent with plan objectives?* This monitoring is responsive to the 2012 Planning Rule 219.12.a.5, elements ii-iv, vi, and vii.

ii) status of select ecological conditions
iii) status of focal species (related to 219.9 Diversity)
iv) status of ecological conditions (see 219.9) related to T&E, candidate, and conservation concern species
vi) changes due to climate change and other stressors
vii) progress toward meeting DCs and Objectives, including multiple use opportunities.

Plan component	Objectives
Population of interest	all activities with established plan objectives relevant to watershed and aquatic resources
Sampling methods	complete census
Monitoring indicators	annual and multi-year accomplishment metrics (e.g., stream miles or watersheds improved)
Measurement scale	Project
Measurement protocol	FS accomplishment reporting procedures
Analysis and reporting scale	Forest
Evaluation scale	Forest
Evaluation methods	GIS summaries
Data Sources	FS databases
Monitoring frequency	Annually
Evaluation and reporting frequency	Every 2 years
Plan Monitoring Element (219.12.a.5)	ii-iv, vi-vii
Responsibility	Forest Supervisors

- **Implementation and Effectiveness of Plan Standards and Guidelines, including Water Quality Best Management Practices**

Similar to the broad-scale monitoring described previously, this monitoring element is intended to answer the following question: *Are activities being implemented in a manner consistent with watershed/aquatic standards and guidelines, including water quality best management practices (BMPs), and other applicable policy and direction? Are the projects effective in protecting watershed conditions and aquatic habitats at a site-scale?*

THE SAME DATA, EVALUATION METHODS, AND EVALUATION FREQUENCIES DESCRIBED UNDER BROAD-SCALE MONITORING WILL BE USED TO ANSWER THIS QUESTION AT A FOREST SCALE. However, only the data from the Forest of interest will be used to assess implementation and effectiveness of Standards, Guidelines and BMPs associated with a specific Forest plan.

This monitoring element is responsive to the 2012 Planning Rule 219.12.a.5, elements i-iii.

i) status of select watershed conditions
ii) status of select ecological conditions
iii) status of ecological conditions (see 219.9) related to T&E, candidate, and conservation concern species

Plan component	Standards and Guidelines
Population of interest	Forest-selected activities that could including those pertaining to vegetation management, roads, range, minerals, fire and fuels, and water uses.
Sampling approach	random sample of projects and activity sites, per National BMP monitoring protocols
Monitoring indicators	multiple field-based indicators, varying by activity
Measurement scale	site-scale
Measurement protocol	National BMP monitoring protocols
Evaluation scale	site-scale
Evaluation methods	National BMP rating system
Analysis and reporting scale	Forest
Data Sources	FS database
Monitoring frequency	Annually
Evaluation and reporting frequency	Every 2 years
Plan Monitoring Element (219.12.a.5)	i-iii
Responsibility	Forest Supervisors

Status and Trend of Watersheds and Aquatic Habitat Conditions

Similar to the broad-scale monitoring described previously, this monitoring element is intended to answer the following question: *What is status and trend of watershed conditions at a Forest scale? Are conditions trending towards desired conditions?*

The same data, evaluation methods, and evaluation frequencies described under broad-scale monitoring will be used to answer this question at a Forest scale. However, only the data from the Forest of interest will be used to assess how conditions there compare with desired conditions, how they fit within the distribution of reference sites or to other ecologically-relevant benchmarks across larger domains (e.g., Interior Columbia River Basin, similar ecoregions), and/or how they change over time (see Figure 25 for an example).

This monitoring element is responsive to the 2012 Planning Rule 219.12.a.5, elements i-iv and vi-vii.

- i) status of select watershed conditions
- ii) status of select ecological conditions
- iii) status of focal species (related to 219.9 Diversity)
- iv) status of ecological conditions (see 219.9) related to T&E, candidate, and conservation concern species
- vi) changes due to climate change and other stressors
- vii) progress toward meeting DCs and Objectives, including multiple use opportunities.

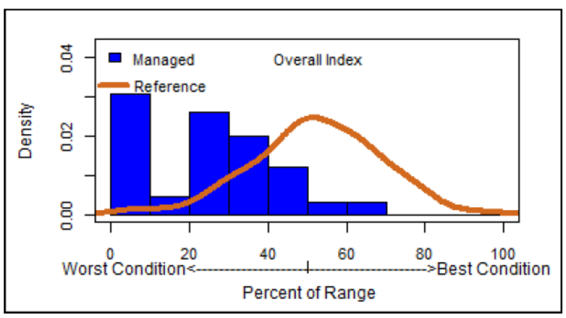


Figure 25. Status and trends of stream habitat conditions on the Malheur National Forest, 2001-2012.

Metric	Desired Change	Actual Change (%)
Overall Habitat Index	+	+8.8
Macroinvertebrates	+	+3.3
Streambank Stability	+	+5.2
% Undercut Streambanks	+	+16.4
Large Wood Frequency	+	+34.1
Bank Angle	-	-2.6
% Fines in Pool Tails	-	+1.8
Median Substrate Size	+	+9.3
Residual Pool Depth	+	+10.2
% Pools	+	-4.7

The figure shows the current status of stream habitat conditions via an overall habitat index [Archer and Ojala (2016b) using the approach of Al-Chockhatchy et al. (2010)]. The accompanying table shows trends in the overall habitat overall index as well as for individual habitat metrics. Cells highlighted in dark green show metrics that have statistically significant changes in the desired direction (+ or -). Metrics in light green cells have changed in the desired direction, but the changes are not statistically significant. Metrics shown in light red have changed in the direction opposite of what is desired, but those changes are not significant. Future monitoring will continue to evaluate status and trends in managed and reference condition watersheds.

Status and Trend of Aquatic Species Distribution

This Forest plan monitoring element is intended to answer the question: *Are native aquatic populations, especially ESA-listed species and species of conservation concern, maintaining or trending toward their desired distribution?*

While the range of a species can be maintained through increasing population resiliency, range can be increased through management actions such as aquatic organism passage projects, invasive species eradication/control, rare species reintroductions, and providing suitable habitat. The Regional Fish Distribution Database is a means for tracking fish distribution through time. The database is supported by USFS fish distribution data (Level 2 stream surveys, redd counts, and other biological surveys) and periodic data exchanges with other fish distribution databases in Oregon and Washington. Other data sources are USFWS, NMFS, state fish and wildlife agencies, and interagency species status assessments.

The scale of this monitoring component is Forest-wide. The frequency of assessment is every 15 years for each species. Forest-wide assessments should compare the current distribution of aquatic ESA-listed species and species of conservation concern with their distribution during the previous planning cycle. The analysis should include a discussion of the factors associated with species distribution increase or decrease. If a species distribution experienced a significant decrease due to factors within USFS control, adjustments should be made in management actions to address the impacts at the District and Forest levels. The relevance of species distribution decrease over a planning cycle (15 years) should be determined at the Forest level and should consider natural stochastic events such as wildfires, but also any anthropogenic impacts upon population resiliency to those disturbances.

This monitoring element is responsive to the 2012 Planning Rule 219.12.a.5, elements i-iv, vi, and vii.

- i) status of select watershed conditions
- ii) status of select ecological conditions
- iii) status of focal species (related to 219.9 Diversity)
- iv) status of ecological conditions (see 219.9) related to T&E, candidate, and conservation concern species
- vi) changes due to climate change and other stressors
- vii) progress toward meeting DCs and Objectives, including multiple use opportunities.

Plan component	Desired Conditions
Population of interest	ESA-listed species and species of conservation concern aquatic species distribution throughout Forest
Sampling approach	Comparison of species distribution currently with the last planning cycle, 15 years ago.
Monitoring indicators	Increase or decrease of species range.
Measurement scale	Forest scale
Measurement protocol	Comparison of species distribution over a decade
Evaluation scale	Forest-wide
Evaluation methods	Use Regional Fish Distribution Database, other agencies' data sources, and status assessments to inform comparison.
Analysis and reporting scale	Forest-wide
Data Sources	Regional Fish Distribution Database, other agencies' data, and species status assessments
Monitoring frequency	Variable, based upon species and unit
Evaluation and reporting frequency	Every 15 years
Plan Monitoring Element (219.12.a.5)	i-iv, vi-vii
Responsibility	Forest Supervisors

Status and Trend of Stream Temperature

Similar to the broad-scale monitoring described previously, this monitoring element is intended to answer the following question: *What is status and trend of stream temperature at a Forest scale? Are conditions trending towards desired conditions?*

The same data, evaluation methods, and evaluation frequencies described under broad-scale monitoring will be used to answer this question at a Forest scale. However, only the data from the Forest of interest will be used to assess how conditions on that unit.

This monitoring element is responsive to the 2012 Planning Rule 219.12.a.5, elements ii, vi, and vii.

- ii) status of select ecological conditions
- vi) changes due to climate change and other stressors
- vii) progress toward meeting DCs and Objectives, including multiple use opportunities.

Validation Monitoring

Similar to the validation component of broad-scale monitoring, Forests may undertake some validation monitoring at the discretion of the local line officer. This type of monitoring is likely to be very limited at a plan level. Forests should coordinate with the Regional Office prior to embarking on this type of monitoring.

Adaptive Management

Potential adaptive management actions associated with Forest plan monitoring would generally be taken by local line officers (District Rangers and Forest Supervisors). Actions associated with Plan implementation monitoring would generally occur over short time-scales (e.g., yearly or every 2-3 years). These could include increasing or decreasing the type, scope, scale or location of different activities (e.g., watershed restoration, timber harvest, road building or decommissioning, fuels treatment).

Actions associated with implementation and effectiveness monitoring of Plan standards and guidelines and Water Quality BMPs would typically occur over short time-scales (e.g., every 1-2 years). They could include correcting problems identified at monitored sites (e.g., addressing excessive erosion a road-stream crossing). They could also address broader programmatic issues such as needs to improve project designs (e.g., ineffective culvert design) or oversight of their implementation (e.g., poor construction practices).

Status and trend monitoring results would generally inform actions over moderate to long time-scale (e.g., a decade or more). They could include increasing or decreasing the type, scope, scale or location of different activities (e.g., watershed restoration, timber harvest, road building or decommissioning, fuels treatment), improving implementation of key plan components, or adding or refining those plan components via a Plan amendment or revision.

Linkages Between Monitoring, Assessment and Watershed Analysis

AS DESCRIBED IN SECTIONS 7 AND 10, THE ASSESSMENT INFORMS PLAN DEVELOPMENT, REVISION OR AMENDMENT AND WATERSHED ANALYSIS INFORMS PLAN IMPLEMENTATION. THOSE PROCESSES AND PRODUCTS ARE LINKED TO MONITORING.

First, as described in Section 10, the findings from status and trend monitoring will be used as part of watershed analysis for specific watersheds. Analysis teams will, for example, use those results to characterize how upslope and instream conditions and trends for a particular watershed fit within the distribution of conditions and trends across all reference and managed watersheds within a larger area (e.g., subbasin, basin, Forest). From there, they will use other information for the analysis watershed to more completely and accurately assess watershed and aquatic habitat conditions, determine why (cause/effect) those conditions exist (e.g., natural disturbance or human impacts), and identify what actions might be warranted in the watershed and generally where they should be implemented.

Second, the watershed condition assessment, including Tier 1 monitoring, and viability assessment described in Section 6 serve as a coarse form of long-term monitoring. Since WCF assessments will be completed about every 5 years and viability assessments will be completed before each plan revision, analysis teams can determine changes in watershed condition and species viability between plan revisions. This information can be used to inform future plan development, revisions or amendments.

13. Coordination and Cooperation

Internal and external coordination and cooperation is essential to ensure successful management of waterbodies and their associated riparian areas and biota. As such, USFS Watershed and Fisheries professionals and other staff will continue to collaborate to accomplish management goals for aquatic and riparian habitat and work with neighboring landowners and other agencies, Tribes, organizations, and individuals to cooperatively manage watersheds across ownership boundaries. Sharing personnel and resources is essential to successful whole watershed management across all lands.

Considering limited personnel and funding, collaboration between agencies with a role in the management of fish, wildlife, and/or water resources is necessary for any of the agencies to fulfill their mission. This has always been true, but has become more of a necessity today as science continues to illuminate the complexities of the management of water quality and fish and wildlife species. For example, management actions such as rare species management, habitat restoration, stocking, harvest, and invasive species control and eradication require collaboration. ***As such, the USFS will collaborate with other agencies, organizations, and Tribes with the development and implementation of conservation agreements and strategies. For example, the USFS will cooperate with Federal, tribal, and State fish management agencies to identify and eliminate impacts associated with habitat manipulation, fish stocking, harvest, and poaching that may threaten the continued existence and distribution of native fish and other aquatic and riparian biota on Federal lands. Similar coordination will occur with State water quality agencies to address impacts to water quality on Federal lands. Forests will cooperate with State and Tribal agencies when aquatic invasive species eradication projects are proposed. State and/or Tribal agencies will take the lead on projects and be responsible for necessary public notification and coordination. Forests will also coordinate and cooperate with State water and water quality management agencies to better align and integrate programs and ensure compliances with applicable laws and regulations.***

14. Risks and Uncertainties

As with any strategy designed to protect and restore ecosystems, it is uncertain whether the ARCS will achieve its goals. There are risks that it may not. These risks and uncertainties stem from several key factors. First, knowledge of these highly complex systems, including the recovery rates of key ecosystem processes, is incomplete. These knowledge gaps mean that the ARCS may be missing key components, though recent research suggests it does not (Reeves et al. 2017). Moreover, the effectiveness of some existing aspects of the strategy has not been fully demonstrated. For instance, there are few examples of successful restoration at the scales of interest (i.e., typically watershed or subbasin, over long-timeframes). At the same time, new threats, such as climate change and invasive species, have emerged and substantially increased risks to and uncertainties associated with watersheds and aquatic ecosystems.

Besides risks and uncertainties associated with the composition of the ARCS, full implementation of the strategy is not guaranteed. For example, implementation is strongly dependent on future budgets and a robust, highly-skilled workforce with access to adequate resource information. However, skills and capacity on Forests in the Region have declined in the past 20 years and future declines are possible. Another key source of risk and uncertainty is the fact that the ARCS pertains only to NFS lands in the Pacific Northwest Region and portions of the Pacific Southwest Region. It does not apply to habitat impacts (including dam operations) and biological impacts (including the introduction of non-native fish) off National Forests or activities on other Federal lands and State and private lands. These activities continue to have a large influence on the maintenance and recovery of aquatic ecosystems and water quality.

15. Conclusion

This strategy is designed to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on NFS lands throughout the Pacific Northwest Region and portions of the Pacific Southwest Region. It is a single, unified strategy that integrates and refines the three existing strategies in the region: NWFP-ACS, PACFISH, and INFISH. Consistent with these existing strategies, the goal of ARCS is to develop networks of properly functioning watersheds supporting populations of fish, other aquatic and riparian-dependent organisms, and State-designated beneficial uses of water across the Region while enabling provision of ecosystem services for multiple uses, including outdoor recreation, range, timber, and wildlife.

ARCS adopts and builds upon the basic structure and elements of the existing strategies because science supports their general framework and assumptions, there is evidence those strategies are working, and there is public support for them. ARCS includes, however, some specific refinements to provide better alignment with recent science and information and new policy direction, particularly the 2012 Planning Rule. It also incorporates lessons learned during 20-years of implementing those strategies.

ARCS itself is not Forest plan direction. Instead, it is a regional strategy for revising Forest plans under the 2012 Planning Rule and implementing other administrative direction. It is intended to provide the minimum core set of plan components (e.g., desired conditions, suitability, objectives, and standards and guidelines) and other plan content to guide watershed and aquatic and riparian resource management throughout the Region.

As such, elements of ARCS may be refined as each Forest works through its interdisciplinary team and collaborative public processes, provided those refinements are based on best available science, are aligned with ARCS goals, and provide comparable outcomes. Moreover, it is expected that Forests will add specificity and local detail as needed to tailor management of watersheds and aquatic and riparian resources to local ecological, social, and economic systems and conditions. Integration with plan direction primarily associated with other resources will be essential.

This version of ARCS (2017) may be updated in the future to address new science or policy needs.

16. Preparers and Contributors

Many people contributed towards the development of the aquatic strategies in the Pacific Northwest and Pacific Southwest Regions, including this version of ARCS.

The principal preparers of this version of ARCS were:

- Brian Staab, Regional Hydrologist, USFS-Pacific Northwest Region
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- Michael Hampton (retired), Regional Planner, USFS-Pacific Northwest Region

Management direction was provided by:

- James Peña, Regional Forester, USFS-Pacific Northwest Region
- Marie-Louise Smith, Director of Natural Resources, USFS-Pacific Northwest Region
- Ric Rine (retired), Director of Resource Planning and Monitoring, USFS-Pacific Northwest Region
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- Julie Riber, Director of Resource Planning and Monitoring, USFS-Pacific Northwest Region
- Jackie Andrew (retired), Assistant Director of Resource Planning and Monitoring, USFS-Pacific Northwest Region

This work built upon and refined a previous version of ARCS developed in 2008, principally by:

- Dave Heller (retired), Regional Fisheries Biologist, USFS-Pacific Northwest Region
- Bruce McCammon (retired), Regional Hydrologist, USFS-Pacific Northwest Region
- Ken MacDonald (retired), Forest Fisheries Biologist, Okanogan-Wenatchee National Forest
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Numerous applied scientists from many disciplines, engineers, planners and managers from the Regional Offices and National Forests throughout the Pacific Northwest and Pacific Southwest provided critical review and input to this strategy. It was founded on decades of discussions with Regional and Forest interdisciplinary teams in Regions 1, 4, 5, and 6 of the Forest Service, numerous other Federal and State agencies, non-governmental organizations, the public, and research scientists about the existing aquatic strategies. It was further informed by the work of the teams implementing NWFP-Aquatic and Riparian Effectiveness Monitoring Program (AREMP) the Pacfish-Infish Biological Monitoring Program (PIBO).

The following research scientists provided critical input to and/or review of this ARCS and previous versions:

- Gordon Reeves, Research Fisheries Biologist, USFS-Pacific Northwest Research Station
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In addition, valuable contributions to this ARCS were made through interagency consultations with the following individuals and their representatives:

- Nancy Munn, NOAA-Fisheries-Interior Columbia Basin Office
- Rollie White, US Fish and Wildlife Service-Pacific Region
- Eric Murray, NOAA-Fisheries-Oregon and Washington Coastal Area Office
- Eric Hein, US Fish and Wildlife Service, Pacific Region
- Teresa Kubo, US Environmental Protection Agency, Region 10

ARCS was built on the foundation established by the existing aquatic strategies (NWFP-ACS, PACFISH, and INFISH) developed in the early 1990s by Jim Sedell, Gordon Reeves, Norm Johnson, Jerry Franklin, Jack Ward Thomas, and John Gordon, the FEMAT science team and many others.

Linda Goodman, Regional Forester-Pacific Northwest Region (retired), first sanctioned the development of a unified regional aquatic strategy in 2001.

Undoubtedly and regrettably, important contributions from many others have been unintentionally omitted.

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18. Abbreviations

ACS: Aquatic Conservation Strategy of the Northwest Forest Plan

ARCS: Aquatic and Riparian Conservation Strategy

ARS: Aquatic Restoration Strategy

AREMP: Aquatic and Riparian Effectiveness Monitoring Program of the Northwest Forest Plan

BLM: Bureau of Land Management

BMP: Best Management Practice, per Clean Water Act

CERCLA: Comprehensive Environmental Response Compensation and Liability Act

ESA: Endangered Species Act

CWA: Clean Water Act

FEMAT: Forest Ecosystem Management Assessment Team

HU: Hydrologic Unit

MAM: Monitoring and Adaptive Management

NOAA: National Oceanic and Atmospheric Administration

NEPA: National Environmental Policy Act

NFS: National Forest System

NWFP: Northwest Forest Plan

PIBO: PACFISH-INFISH Biological Opinion

RMA: Riparian Management Area

RMO: Riparian Management Objective

USFWS: United States Fish and Wildlife Service

USFS: United States Forest Service

WRAP: Watershed Restoration Action Plan

WCF: Watershed Condition Framework

19. Glossary

Anadromous fish: fish that spend their early life in freshwater, move to the ocean to mature, and then return to freshwater to reproduce.

Anchor population*:* population stronghold, source for supplementing or refounding smaller, more vulnerable surrounding populations.

Active floodplain: Active floodplain is defined as the area bordering a stream inundated by flows at a surface elevation defined by two times the maximum bankfull depth measured at the thalweg.

Active Restoration: The deliberate activities related to restoration. As an example, this might include seeding native grasses and planting native trees.

Assessment: The identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents, but provide current information on select topics relevant to the plan area, in the context of the broader landscape (2012 Planning Rule).

Aquatic (and riparian) health: Aquatic and riparian habitats that support animal and plant communities that can adapt to environmental changes and follow natural evolutionary and biogeographic processes. Healthy aquatic and riparian systems are resilient and recover rapidly from natural and human disturbance. They are stable and sustainable, maintaining their organization and autonomy over time, and are resilient to stress. In a healthy aquatic/riparian system there is a high degree of connectivity from headwaters to downstream reaches, from streams to floodplains, and from subsurface to surface. Floods can spread into floodplains, and fish and wildlife populations can move freely throughout the watershed. Healthy aquatic and riparian ecosystems also maintain long-term soil productivity. Mineral and energy cycles continue without loss of efficiency. (www.icbemp.gov/) [section 1 page 5]

Aquatic ecosystem: Any body of water, such as a stream, lake or estuary, and all organisms and nonliving components within it, functioning as a natural system. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Channel migration zone (CMZ): the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings. CMZs are those areas with a high probability of being subject to channel movement based on the historic record, geologic character and evidence of past migration. It should also be recognized that past action is not a perfect predictor of the future and that human and natural changes may alter migration patterns. Consideration should be given to such changes that may have occurred and their effect on future migration patterns.

Coarse filter management: Land management that addresses the needs of all associated species, communities, environments and ecological processes in a land area (see fine filter management)

Connectivity: The arrangement of habitats that allows organisms and ecological processes to move across the landscape. Patches of similar habitats are either close together or linked by corridors of appropriate vegetation. The opposite of fragmentation. (www.icbemp.gov/) [pg 33]

Connectivity (of habitats): The degree in which habitat patches are connected.

Decommission: To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. Another term for this is "hydrologic obliteration." FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Degrade: A change to an existing condition to one that is measurably worse.

Desired Conditions: Descriptions of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates.

Ecological health: - The state of an ecosystem in which processes and functions are adequate to maintain diversity of biotic communities commensurate with those initially found there. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Ecosystem health: A condition where the parts and functions of an ecosystem are sustained over time and where its capacity for self-repair is maintained, such that goals for uses, values, and services of the ecosystem are met. (www.icbemp.gov)

Evolutionary Significant Unit (ESU): a group of salmon or trout populations that is a distinct population segment. Scientists established two criteria for ESUs: 1) the population must show substantial reproductive isolation; and 2) there must be an important component of the evolutionary legacy of the species as a whole.

Facultative Plants: Plants that occur usually (estimated probability >67 percent to 99 percent) in wetlands, but also occur (estimated probability 1 percent to 33 percent) in non-wetlands (USCOE Wetlands Delineation Manual).

Fine-filter management: Management that focuses on the welfare of a single or only a few species rather than the broader habitat or ecosystem (see coarse filter management).

Forest road or trail: A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization (Title 36, Code of Federal Regulations, Part 212—Administration of the Forest Transportation System, section 212.1.)

Freshwater: Water that generally contains less than 1,000 milligrams-per-liter of dissolved solids.

Geographic Areas: Spatially contiguous land areas identified within the planning area. A geographic area may overlap with a management area.

Guidelines: Constraints on project and activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met (36 CFR 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Herbicide: A chemical pesticide designed to control or destroy plants, weeds, or grasses.

Hyporheic zone: The hyporheic zone is a region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone (termed hyporheic flow) is recognized to be important for surface water/groundwater interactions, as well as fish spawning, among other processes.

INFISH: Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (Forest Service). (www.icbemp.gov/)

Insecticide: A pesticide compound specifically used to kill or prevent the growth of insects.

Landscape: A collection of biophysical elements and ecosystem types that occupy relatively large (10^5-10^7 acres) contiguous areas (Hunter 1996, Concannon et al. 1999).

Late-seral condition: The existing riparian vegetation community is similar to the potential natural community composition, per Winward (2000).

Late-season grazing: Grazing that generally begins after sugar storage in woody vegetation is complete and leaf fall has started. Upland plant seeds have shattered and mean air temperatures begin to cool.

Leasable minerals: Minerals that may be leased to private interests by the Federal government. Leasable minerals include oil, gas, geothermal resources, and coal. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Maintain: To produce no change in the existing conditions of a resource relative to their condition status (i.e., properly functioning, functioning at risk, or not functioning properly). Conditions that are “maintained” are neither restored nor degraded, but remain essentially the same as the existing condition. The term “maintain” can apply to any condition indicator at the appropriate scale, but those scales need to be identified.

Management areas: Land areas identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous.

Meta-population: A population comprising local populations that are linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Mitigation: Modifications of actions taken to:

- avoid impacts by not taking a certain action or parts of an action;
- minimize impacts by limiting the degree or magnitude of the action and its implementation;
- rectify impacts by repairing, rehabilitating, or restoring the affected environment;
- reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or,
- compensate for impacts by replacing or providing substitute resources or environments.

Municipal Supply Watershed: A watershed that serves a public water system as defined in the Safe Drinking Water Act of 1974, as amended (42 U.S.C. §§ 300f, et seq.); or as defined in state safe drinking water statutes or regulations.

Natural Disturbance Regime: NDRs are characterized by the pattern and dynamics of disturbance events that mold the structure and species composition of an ecosystem. The natural disturbance regime concept includes disturbance distribution, frequency, rotation period, predictability, area disturbed, and magnitude intensity (or severity). Distribution is how the disturbances are spatially organized across a landscape. Frequency is the mean number of events per time period. Magnitude intensity is the physical force of the event. There is interplay between the conditions of an area and the natural disturbance regime and how they are influenced by each other over time (Mendez and Stone 2009, Frelich 2003, Pickett and White 1985, and Turner et al. 2001).

Natural Range of Variation (NRV) and Natural Disturbance Regimes: The variation of ecological characteristics and processes over scales of time and space that are appropriate for a given management application. In contrast to the generality of historical ecology, the NRV concept focuses on a distilled subset of past ecological knowledge developed for use by resource managers; it represents an explicit effort to incorporate a past perspective into management and conservation decisions (adapted from Weins, J.A. et al., 2012). The pre-European influenced reference period considered should be sufficiently long, often several centuries, to include the full range of variation produced by dominant natural disturbance regimes such as fire and flooding and should also include short-term variation and cycles in climate. The NRV is a tool for assessing the ecological integrity and does not necessarily constitute a management target or desired condition. The NRV can help identify key structural, functional, compositional, and connectivity characteristics, for which plan components may be important for either maintenance or restoration of such ecological conditions.

Objectives: Concise, measurable, and time-specific statements of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets.

Obligate species: A plant or animal that occurs only in a narrowly defined habitat such as tree cavity, rock cave, or wet meadow. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

PACFISH: Interim Strategies for Managing Pacific Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California. (www.icbemp.gov/)

Passive Restoration: Allowing a site to self-restore through natural processes.

Priority Watershed: as referenced in Chapter 20 of the Land Management Planning Handbook, Priority Watersheds are those 12-digit hydrologic unit watersheds specifically identified as the focus for investments in maintenance or improvement of watershed conditions (soil and hydrologic functions supporting aquatic ecosystems) that have been established under the agency's Watershed Condition Framework (WCF) process. http://www.fs.fed.us/biology/watershed/condition_framework.html

Pesticide: Substances or mixture there of intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

Recovery unit: A management sub-unit of a Federal ESA-listed entity, geographically or otherwise identifiable, that is essential to the recovery of the entire listed entity. It conserves genetic or demographic robustness, important life history stages, or other feature for long-term sustainability of the entire listed entity. Recovery criteria for the listed entity should address each identified recovery unit. Every recovery unit must be recovered before the species can be delisted.

Reference Condition: A set of selected measurements or conditions of unimpaired or minimally impaired waterbodies characteristic of a water body type in a region. A standard or benchmark for a river monitoring program that measures physical and/or biological integrity.

Refugia: Locations and habitats that support populations of organisms that may be limited to small fragments of their previous geographic range (i.e., endemic populations). FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Resilience: The ability of an ecosystem to maintain diversity, integrity, and ecological processes following a disturbance.

Resiliency: The degree to which the system can be disturbed and recover to a state where processes and interaction function as before (Holling 1973 in Reeves et al 1995).

Restore: Design and implement actions for the specific purpose of moving toward desired conditions. This generally applies when the existing conditions are outside the range of desired conditions.

Retard Attainment: Measurably slow the recovery rate towards the desired conditions.

Riparian-dependent resources: Resources that are dependent upon the habitat conditions (cool, shady, moist) that occur in riparian areas (see 2526.05 - Definitions).

Riparian ecosystem: An ecosystem that is a transition between terrestrial and aquatic ecosystems. It includes the vegetation communities associated with rivers, streams, lakes, wet areas 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 (www.icbemp.gov).

Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Salable minerals: High volume, low value mineral resources, including common varieties of rock, clay, decorative stone, sand, and gravel. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Site potential: A measure of resource availability based on interactions among soils, climate, hydrology, and vegetation. Site potential represents the highest ecological status an area can attain given no political, social, or economic constraints. It defines the capability of an area, its potential, and how it functions. (www.icbemp.gov/)

Site-potential tree: A tree that has attained the average maximum height possible given site conditions where it occurs. FEMAT glossary, http://www.reo.gov/library/policy/ROD/FEMAT.pdf

Site potential tree height (SPTH): The average maximum height of the tallest trees (200 years or older) for a given site class. (http://www.icbemp.gov/)

Spatial: Related to or having the nature of space. (http://www.icbemp.gov/)

Standards: Mandatory constraints on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Stochastic Event: Random natural event such as wildfire, landslide, or flood.

Temporal: Related to time. (http://www.icbemp.gov/)

Unstable and potentially unstable lands: The unstable land component includes lands that are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which in turn will affect aquatic ecosystems, including streams, seeps, wetlands, and marshes. (www.icbemp.gov/)

Watercourse: A watercourse is any flowing body of water. These include rivers and streams. A natural stream of water fed from permanent or periodical natural sources and usually flowing in a particular direction in a defined channel, having abed and banks or sides, and usually discharging itself Into some other stream or body of water.

Watershed: The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the streamflow at that point.

a) The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. *(FEMAT, IX-39)*

b) Any area of land that drains to a common point. A watershed is smaller than a river basin or subbasin, but it is larger than a drainage or site. The term generally describes areas that result from the first subdivision of a subbasin, often referred to as a "fifth-field watershed." *(Ecosystem Analysis at the Watershed Scale v 2.2, p. 25)*

c) The entire region drained by a waterway (or into a lake or reservoir). More specifically, a watershed is an area of land above a given point on a stream that contributes water to the streamflow at that point.

Wetlands: Those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Whole Watershed Restoration: An interdisciplinary approach to restoration that considers opportunities to restore watershed structure and process throughout the watershed, from ridgetop to valley bottom.