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Forest Service

Hydrology Report

Colville National Forest Plan Revision
Draft Environmental Impact Statement

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Table of Contents

Introduction 1
Purpose and Need for Change 1
Revision Topics Addressed in this Analysis 2
Relevant Laws, Regulations and Policy that Apply 4
Affected Environment 4
Setting 4
Physiography 4
Climate 4
Geomorphology 4
Geology 5
Land Use History 5
Surface Water Characteristics 6
Watershed Hierarchy and Spatial Bounds of Analysis 8
Existing Condition—Watershed Function, Water Quality, Quantity, and Water Uses 15
Watershed Function 15
Watershed Condition 16
Streams 21
Stream Channel Condition and Function 21
Riparian and Wetland Function 22
Land Uses and Disturbances Affecting Watershed Function 27
Watershed Restoration and Monitoring 39
INFISH 39
Aquatic Restoration Strategy 41
Watershed Condition Framework 42
Aquatic and Riparian Conservation Strategy 43
ARCS-Modified 44
Water Quality, Quantity, and Uses 44
Water Quality 45
Water Quantity and Uses 50
Instream Flows 50
Source Water Protection Areas 51
Water Rights 52
Environmental Consequences 57
Methodology 57
Assumptions 57
Spatial and Temporal Context for Effects Analysis 59
Summary of Effects Common to All Alternatives 59
No Action Alternative: Existing Management Direction 60
Indirect Effects 61
Riparian and Aquatic Resource Management 61
Roads/Access 64
Old Forest Management, Timber Production, and Upland Vegetation Condition 64
Summary of Effects and Comparison to Other Alternatives 66
Proposed Action 68
Indirect Effects 68
Riparian and Aquatic Resource Management 68
Roads/Access 74
Old Forest Management, Timber Production, and Upland Vegetation Condition 76

DRAFT

Summary of Effects and Comparison to Other Alternatives ... 78
Alternative R ... 79
Indirect Effects ... 80
Riparian and Aquatic Resource Management ... 80
Roads/Access ... 86
Old Forest Management, Timber Production, and Upland Vegetation Condition ... 88
Summary of Effects and Comparison of Other Alternatives ... 91
Alternative P ... 92
Indirect Effects ... 92
Riparian and Aquatic Resource Management ... 92
Roads/Access ... 93
Old Forest Management, Timber Production, and Upland Vegetation Condition ... 94
Summary of Effects and Comparison of Other Alternatives ... 96
Alternative B ... 97
Indirect Effects ... 97
Riparian and Aquatic Resource Management ... 97
Roads/Access ... 97
Old Forest Management, Timber Production, and Upland Vegetation Condition ... 98
Summary of Effects and Comparison of Other Alternatives ... 99
Alternative O ... 100
Indirect Effects ... 101
Riparian and Aquatic Resource Management ... 101
Roads/Access ... 101
Old Forest Management, Timber Production, and Upland Vegetation Condition ... 102
Summary of Effects and Comparison of Other Alternatives ... 103
Comparison of Key Indicators between Alternatives ... 104
Cumulative Effects ... 106
Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis ... 106
No Action Alternative Cumulative Effects ... 108
Proposed Action Cumulative Effects ... 108
Alternative R Cumulative Effects ... 108
Alternative P Cumulative Effects ... 109
Alternative B Cumulative Effects ... 109
Alternative O Cumulative Effects ... 109
Acronyms ... 110
References ... 111
Appendices ... 128
Appendix A ... 128
Appendix B ... 134
Appendix C ... 167

List of Tables

Table 1. Hydrologic stream classification for the CNF (Reidy Lierman et al. 2012). ... 7
Table 2. Classification, naming conventions, and average size of hydrologic units in the hydrologic unit code system. ... 10
Table 3. Region, subregions, and basins on the CNF. ... 10
Table 4. Subbasins within the CNF administrative boundary. ... 13
Table 5. Watersheds within the CNF administrative boundary. ... 13

DRAFT

Table 6. Results of the WCF summarized by number of subwatersheds within each condition class. 19
Table 7. Stream miles within the administrative boundary of the CNF (from national hydrography dataset (NHD) flowline). 21
Table 8. Other water resources within the CNF administrative boundary. 21
Table 9. Existing Riparian Habitat Conservation Areas (RHCA) acreage on the CNF administrative boundary. 23
Table 10. Riparian and wetland acreage for the CNF (National Wetlands Inventory). 24
Table 11. Soil water flow category acreage across the CNF administrative forest and number of springs and seeps within each soil water flow category. 26
Table 12. Affects to hydrologic processes from timber harvest, die-off from insect and disease outbreaks, and wildland fire (Adams et al. 2012). 29
Table 13. Historical range of variability percentage by vegetation type for 5 structure classes compared to current conditions. Values below HRV are shaded in black, values above HRV are shaded in gray (Day 2015). 32
Table 14. Miles of road on the CNF. 36
Table 15. Miles of road by jurisdiction on the CNF. 36
Table 16. Subwatersheds categorized by road density and riparian road density. 37
Table 17. Number of crossings and relative risk of sediment delivery. 38
Table 18. INFISH Priority watersheds on the CNF designated at the subwatershed scale. 40
Table 19. Differences in RHCA widths for INFISH priority and non-priority watersheds. 40
Table 20. Focus 5th field watersheds on the CNF. 41
Table 21. Priority Watersheds on the CNF. 42
Table 22. Existing priority and focus watersheds. 42
Table 23. Crosswalk between subbasins and WRIAs on the CNF administrative forest. 45
Table 24. Water quality standards for waters of the CNF (WAC 173-201A-200). 47
Table 25. Miles of stream by pollutant by subbasin on the Colville National Forest under an approved TMDL and WQIP, and miles of stream on the current 303d list not specifically covered under at TMDL and WQIP (WADoE 2014(a)). 48
Table 26. Certificated water rights and PODs in the name of the Colville National Forest* by purpose of use and volume. 53
Table 27. Certificated water rights within the CNF administrative boundary in the name of others. 54
Table 28. Dams on the CNF. 54
Table 29. Issues, indicators, and analysis criteria for analysis of effects of alternatives on hydrologic resources. 58
Table 30. RHCA width and acreages on the CNF in the no action and alternative B. 61
Table 31. INFISH priority watersheds (designated at the subwatershed scale). 62
Table 32. Existing management areas and authorization of road building and timber production by MA. 64
Table 33. Vegetation and structure type within HRV modeled after 100 years of management under the no action alternative. 65
Table 34. RMA widths and total acreage for the proposed action and alternatives R, P, and O... 68
Table 35. Key watersheds in the proposed action. 70
Table 36. Objectives for key watersheds that are a priority for restoration. 72
Table 37. Existing road density by 5th field watershed for the focused and general restoration management areas under the proposed action. 74
Table 38. Proposed action management areas and activities authorized in each management area that can affect the hydrologic resource. 76
Table 39. Vegetation and structure type within HRV modeled after 100 years of management under the proposed action. 77

DRAFT

Table 40. Key watersheds (subwatershed scale) for alternatives R, P, and O. 82
Table 41. Key watersheds that are priorities for restoration and projected restoration activities based on key watershed objectives that will be completed through the life of alternative R. 84
Table 42. Existing road density by 5th field watershed for the focused and general restoration management areas in alternative R. 86
Table 43. Alternative R management areas and activities authorized in each management area that can affect the hydrologic resource. 89
Table 44. Vegetation and structure type within HRV modeled after 100 years of management under alternative R. 90
Table 45. Comparison of grazing plan components that are different between alternative R and other alternatives (not under INFISH). 90
Table 46. Existing road density by 5th field watershed for the focused and general restoration management areas in alternative P. 93
Table 47. Alternative P management areas and activities authorized in each management area that can affect the hydrologic resource. 95
Table 48. Alternative B management areas and activities authorized in each management area that can affect the hydrologic resource. 98
Table 49. Vegetation and structure type within HRV modeled after 100 years of management under alternative B. 99
Table 50. Alternative O management areas and activities authorized in each management area that can affect the hydrologic resource. 102
Table 51. Vegetation and structure type within HRV modeled after 100 years of management under alternative O. 103
Table 52. Comparison of key indicators between alternatives. 104
Table 53. Adjudications and surface water limitations for WRIAs on the CNF. 107
Table 54. Number of applications, claims, certificates, and permits for WRIAs within the CNF. 109
Table 55. SWE classification and acres of CNF administrative forest within each category (Kramer and Snook 2014). 111
Table 56. Percent change in mean summer flow (cfs) from historic data and perennial stream mileage within each category under the 2040 and 2080 warming scenarios. 113
Table 57. Projected vulnerability of roads within 300ft of perennial streams for 2040 and 2080 categorized by percent increase in bankfull flows from VIC data. 107

List of Figures

Figure 1. Average annual discharge at the Kettle River near Laurier (USGS 2014). 6
Figure 2. Average annual precipitation and water yield at low-flow on the CNF (Murray and Coots 2003). 8
Figure 3. Major drainage basins (subbasins), rivers, and elevation on the CNF. 9
Figure 4. Hydrologic hierarchy of the Ninemile subwatershed on the CNF showing its location in the Upper Columbia basin, the Sanpoil subbasin, and the Upper Sanpoil watershed. 12
Figure 5. WCF process category, indicator, and attribute results. 18
Figure 6. Watershed condition ratings. 20
Figure 7. Condition rating for the channel shape and function attribute. 22
Figure 8. Riparian wetland vegetation indicator ratings from WCF. 24
Figure 9. Soil water flow and springs and seeps across the CNF. 27
Figure 10. Physical and biological variables that control forest watershed processes (Elliot 2010). 27

DRAFT

Figure 11. Hydrologic hillslope processes in forested ecosystems (Elliot 2010). 28
Figure 12. Results of the WCF analysis for the roads and trails indicator. 35
Figure 13. Road sediment delivery in four watersheds in the Pacific Northwest (GRAIP 2014). 38
Figure 14. Focus and priority watersheds. 43
Figure 15. Water rights and uses on the CNF. 52
Figure 16. INFISH priority watersheds 63
Figure 17. Proposed action key watersheds 70
Figure 18. Key watersheds (subwatershed scale) in alternatives R, P, and O. 81
Figure 19. Surface water source limitation areas and adjudicated watersheds on and within subbasins with CNF ownership. 108
Figure 20. Snowpack sensitivity on the CNF (Kramer and Snook, 2014). 112
Figure 21. Stream low flow vulnerability for the 2040 and 2080 warming scenarios. 113
Figure 22. Infrastructure vulnerability to increases in bankfull flow for 2040 and 2080. 107

DRAFT

Introduction

Securing favorable conditions of water flows was one of the primary reasons for the establishment of National Forest Lands under the 1897 Organic Act. Water is a vital resource on the Colville National Forest (CNF), providing economic, ecological, and social benefits to people in Washington and beyond. The 2,483 miles of streams and rivers, and 100 natural and man-made lakes and ponds support diverse communities of resident aquatic and terrestrial species, and thousands of people rely on water from the CNF for drinking, recreation, agriculture, industry, and other uses. Millions of people rely on water for hydropower generation from the nearby Lake Roosevelt and other hydroelectric facilities across the Forest.

This report discusses the affected environment, existing condition, and the environmental consequences of 6 forest plan alternatives on watershed and hydrologic function, water quality and quantity, and water uses. Hydrologic function and stream condition reflect the integrated effect of climate, geology, land use, and physiography (Beschta and Platts, 1986; Naiman and Bilby, 1998). Existing condition and affected environment in this report are evaluated in terms of how climate, geology, physiography affect hydrologic processes, and how past and present disturbance interacts with these controls to affect hydrologic function, and condition of streams, rivers, and other water resources across the CNF.

Purpose and Need for Change

This report addresses the following needs to revise the 1988 forest plan:

- Accelerate improvement in watershed condition across the Forest. The current forest plan and amendments do not adequately provide integrated management direction to maintain and restore properly functioning watersheds that provide a range of benefits on and off the Colville National Forest within a meaningful timeframe. This is supported by best available science, the listing of bull trout (*Salvelinus confluentus*) under the Endangered Species Act (1988), designation of critical habitat for bull trout (2010), information provided by the bull trout recovery plan (2014), and the results of new assessment tools such as the national Watershed Condition Framework. Properly functioning watersheds provide stable and productive ecological systems and allow for conditions that support aquatic species viability and self-sustaining populations, contribute to the recovery and de-listing of threatened and endangered species, and restore stream systems that don't meet Washington State water quality standards (WADoE 2014(f)).

- Integrate watershed and aquatic strategies across the Forest. The existing Colville Forest Plan was completed in 1988, and was amended by the Inland Native Fish Strategy (INFISH; USDA 1995) in 1995. Since 1988, the Aquatic Restoration Strategy (ARS; USDA 2005), the Aquatic and Riparian Conservation Strategy (ARCS; USDA 2008) and the Watershed Condition Framework (WCF; Potyondy and Geier 2010) have been developed to reflect management direction recommended by current research and supported by regional and national policy. The ARS is a Forest Service Pacific Northwest Regional operational strategy that reinforces the foundation of existing forest plan strategies, including broad-scale passive restoration, and strategically-focused active restoration and guides implementation through establishment of specific goals and objectives and a formal process for near-term active restoration. The 2010 National Watershed Condition Framework process evaluated current conditions at the subwatershed scale and identified priority subwatersheds where focused

restoration could improve watershed condition on NFS lands. ARCS is a refinement of previous forest plan strategies (including the Northwest Forest Plan, PACFISH, and INFISH) incorporating key concepts from the ARS and WCF, and is intended to provide the core set of desired conditions, suitability, objectives, standards and guidelines for aquatic and riparian management. ARCS provides additional watershed direction intended to restore and maintain watershed conditions and processes that sustain a full range of ecosystem services and support beneficial uses of water, with a focus on protection and restoration of native anadromous and non-anadromous fisheries. Consistency and integration of new research and regional and national direction on restoration and protection of watershed and aquatic habitat and function will contribute to the restoration and maintenance of riparian and aquatic habitats and beneficial uses of water and increase resilience to disturbance.

- Address climate change implications and vulnerabilities. The existing forest plan does not address the potential effect of climate change. Recent scientific findings on climate change (Intergovernmental Panel on Climate Change [IPCC] 2014) have dramatically improved our understanding of how ecosystems have changed and are likely to change in the future. Changing climate conditions have affected ecosystem composition, structure, process, and spatial pattern, altering the character and distribution of habitats for key surrogate plant and animal species. In addition, climate change has altered, and will continue to alter disturbance regimes, including forest insects and diseases, fire, and hydrologic regimes. Future conditions may be more favorable to some undesired non-native plant, wildlife, and aquatic species (IPCC 2014). The full impact of climate change on ecosystems is uncertain, but an integrated management direction that provides flexibility to respond to a changing environment is needed to maintain or restore the resilience of the national forests in the face of these changes.

Revision Topics Addressed in this Analysis

Comments submitted on the proposed action were reviewed to determine how they would be considered in the analysis. Old forest management and timber production, motorized recreation trails, road access, recommended wilderness, wildlife habitat, and riparian and aquatic resource management were identified as significant issues used to formulate alternatives. This hydrologic analysis focuses on the “riparian and aquatic resource management”, “access”, and “old forest management and timber production” issues. While other issues, including recommended wilderness, and motorized recreation trails are tangentially applicable to water resources, public concerns on these issues are not specific to the hydrologic resource. Analysis of the riparian and aquatic resource management, access, and old forest management and timber production issues would indirectly address the potential effects of recommended wilderness and motorized recreation trails to water resources, and how these effects vary across alternatives.

Riparian and Aquatic Resource Management Issue

Some members of the public expressed concern that the proposed action does not adequately protect riparian areas adjacent to streams, lakes, wetlands, and rivers. They want the Forest Service to limit the negative effects of roads, grazing, and off-highway vehicles in these areas. Other members of the public are concerned that the protection of these aquatic resources limits timber production, grazing, and recreation. Public comments raised concerns that the proposed action does not provide watershed and aquatic resource protections that are as effective as current forest plan direction. Other stakeholders commented that there is a need to balance

uses. There were concerns raised that the potential impact of increased aquatic protection impacted the ability to effectively manage grazing allotments.

Access Issue

The public expressed concern that the proposed action does not provide enough roads for recreation, grazing, fire suppression, timber harvest, and firewood collection. They commented that lack of access will have a negative impact on economic well-being. Other stakeholders expressed concern that the Forest Service does not have the capacity to maintain the current road network, and that unmaintained roads damage wildlife, water, and fish.

Old Forest Management and Timber Production Issue

Some members of the public are concerned that the proposed action does not protect old forests as well as the current forest plan. Other members of the public are concerned that the proposed action does not allow enough timber production, which hurts the economy. Some are also concerned that the proposed action limits the Forest Service's ability to defend forests from insects, disease, and fire.

In addition to issues raised by the public, there are several additional topics addressed in this analysis required by law, regulation, and policy, including water quality, and water uses. The riparian and aquatic resource management, access, and old forest management and timber production issues are addressed throughout this analysis in terms of how management of vegetation, roads, and riparian and aquatic resources affects watershed and hydrologic function and processes, water quality, and water uses and availability.

The affected environment, existing condition, and environmental consequences of 6 alternatives are analyzed for the following issues:

- Riparian and Aquatic Resource Management;
- Roads/Access;
- Old Forest Management, Timber Production, and Upland Vegetation Condition

Indicators for effects analysis for each issue are shown in Table 29.

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Relevant Laws, Regulations and Policy that Apply

See Appendix A

Affected Environment

Setting

Physiography

The CNF is located in the foothills of the Rocky Mountains and is bisected from west to east by Lake Roosevelt on the Columbia River, impounded by the Grand Coulee Dam, and the Kettle and Selkirk mountain ranges in the western and northeastern sections of the forest, respectively. Average elevation is 3,800 ft and ranges between 1,394 ft near Lake Roosevelt to 7,200 ft in the high ridges of the Selkirk Range. The Selkirk Range includes the Salmo-Priest Wilderness—the only designated wilderness on the CNF. Elevation across the CNF is shown in Figure 3.

Climate

Climate is consistent with both maritime and continental regimes, with air masses from both the Pacific Ocean and interior North America crossing the region. Climate is influenced primarily by latitude, topography, proximity to the Pacific Ocean, prevailing westerly winds, and development and movement of weather systems over the North Pacific (Phillips and Durkee 1972). The majority of precipitation falls between October and April as snow. Summers are usually dry, with most precipitation associated with thunderstorms. Humidity is low throughout the year.

Annual precipitation varies between 10 to 55 inches per year and increases with elevation. The western-most section of the forest is in the rain shadow of the North Cascades and has annual precipitation levels of 10 to 15 inches per year. The eastern portion of the CNF has a moist near-maritime climate caused by the forcing of westerly air flow over the 5,000-7,000 foot peaks of the Kettle River and Selkirk ranges. Throughout the year, maritime air from the Pacific exerts a moderating influence on temperatures with more extreme summer and winter temperatures caused by drier air from the interior. The greatest precipitation levels occur in the Selkirk Mountains where uplifting of prevailing winds results in increased precipitation (Baldwin 2006).

Geomorphology

The CNF is located in the Okanogan Highlands Section of the northern Rocky Mountain forest-steppe-coniferous forest- alpine meadow province, delineated through the national hierarchical framework of ecological units (ECOMAP 1993). This framework provides a nationally-standardized method for the classification, mapping, and description of ecological units at multiple scales based on similarity in potential vegetation, climate, and geomorphology. The Okanogan Highlands are characterized by moderate slopes with broad, rounded summits weathered from repeated continental glaciation. Ice sheets covered the areas during the Pleistocene, and their retreat formed the Columbia and Pend Oreille valleys (WA DNR 2015).

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Glacial scour has exposed rock outcrops on many slopes. Most of the area is covered with glacial till, outwash, and debris. Glacial lakes, rivers and streams are common as well as mountains with both narrow and broad valleys (McNab and Avers 1994). The history and effects of continental glaciation on the CNF is discussed in greater detail in the soils specialist report (Farr and Craigg 2015).

Geology

The Okanogan Highlands is divided into two geographic regions divided by the Columbia River; the Selkirk, Chewelah, and Huckleberry Mountains to the east, and the Kettle, and Sanpoil Mountains to the west. The eastern Okanogan Highlands contains the oldest sedimentary and metamorphic rocks in Washington formed from the deposition of sediments with metasedimentary rocks overlain by layers of marine rocks including sandstone (metamorphosed into quartzite), shales, and limestones. The western Okanogan Highlands is less complex geologically than the eastern section, and contains metasedimentary rocks formed from the deposition of volcanic sediments (Lasmanis 1991). The western Okanogan Highlands is an important mineral-producing area with gold, silver, magnetite, pyrite, molybdenum, and cobalt mineral deposits (WA DNR 2015).

Land Use History

Historical disturbances and management practices affect water quantity and quality and the physical processes within a stream system, including erosion and sedimentation and the distribution of organic material (ICBEMP). The combined impacts of past land uses and disturbance patterns as well as current management and development have shaped and continue to affect hydrologic function and physical stream characteristics.

Abundant salmon runs attracted the first humans to northeastern Washington, and evidence exists that people existed in the region as early as 9,000-12,000 years ago (Holstine 1987). Based on the availability of salmon, the area became one of the most important prehistoric trading sites in the Pacific Northwest, however effects to the physical environment from early inhabitants were minor and diffuse (Holstine 1987). Early uses affecting hydrologic systems increased as European settlers moved into the area. The remnants of these activities including mining, logging, homesteads, livestock grazing, and road building can be found across the landscape.

Beginning in the mid-1800s, fur trapping was one of the most widespread uses resulting in significant declines in beaver populations. Beaver dams in small streams alter hydrology, geomorphology, and habitat, increasing water and sediment storage (Pollack et al. 2003). Beaver dams also dissipate stream energy, provide channel stability, and create diverse aquatic habitat (Gurnell 1998). Loss of beaver populations has affected hydrology and sediment dynamics and has contributed to channel incision and lowering of groundwater levels (Pollack et al. 2003) across the CNF.

Fires burned across 160,000 acres of the CNF in 1910. Historical accounts suggest that as late as 1916 areas that had burned to the ground were still bare. In 1917, fires again swept through the area, burning 23,000 acres in the western portion of the CNF. Fires in the 1920s burned over half of the timber land on the CNF (Holstine 1987). The effects to stream channels of increased

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erosion, sedimentation, and peak flows from these fires can still be observed. Channel incision common in streams across the CNF was likely accelerated following the fires of the early 1900s.

Placer mining of gold began in 1855 and ended by the 1870s when prospectors began upland "hard rock" mining for gold, silver, and lead which continues in the present (Holstine 1987).

Changes in hydrologic and erosional and depositional processes from land uses including homesteading, logging agriculture, grazing, mining, road construction, and hydro-developments (dams, irrigation, and flood control) have altered flow and sediment regimes, floodplain and riparian function and resulted in loss and fragmentation of aquatic habitat (Wissmar 2004). Current land uses including maintenance and construction of roads, fire exclusion, silvicultural practices, planned and unplanned wildland fire, mining, livestock grazing, and alteration of hydrologic regime and stream morphology through dams and diversions, and stream and watershed restoration are discussed in greater detail throughout this report.

Surface Water Characteristics

Climate, geology, and physiography are large-scale drivers of hydrologic processes, and control hydrologic regime and stream channel characteristics. Most streams across the CNF flow through glacial outwash within narrow valleys. Present-day glacial lakes and wet valleys are associated with the last retreat of glaciers across the region (McNab and Avers 1994).

Streamflow Regime

Most streams have a snow-melt flow regime with a peak in flow from April-June during spring snowmelt and no discernable peaks in discharge from fall/winter rains. The annual hydrograph from 84 years of gage data on the Kettle River near Laurier shows the typical seasonal discharge pattern for unregulated streams across the CNF (Figure 1).

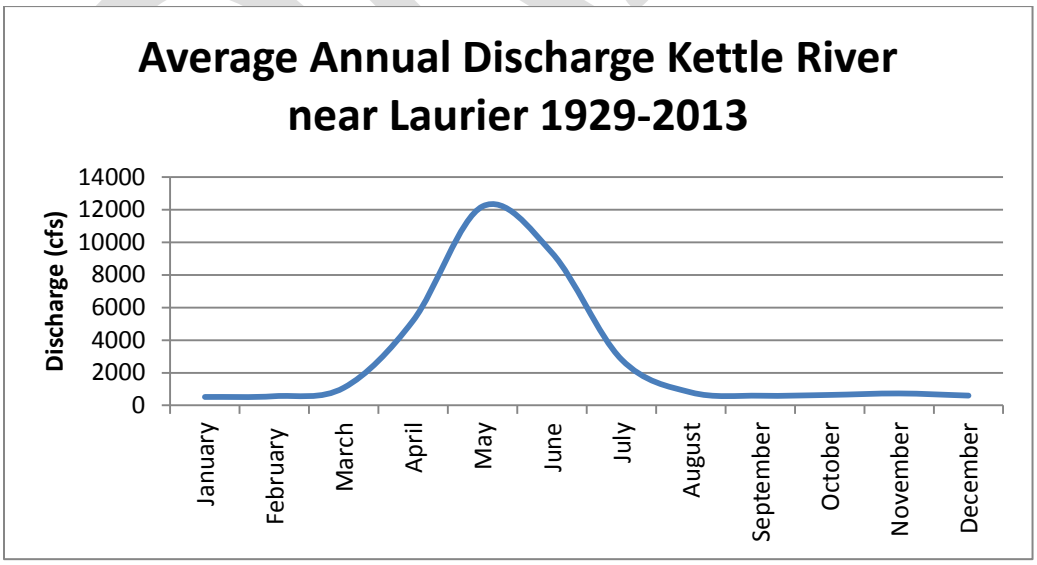

Figure 1. Average annual discharge at the Kettle River near Laurier (USGS 2014).

There are approximately 20 stream gages on or near the CNF, however many of these gages are on regulated systems and have variable years of data available. Therefore, streamflow data from these gages does not necessarily represent all streamflow regime types on the CNF. Reidy Lierman et al (2012) classified flow regimes for ungaged streams and rivers across Washington using gage data and climactic and physical drainage basin characteristics. Across the CNF 97% of streams are categorized as either snowmelt, ultra-snowmelt, or snow-rain systems. Only 3% of streams are hydrologically classified as groundwater systems. Characteristics of these different systems are described in Table 1 (Reidy Lierman et al. 2012).

Table 1. Hydrologic stream classification for the CNF (Reidy Lierman et al. 2012).

Stream Hydrologic Classification	Description	Percent of Streams on the CNF
Snowmelt	Peak in flow during spring snowmelt, with little discernable winter rain influence	84%
Ultra Snowmelt	Higher-elevation streams that exhibit a peak at spring slightly later in spring than snowmelt-regime streams	12%
Snow-Rain	Mixture of spring snowmelt and winter rain	1%
Groundwater	Predictable annual minimum and base flow values, exhibit a slight increase at snowmelt, but no increase from winter rains	3%

Water Yield

Water yield refers to the runoff from a drainage basin and is calculated as precipitation minus evapotranspiration. Physiography, geology, and spatial variation in the magnitude and timing of precipitation are controls of water yields for streams and rivers across the CNF. Water yield at low-flow was calculated for select gages across the CNF based on average streamflow (cubic feet/second (cfs)) in July and August divided by the drainage area upstream of the stream gage (mi^2) for the development of the Total Maximum Daily Load (TMDL) for the CNF (discussed later in this report). In the drier, western section of the CNF water yields are less than in the wetter, eastern portion of the Forest (Figure 2).

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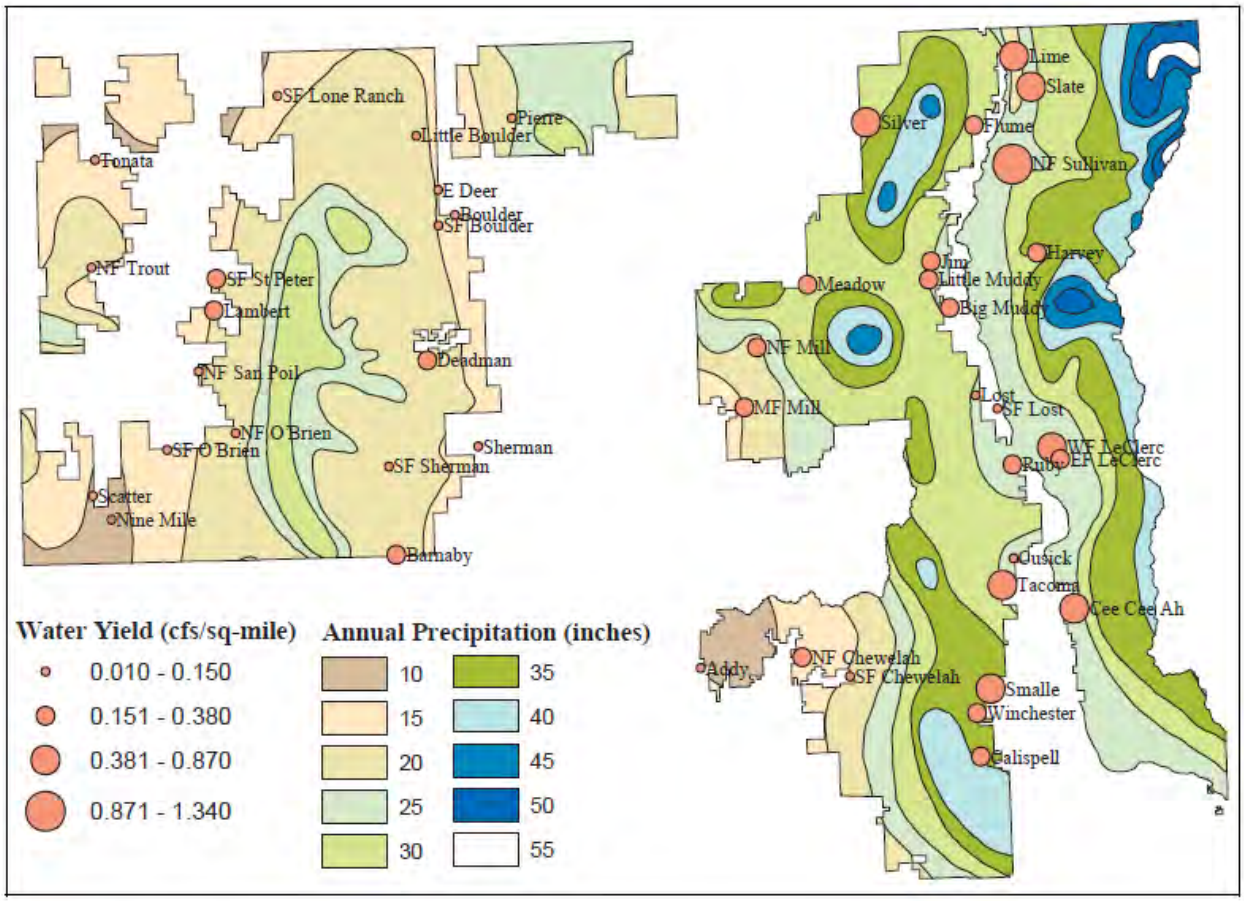

Figure 2. Average annual precipitation and water yield at low-flow on the CNF (Murray and Coots 2003).

Colville National Forest Contribution to Water Supply

Brown and Froemke (2009) estimated the annual contribution of water supply for all National Forests in the contiguous United States based on data from 1953-1994. Water supply estimates were calculated as "precipitation minus natural evapotranspiration", with the assumption that water that infiltrates into the soil is not evaporated or transpired is eventually available as surface water (Brown and Froemke 2009). Estimated annual contribution to water supply from lands within the CNF administrative boundary is 65,121 million cubic feet per year. Estimated annual contribution from lands within the CNF ownership boundary is 51,525 cubic feet per year.

Watershed Hierarchy and Spatial Bounds of Analysis

Major Drainage Basins

Major drainage basins (subbasins) and elevations across the CNF are shown in Figure 3. The CNF is located entirely in the Columbia River basin, which originates in Canada and flows southwest through Washington forming the border between Washington and Oregon to its mouth at the Pacific Ocean. Major river basins include the Pend Oreille, Sanpoil, Kettle, and Colville. The

Pend Oreille River originates in Montana, flows through Idaho into Washington where it flows north into Canada to its mouth at the Columbia River. The Pend Oreille River is the fourth largest contributor of streamflow to the Columbia River. The CNF east of the Selkirk Mountain Crest drains into the Pend Oreille River. The Sanpoil River drains the southwest portion of the CNF west of the Kettle Crest and flows directly into Lake Roosevelt downstream of the CNF administrative boundary. The Kettle River receives most of the runoff from the northwestern portion on the CNF. It flows north into Canada, and south to its confluence with Lake Roosevelt (Columbia River) west of the community of Kettle Falls. The Colville River drains the central portion of the Forest east of the Selkirk Range, and west of Lake Roosevelt. The Colville River drains into the eastern side of Lake Roosevelt near Kettle Falls.

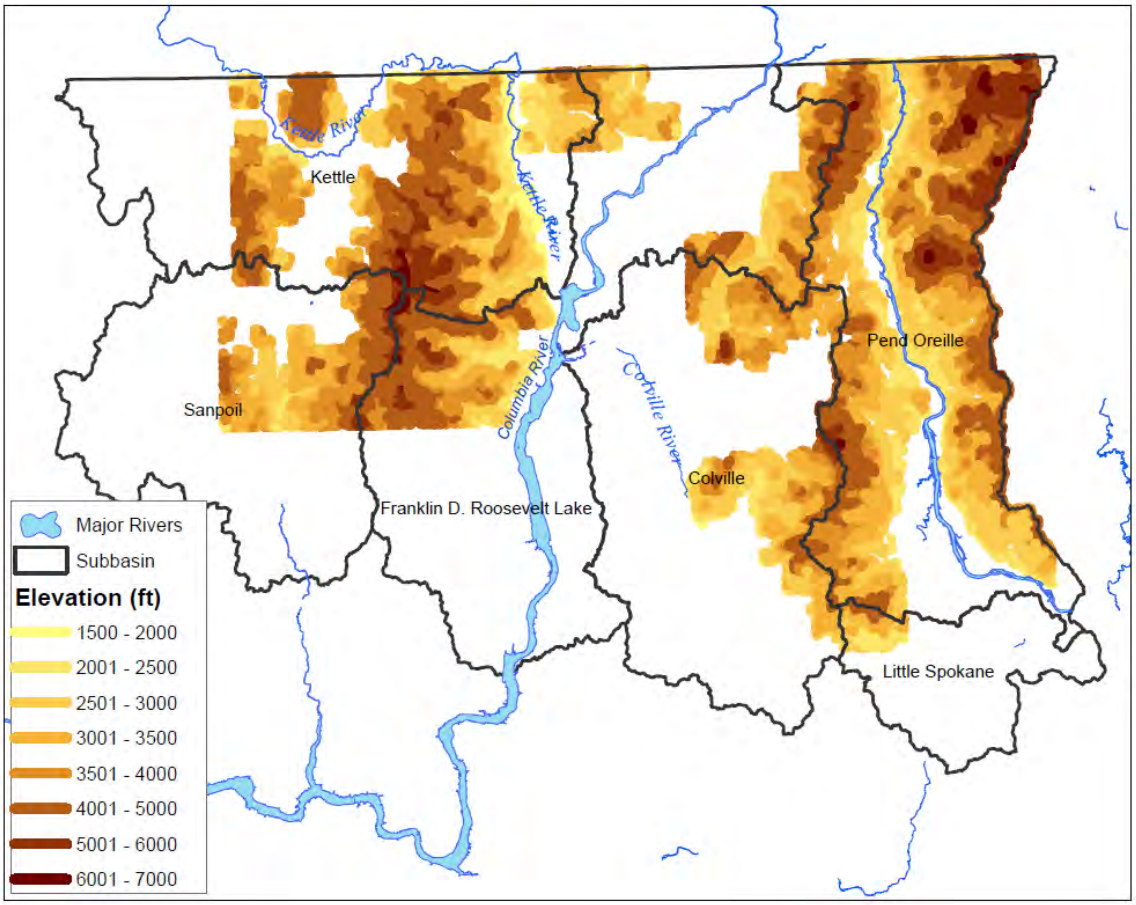

Figure 3. Major drainage basins (subbasins), rivers, and elevation on the CNF.

Watershed Hierarchy

A watershed is an area of land where all the water drains into a particular water body. Watersheds occur at various scales and are appropriate boundaries for hydrologic analysis because physical processes including rainfall, precipitation, runoff, erosion, and sedimentation interact within watershed boundaries to shape the landscape (MacDonald 2015), affecting

hydrologic function, stream condition, water quality, and water uses.

Watershed boundaries are delineated for this analysis using the hydrologic unit (HU) system. Hydrologic units are delineated and classified by the USGS based on size using a standard nested-hierarchical system with six levels of classification of successively smaller watersheds (FGDC 2005). Individual hydrologic units are denoted both numerically by a unique hydrologic unit code, and name. Classification and general size of hydrologic units within the system are shown in Table 2. Table 2 also includes an example of both the name and number of the hydrologic hierarchy of the Ninemile subwatershed.

Table 2. Classification, naming conventions, and average size of hydrologic units in the hydrologic unit code system.

HU name	# of digits in HUC	HU Level	Average Size (mi^2)	Example Name	Example Number
Region	2	1st	180,000	Pacific Northwest Region	17
Subregion	4	2nd	17,000	Upper Columbia Subregion	1702
Basin	6	3rd	10,000	Upper Columbia Basin	170200
Subbasin	8	4th	700	Sanpoil Subbasin	17020004
Watershed	10	5th	227 (40,000-250,000 acres)	Upper Sanpoil Watershed	1702000401
Subwatershed (SWS)	12	6th	40 (10,000-40,000 acres)	Ninemile Subwatershed	170200040107

The CNF is located in the Pacific Northwest region, 2 subregions, and the Pend Oreille, Upper Columbia, and Spokane basins (Table 3).

Table 3. Region, subregions, and basins on the CNF.

Region	Region Number	Subregion	Subregion Number	Basin	Basin Number
Pacific Northwest Region	17	Kooteney, Pend Oreille, and Spokane River Basins Subregion	1701	Pend Oreille Basin	170102
				Spokane Basin	170103
		Upper Columbia; Columbia River above the	1702	Upper Columbia	170200

Region	Region Number	Subregion	Subregion Number	Basin	Basin Number
		confluence with the Snake River, excluding the Yakima River Subregion			

An illustration of the nested hierarchical hydrologic unit system from the basin to subwatershed scale is shown for the Ninemile subwatershed in Figure 4. The Upper Columbia Basin (3rd field 6-digit HUC) contains four subbasins on the CNF, including the Sanpoil subbasin (4th field 8-digit HUC). Within the Upper Sanpoil subbasin there are 3 watersheds (5th field 10-digit HUC), including the Upper Sanpoil River watershed. Within the Upper Sanpoil River watershed, there are 8 subwatersheds (6th field 12-digit HUC), including the Ninemile subwatershed.

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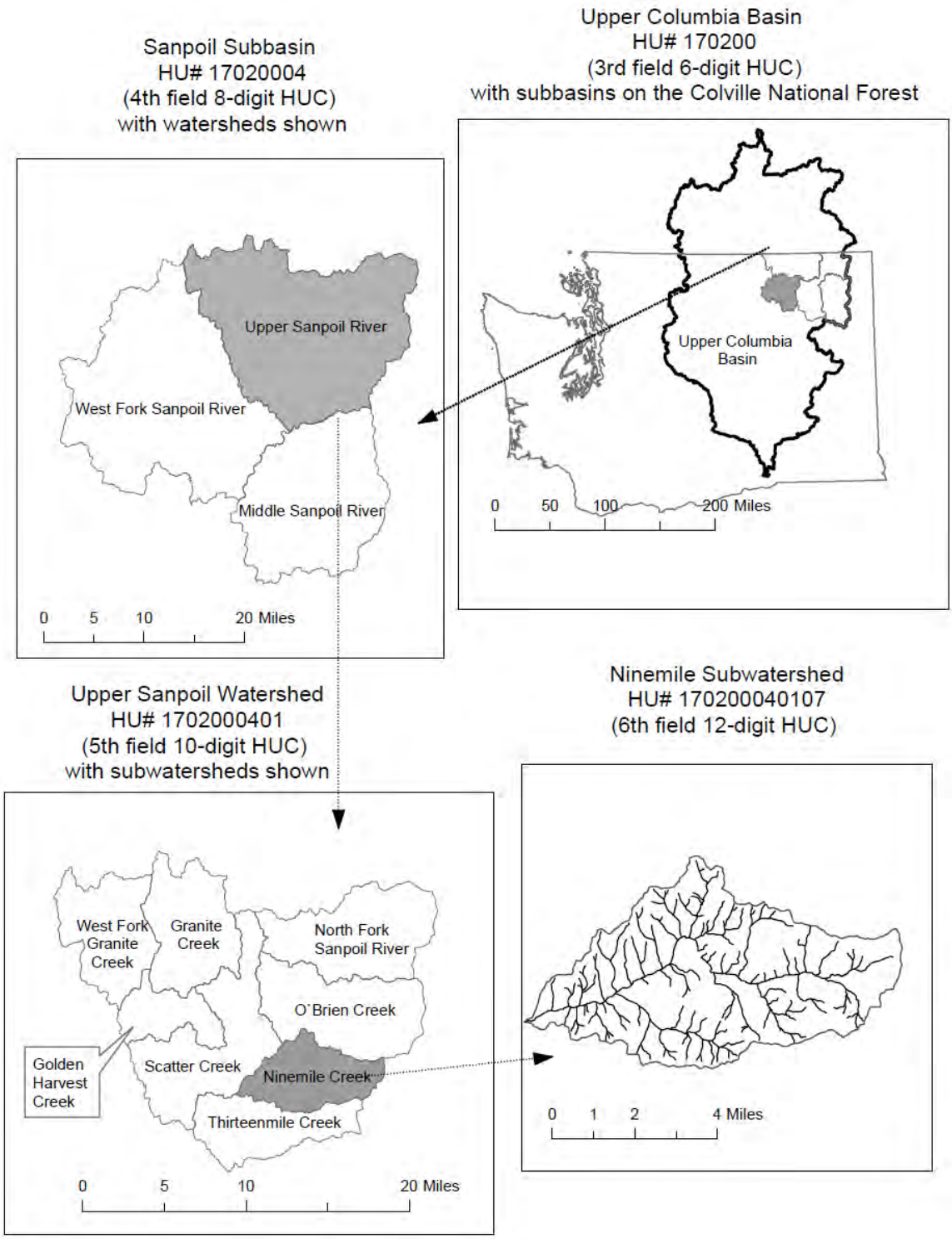

Figure 4. Hydrologic hierarchy of the Ninemile subwatershed on the CNF showing its location in the Upper Columbia basin, the Sanpoil subbasin, and the Upper Sanpoil watershed.

The administrative forest boundary of the CNF is located within 6 subbasins, all within the Columbia River drainage. A small portion of the administrative forest (15,826 acres) falls within the Upper Spokane subbasin. Although a portion of the CNF administrative boundary falls within the Upper Spokane subbasin, there is no Forest Service ownership within the subbasin. Therefore, RHCAs, roads, and other features affecting hydrologic function are generally not analyzed in the Upper Spokane subbasin. Subbasins on the CNF and the percentage of each subbasin within the CNF administrative boundary are shown in Table 4.

Table 4. Subbasins within the CNF administrative boundary.

HUC 8 Number	Subbasin Name	CNF Administrative Acres	Total Acres (in US only)	% subbasin within CNF Administrative Forest
17020001	Upper Columbia River (FDR Lake)	212,863	1,327,733	16
17020002	Kettle River	321,743	659,201	49
17020003	Colville River	145,579	650,712	22
17020004	Sanpoil River	105,291	627,732	17
17010216	Pend Oreille River	557,449	698,349	80
17010308	Little Spokane	15,826	453,912	3

There are 27 5th field watersheds within > 1% of land area within the CNF administrative boundary. The hierarchy of these watersheds within their respective subbasins and percent acres of the CNF administrative boundary within each watershed are shown in Table 5.

Table 5. Watersheds within the CNF administrative boundary.

Subbasin	Watershed Name	HUC 10	Total Acres (in US and Canada)	CNF Administrative Acres	% Watershed within CNF Administrative Forest
Upper Columbia River (FDR Lake)	Deep Creek	1702000110	122,290	66,529	54
	Big Sheep Creek	1702000111	143,633	15,060	10
	Onion Creek-Franklin D Roosevelt Lake	1702000112	186,401	19,895	11
	Sherman Creek-Franklin D Roosevelt Lake	1702000113	211,509	94,641	45
	Hall Creek-Franklin D Roosevelt Lake	1702000114	110,157	16,741	15

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Subbasin	Watershed Name	HUC 10	Total Acres (in US and Canada)	CNF Administrative Acres	% Watershed within CNF Administrative Forest
Kettle River	Boundary Creek	1702000210	147,279	1,844	1
	Rock Creek-Kettle River	1702000211	152,801	1,829	1
	Toroda Creek	1702000212	104,125	7,698	7
	Curlew Creek	1702000213	98,976	43,232	44
	Vulcan Mountain-Kettle River	1702000217	154,221	71,280	46
	Boulder Creek-Kettle River	1702000219	180,245	131,405	73
	Deadman Creek-Kettle River	1702000220	102,133	64,423	63
Colville River	Chewelah Creek-Colville River	1702000301	273,840	72,981	27
	Little Pend Oreille River	1702000302	117,703	19,537	17
	Mill Creek	1702000303	90,809	45,556	50
	Stensgar Creek-Colville River	1702000304	168,840	7,508	4
Sanpoil River	Upper Sanpoil River	1702000401	181,184	99,663	55
	West Fork Sanpoil River	1702000402	198,987	4,828	2
	Middle Sanpoil River	1702000403	120,607	802	1
Pend Oreille River	Calispell Creek	1701021601	91,577	64,144	70
	Tacoma Creek-Pend Oreille River	1701021602	195,073	125,202	64
	Le Clerc Creek-Pend Oreille River	1701021603	159,801	145,116	91
	Sullivan Creek	1701021604	91,224	91,203	100
	South Salmo River	1701021607	62,989	15,944	25
	Slate Creek-Pend Oreille River	1701021609	127,186	105,844	93

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Subbasin	Watershed Name	HUC 10	Total Acres (in US and Canada)	CNF Administrative Acres	% Watershed within CNF Administrative Forest
	Cedar Creek-Pend Oreille River	1701021610	59,488	10,007	17
Little Spokane	Upper Little Spokane River	1701030801	178,244	15,826	9

There are 109 subwatersheds with acreage in the CNF administrative boundary. There are 104 subwatersheds with >5% of total area in the CNF administrative boundary, and 75 subwatersheds with >25% of total area in the CNF boundary. There have been several changes to subwatershed names and numbers since the forest plan revision process began. Subwatersheds and 5th field watersheds used in this analysis reflect the most current acreages, names, and numbers at the time this report was submitted in 2014.

The terms subbasin, watershed, subwatershed, priority watershed, focus watershed, and key watershed are used throughout this report. While the term watershed can refer specifically to a 5th field watershed designated in the hydrologic unit system, the term also refers to the drainage area that contributes runoff to a specific stream. Throughout this report priority and key watersheds are delineated at the subwatershed scale, and focus watersheds are delineated at the 5th field watershed scale.

Existing condition is analyzed at different watershed scales depending on the type of analysis, quality and extent of data, and the scale that best fits the intent of the analysis. Existing condition is primarily analyzed at the scale of the CNF administrative boundary. Where appropriate, existing condition is analyzed at the smaller subwatershed scale. The Watershed Condition Framework (WCF) described in detail later in this document analyzed data for subwatersheds with >25% CNF administrative ownership. The spatial and temporal bounds for effects analysis are described in the Environmental Consequences section of this report.

Existing Condition—Watershed Function, Water Quality, Quantity, and Water Uses

Watershed Function

This section describes the existing condition of individual landscape components, processes, and land uses that affect watershed and hydrologic function, water quality and quantity, including condition and function of streams, riparian areas, wetlands, groundwater-dependent ecosystems, upland vegetation condition, and disturbance and restoration. Watershed hydrologic function includes the processes that convert precipitation to streamflow, including canopy interception, snowmelt, surface runoff, infiltration, subsurface flow, and groundwater flow. Hydrologic function is influenced by upland physical and vegetation condition, ground cover, soil properties and function, stream channel condition, and riparian vegetation condition, all of which affect the rate and timing of water, nutrients, and sediment into streams.

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Watershed function is a component of ecosystem function where ecosystems are dynamic and resilient to perturbations to structure, composition, and processes of their biological and physical components (USDA 1998), and includes hydrologic, vegetative, aquatic, and riparian biological characteristics, physical structure, and water quality.

Watershed Condition

A fundamental goal of the Forest Service is "To protect NFS watersheds by implementing practices designed to maintain and improve watershed condition, which is the foundation for sustaining ecosystems and the production of renewable natural resources, values, and benefits" (FSM 2521). Watershed condition is defined as "The state of the physical and biological characteristics and processes within a watershed that affect the hydrologic and soil functions supporting aquatic ecosystems" (Potyondy and Geier 2010). Properly functioning watersheds have five characteristics (Williams et al. 1997, and Potyondy and Geier 2010):

1. Provide for high biotic integrity, and support adaptive animal and plant communities that reflect natural processes;
2. Resilient and recover rapidly from natural and human disturbances;
3. Exhibit a high degree of connectivity along the stream both laterally across the floodplain and valley bottom, and vertically between surface and subsurface flows;
4. Important ecosystem services including high water quality, recharge of streams and aquifers, maintenance of riparian communities, and resiliency to climate variability and change;
5. Maintain long-term soil function.

The Watershed Condition Framework (WCF) was conceptualized at the National scale to change the Forest Service's approach to landscape and watershed restoration. The WCF established a nationally-consistent approach to classify watersheds based on underlying ecological, hydrological, and geomorphic functions and targets implementation of focused restoration activities in priority subwatersheds. The WCF provides outcome-based performance measures for documentation of improvement in watershed condition at Forest, Regional, and National scales (Potyondy and Geier 2010).

National Forests throughout the U.S. implemented the WCF process in 2010. Subwatersheds on the CNF were classified into three categories through the WCF based on classes described in FSM 2521.1 and Potyondy and Geier (2010):

- Class 1: Functioning Properly—SWSs that exhibit high geomorphic hydrologic, and biotic integrity relative to natural potential conditions. The watershed is functioning similar to natural wildland conditions (Karr and Chu 1999, Lackey 2001). There are minimal adverse human impacts on natural physical or biological processes, and the watershed is able to naturally recover to previous condition in response to natural and human disturbance (Yount and Neimi 1990);
- Class 2: Functioning at Risk—SWSs exhibit moderate integrity as described above;
- Class 3: Impaired Function—SWSs exhibit low integrity as described above. Adverse human impacts have caused a threshold to be exceeded where the watershed is no longer as resilient to physical and biological processes.

Subwatersheds are classified by WCF based on geomorphic, hydrologic, and biotic integrity relative to potential natural condition, which relates to geomorphic, hydrologic, and biological

watershed function. Integrity is evaluated in the context of the natural disturbance regime and geoclimatic setting and includes aquatic and terrestrial components because water quality and aquatic habitat are related to the integrity and functionality of the upland and riparian areas across the watershed (Potyondy and Geier 2010).

The WCF classification process includes four process categories including “aquatic physical”, “aquatic biological”, “terrestrial physical”, and “terrestrial biological”. These process categories are represented by 12 indicators comprised of attributes that represent underlying ecological function and processes that affect soil and hydrologic function (Potyondy and Geier 2010). Each indicator attribute receives a rating that is summed and averaged to produce an indicator score. The indicator scores within each process category are averaged, and the final watershed condition score is computed as a weighted average of the four process category scores. Process categories, attributes, and indicators used by WCF to assess condition are shown in Figure 5.

The results of the WCF for the CNF with data compiled in 2010 are used throughout this analysis to describe the existing condition of attributes and indicators that affect watershed function for SWSs across the CNF. Certain parameters have been updated with greater detail to reflect newer data analyzed for the Forest Plan Revision process. This process is discussed in greater detail elsewhere in this document. Additional analysis is discussed in the following sections where applicable. Results of the WCF by SWS are shown in Table 6 and Figure 5.

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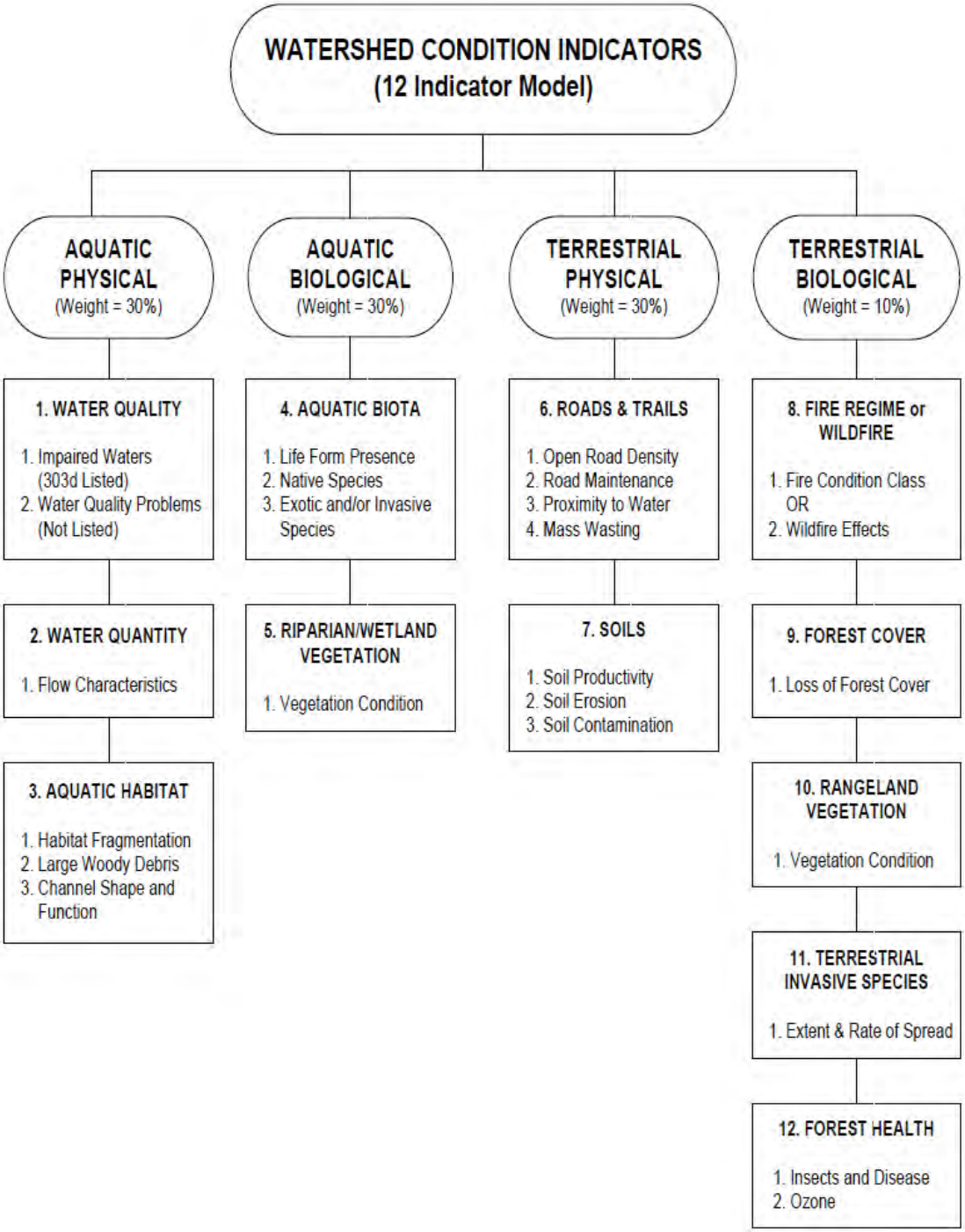

Figure 5. WCF process category, indicator, and attribute results.

Table 6. Results of the WCF summarized by number of subwatersheds within each condition class.

			# of Subwatersheds		
Process Category	**Indicator**	**Attribute**	**Class 1 Functioning Properly**	**Class 2 Functioning at Risk**	**Class 3 Impaired Function**
Aquatic Physical			64	24	1
	Water Quality		67	13	9
		Impaired Waters	61	19	9
		Water Quality Problems	58	22	9
	Water Quantity	**Flow Characteristics**	86	3	0
	Aquatic Habitat		11	47	31
		Habitat Fragmentation	48	16	25
		Large Woody Debris	15	44	30
		Channel Shape and Function	4	80	5
Aquatic Biological			13	37	39
	Aquatic Biota		12	26	51
		Life Form Presence	12	26	51
		Native Species	12	26	51
		Exotic and/or Invasive Species	12	26	51
	Riparian Wetland Vegetation	**Vegetation Condition**	34	21	34
Terrestrial Physical			15	74	0
	Roads and Trails		5	11	73
		Open Road Density	6	9	74
		Road Maintenance	5	9	75
		Proximity to Water	6	10	73
		+Mass Wasting	n/a	n/a	n/a
	Soils				
		Soil Productivity	89	0	0
		Soil Erosion	89	0	0
		Soil Contamination	79	10	0
Terrestrial Biological			89	0	0
	Fire Regime	**Fire Condition Class**	32	57	0
	Forest Cover	**Loss of Forest Cover**	89	0	0
	***Rangeland Vegetation**	***Vegetation Condition**	83	2	0
	Terrestrial Invasive Species	**Extent and Rate of Spread**	85	4	0

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			# of Subwatersheds		
Process Category	**Indicator**	**Attribute**	**Class 1 Functioning Properly**	**Class 2 Functioning at Risk**	**Class 3 Impaired Function**
	Forest Health		87	2	0
		Insect and Disease	64	23	2
		Ozone	89	0	0
Final Score			**15**	**73**	**1**

+Mass wasting was not assessed in this analysis, but is addressed elsewhere in this document.
*****Attribute and indicator assessed only in SWSs with range allotments

Composite results of the WCF for the CNF indicate that 82% of SWSs are "functioning at risk". Only 1 SWS was rated as "not functional", and 15 SWSs are "functioning properly". Scores in the aquatic physical process category are generally good, with 72% of SWSs functioning properly. Both water quality and water quantity attributes show the majority of SWSs "functioning properly". Aquatic habitat conditions are the primary driver of reduced function within the aquatic physical process category; 88% of SWS were rated as either "functioning at risk" or "not functional" for the aquatic habitat indicator.

Scores are low across the aquatic biological process category, with scores of "functioning at risk" and "not functional" for most indicators and attributes. Riparian wetland condition scores are higher than other indicators and attributes in this process category. Aquatic habitat is discussed in greater detail in the aquatics BA/BE (MacDonald 2015).

Within the Terrestrial Physical process category, roads attributes and indicators are the primary driver of low scores. Eighty three percent of SWSs received "not functional" scores in all road attributes and indicators. Roads are discussed in greater detail in the roads section of this analysis. Soil attributes and indicators were rated "functioning properly" across most SWSs.

Most indicators and attributes within the Terrestrial Biological process category are rated "functional", with a greater percentage of SWSs falling within the "functional at risk" category in the fire condition class and insect and disease attributes.

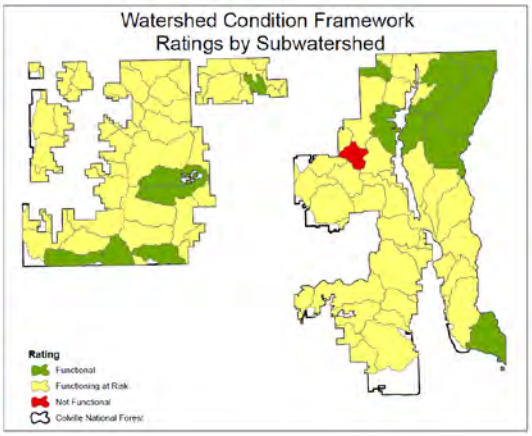

Figure 6. Watershed condition ratings.

Select indicators and attributes from the WCF were used in the aquatic ecological condition (AEC) model to assess the function of aquatic ecological conditions and its ability to support viable populations of aquatic focal species. The AEC model was used to determine key watersheds in the forest planning process and to assess aquatic species viability. The AEC process and results are discussed in the fisheries report (MacDonald 2015).

Streams

There are approximately 2,483 miles of perennial streams that flow throughout the year within the CNF administrative boundary (Table 7). There are approximately 4,191 miles of intermittent streams across the CNF that flow either seasonally or spatially (flow subsurface in some reaches). The intermittent stream category for purposes of this analysis also includes ephemeral channels, which flow for a short period following precipitation or snowmelt. Ephemeral streams generally do not have the surface groundwater interaction to support riparian or wetland vegetation and do not show evidence of yearly scour. Other water features on the CNF include lakes, ponds, reservoir, and seeps and springs (Table 8).

Table 7. Stream miles within the administrative boundary of the CNF (from national hydrography dataset (NHD) flowline).

Perennial	Intermittent/Ephemeral	Total
2,483	4,191	6,674

Table 8. Other water resources within the CNF administrative boundary.

Water Resource Type	Quantity	Acres
Lakes ponds and reservoirs	102	5,471

Stream Channel Condition and Function

Stream channel condition and function is affected by processes occurring throughout a watershed. Stream channel condition is often discussed in terms of the habitat it provides for fish; however channel conditions also affect how stream system responds to changes in inputs of water, nutrients and sediment from natural or anthropogenic disturbance. Although stream systems are variable, functional streams are generally more resilient to disturbance and recover from faster than non-functional systems.

The “channel shape and function” attribute was assessed for WCF using stream channel condition data collected using the level II Region 6 stream inventory protocol (USDA 2012(b)) for most named streams across the CNF. Streams in most SWSs are “functioning at risk” (80) with 4 SWSs functioning properly, and 5 SWSs with impaired function (Figure 7).

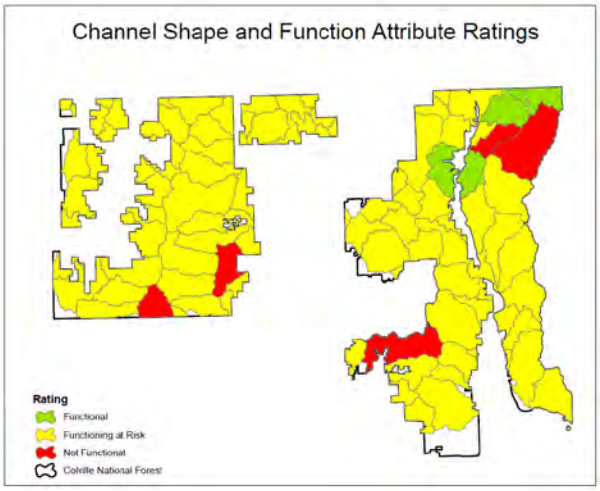

Figure 7. Condition rating for the channel shape and function attribute.

Data collected on stream channel variables that are indicators of channel shape and function under the PACFISH INFISH Effectiveness Monitoring Program (PIBO EMP) collected on selected reaches across the CNF since 2001 indicate that channel conditions in reaches in managed watersheds are poorer than in reference reaches located in watersheds with minimal disturbance. See MacDonald, 2015 for further discussion of the PIBO EMP and results of monitoring.

Riparian and Wetland Function

Although riparian and wetland ecosystems comprise a small portion of lands on the CNF, they provide important ecological function and habitat for plants and aquatic and terrestrial wildlife (Wissmar 2004). Riparian areas and wetlands provide ecological, economic, and social benefits and are valued for recreation, livestock grazing, mining, transportation corridors, and water supply for cropland and irrigation (Kovalchik and Clausnitzer 2004). They provide a linkage between upland and stream habitats and are important habitat for aquatic and terrestrial wildlife and a variety of plants. Vegetation production is generally higher in wetland and riparian ecosystems than in the uplands, and riparian structure and function influence the rate, amount, and timing of discharge of water, sediment, nutrients, and other potential pollutants (Kovalchik and Clausnitzer 2004).

Historical and current uses in riparian areas have influenced structure, composition, and function of these ecosystems, and conservation, rehabilitation, and restoration of function is a high priority on the CNF. Riparian, aquatic, and wetland ecosystems are diverse in eastern Washington, with 163 recognized aquatic, wetland, and riparian plant associations or community types (Kovalchik and Clausnitzer 2004).

Riparian Areas

Riparian areas act as a filtration system for overland water and sediment runoff before it enters the stream system. This function is especially important where watersheds have experienced disturbance or management that alters the routing of water and sediment upslope of the riparian area. Trees and shrubs in riparian areas create shade, regulate air, soil, and water

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temperature, and provide inputs of downed trees and woody debris to the stream system (Wissmar 2004).

Roots of riparian vegetation provide bank stability and slow the rate of erosion and potential channel migration (Gregory et al. 1991). Riparian vegetation also slows flowing water during high flow events, trapping sediment within the floodplain (Platts et al, 1985), resulting in a reduction in the sediment load in flood water (Wondzell 2001).

INFISH (USDA Forest Service 1995) designates riparian habitat conservation areas (RHCAs) to be managed for the benefit of aquatic and riparian-dependent species. Since RHCAs are designated by width rather than riparian function or existence of riparian vegetation, there is often upland vegetation on the outer width of RHCAs. RHCA widths designated by INFISH vary based on stream/wetland type and are wider in priority watersheds (designated by INFISH). Acres of RHCA across the CNF by stream type are shown in Table 9. Since RHCA width only apply to management on lands owned by the CNF, RHCA acreage is calculated for lands owned by the CNF rather than lands within the CNF administrative boundary.

Table 9. Existing Riparian Habitat Conservation Areas (RHCA) acreage on the CNF administrative boundary.

RHCA Designation/Description	RHCA Width (ft)	RHCA Acres across the CNF
Fish Bearing Perennial	300	35,427
Non-fish Bearing Perennial	150	49,075
INFISH Natural Waterbody; ponds, lakes, reservoirs	150	6,091
INFISH Non-fish Bearing Intermittent	50	25,987
INFISH Wetland <1 acre	50	805
INFISH Wetland >1 acre	150	14,736
Priority Watershed No Fish Intermittent	100	15,904
Priority Watershed Wetlands < 1 acre	100	233
Priority Watershed Wetlands > 1 acre	150	2,434
Total		150,692

Riparian Wetland Vegetation Condition

Conditions across riparian areas on the CNF vary across SWSs (Figure 8). Thirty four SWSs are rated as “properly functioning”; these riparian areas have native mid to late seral vegetation in dynamic equilibrium with the stream or wetland system in > 80% of riparian areas. Twenty-one SWS are rated as “functioning at risk” with native vegetation showing a moderate loss of vigor, with a lesser component of mid to late seral vegetation occupying 25-80% of riparian areas.

Thirty-four SWSs are rated as “not functional”, with native vegetation displaying a loss in vigor and cover and composition are mostly early seral. Riparian areas in SWSs rated “not functional” are generally disconnected from surface water and shallow groundwater and reflect the loss of available soil water (Potyondy and Geier 2010).

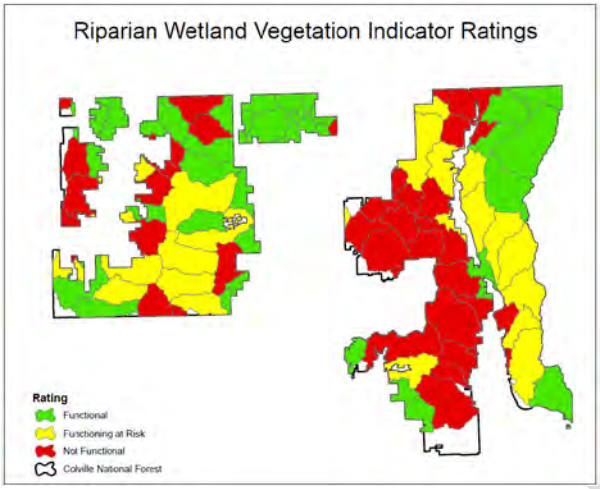

Figure 8. Riparian wetland vegetation indicator ratings from WCF.

Degraded riparian conditions are influenced by livestock grazing, mining, timber harvest and associated infrastructure, fire suppression, and road construction and use. Riparian conditions are also affected by stream channel function and the ability of the stream system to provide water to support persistence of riparian vegetation. Channel incision can lower the water table, making the water table too low to support riparian vegetation (Wondzell and Swanson 1999).

Wetlands

Wetlands are critical for water storage and slowing the release of flood water and snow melt, recharge groundwater, and recycle nutrients (Keddy 2010). The National Wetlands Inventory (NWI) is a detailed spatial inventory of wetland data mapped across the lower 48 states competed by the US Fish and Wildlife Service. Wetland type and acreage across the CNF are shown in Table 10.

Table 10. Riparian and wetland acreage for the CNF (National Wetlands Inventory).

Wetland Type	General Description	Total Acres
Freshwater Emergent Wetland	Herbaceous marsh, fen, swale, or wet meadow, palustrine emergent	5,001
Freshwater Forested/Shrub Wetland	Forested swamp or shrub bog wetland, palustrine forested/shrub	6,767
Total		**11,768**

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Groundwater Dependent Ecosystems

Groundwater is the portion of precipitation that infiltrates into soil and bedrock and flows subsurface until it reaches the surface in streams, lakes, springs, seeps, and wetlands (USDA Forest Service, 2014(b)). Ground and surface water are interconnected, with groundwater contributing to flow, chemistry, and temperature of streams, lakes, springs, and wetlands, providing the water to support terrestrial and aquatic plants and animals. Groundwater is also critical to water supply and provides drinking water to communities across the country (USDA Forest Service 2007).

Groundwater-dependent ecosystems (GDEs) are areas that require access to groundwater to maintain the community of plants, animals, and physical processes. Examples of GDEs include, springs, seeps, fens, and wetlands. Proper hydrologic function is critical to maintaining conditions in GDEs that support wetland plants and animals. Management activities with the potential to impact groundwater-dependent ecosystems (GDEs) include grazing, road building and maintenance, recreation, vegetation management, large wildfires, and climate change. Impacts to GDEs from these activities are mitigated through standards, guidelines, and BMPs, which are discussed in the effects analysis of this report.

Inventories of GDEs on the CNF have primarily been completed at the project-level. The National hydrography dataset (NHD) shows mapped springs and seeps and provides a basis for quantifying springs and seeps across the CNF, however this dataset underrepresents the actual number of springs, seeps, and other groundwater dependent ecosystems. A summary of the number of springs and seeps across the CNF from NHD data is shown in Table 11. Location of GDEs can also be approximated using the National Wetland Inventory's categorization of palustrine emergent wetlands which occupy only 12 acres on the CNF. Data from the NWI also underrepresents GDEs and underscores the need for project-level analysis of location and condition of GDEs during planning.

The Forest Service released a draft groundwater management directive on May 7, 2014 to amend its internal direction to establish comprehensive direction for management of groundwater resources on NFS lands. The intent of the proposed directive was to clarify roles and establish new processes and procedures for special uses involving withdrawal of groundwater resources (FSM 2560(draft)). The proposed directive was withdrawn on June 19, 2015 because concerns were raised through collaboration with Tribes, conservation organizations, States and other organizations that the proposed directive may exceed the Agency's authorities and infringe on State authorities to allocate water (Federal Register 2015). The intent of any new groundwater directive would be to establish a clear and consistent approach for evaluation and monitoring of the effects of different actions on groundwater resources on NFS lands through a collaborative process (Federal Register 2015).

Groundwater Aquifers

The CNF is underlain by aquifers that occur in pre-Miocene rocks including igneous, metamorphic, volcanic, and marine and non-marine sedimentary rocks that vary in permeability and water yield. Higher water-yielding aquifers in unconsolidated-deposits consisting of primarily of sand and gravel with lesser components of clay and silt occupy less than 25% of the CNF land base (Whitehead 1994). Aquifers occurring in unconsolidated deposits occur primarily in the eastern portion of the CNF

Surface and Groundwater Interaction

The interaction between surface and groundwater is a function of climate, geology and aquifers, and soils. Soil affects how water moves across the landscape, and the quantity and timing of stream discharge. Soil water movement was modeled across the CNF using soil erodibility, soil runoff potential, and soil available water storage (Farr et al. 2015). Soil water flow categorization and description, and springs and seeps (from NHD) are shown in Table 11 and Figure 9.

Table 11. Soil water flow category acreage across the CNF administrative forest and number of springs and seeps within each soil water flow category.

Soil Water Flow Category	Description	Total Acres	Number of Seeps and Springs
Runoff	Primary water movement is on the surface of the soil	393,297	61
Storage	Water primarily infiltrates and is stored in the soil	693,438	116
Lateral Flow	Water infiltrates and water movement is primarily subsurface	180,149	29
No Category	n/a	0	5
Total		**1,266,884**	**211**

Over half (54%) of the area of the CNF have soils that support infiltration and storage. Thirty-one percent of the soils support runoff of water across the soil surface; however runoff potential is also affected by vegetation and litter cover, and precipitation intensity. Lateral flow is the primary soil water flow mechanism on 14% of soils across the CNF. Springs and seeps are most prevalent in areas where storage is the primary soil water flow mechanism.

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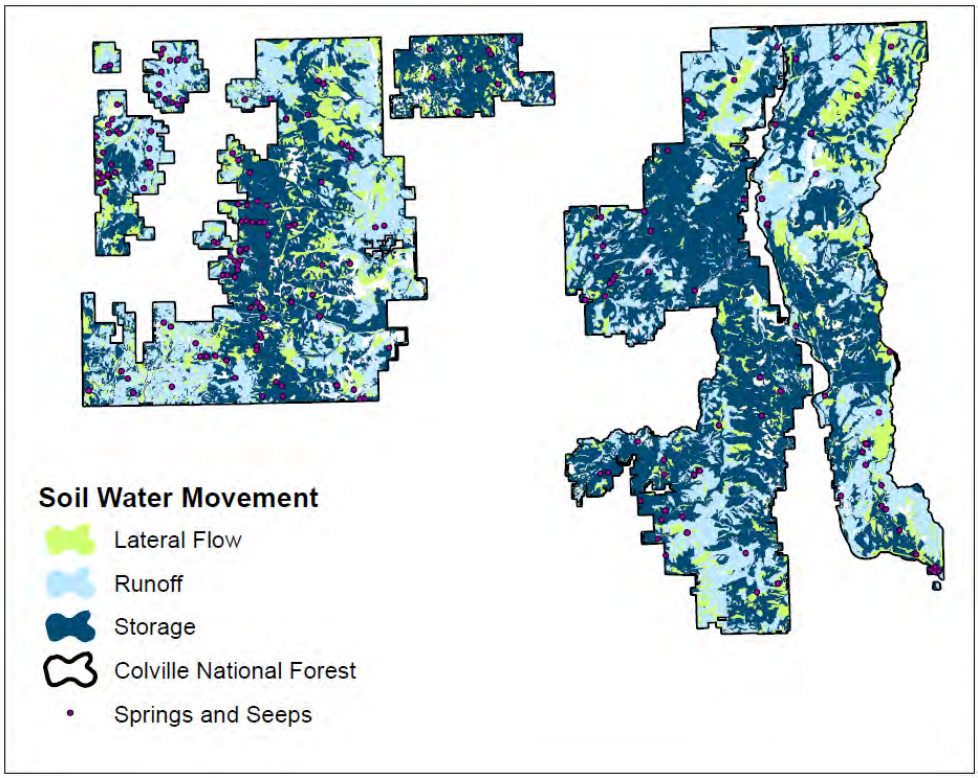

Figure 9. Soil water flow and springs and seeps across the CNF.

Land Uses and Disturbances Affecting Watershed Function

Climate, topography, geology/soils and topography interact to affect runoff, erosion, and ultimately water quality and quantity, and stream channel function (Figure 10) (Elliot 2010). The primary land uses that affect watershed function addressed in this report include vegetation management, wildland fire, insect and disease outbreaks, grazing, roads, and watershed restoration.

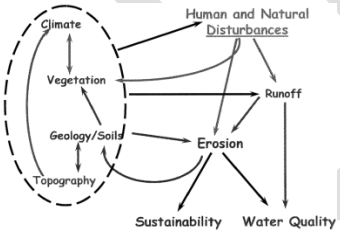

Figure 10. Physical and biological variables that control forest watershed processes (Elliot 2010).

The Role of Upland Vegetation Condition in Hydrologic Processes

Forest vegetation plays a significant role in hydrologic processes (Figure 11) (Hubbart 2007). In an intact forest ecosystem when precipitation falls as rain, vegetation intercepts a percentage of water that evaporates back into the atmosphere. Un-intercepted precipitation falls to the forest floor, where uncompacted soils and the vegetative litter layer allow water to slowly infiltrate into the soil. Infiltrated water enters the groundwater system where it is used by plants and

other organisms, and transpired back into the atmosphere through plant photosynthesis. Infiltrated groundwater eventually flows back onto the surface, feeding streams, lakes, rivers, springs, and other surface waters. A small percentage of precipitation may not be intercepted or infiltrated and may travel overland in a process known as overland flow. Overland flow is limited on forested lands with little disturbance to locations where precipitation intensity exceeds infiltration capacity (Horton overland flow), when soils are saturated and precipitation continues to fall (saturation excess overland flow), or disturbance results in soil compaction or loss of ground cover.

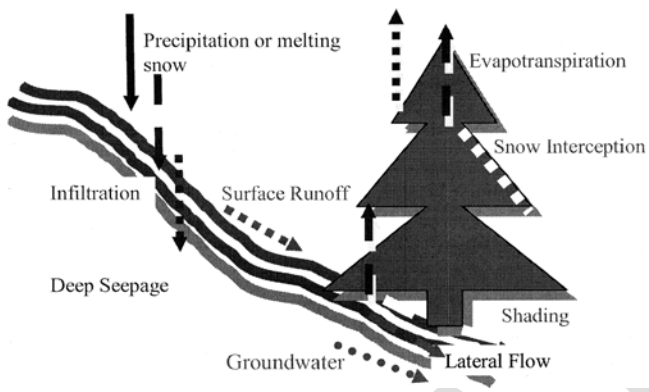

Figure 11. Hydrologic hillslope processes in forested ecosystems (Elliot 2010).

Precipitation falling as snow is associated with climatic processes, but is also dependent on forest cover. In winter, trees intercept significant amounts of snow that often sublimates (changes directly from solid to gas state) and never reaches the ground, reducing the amount of precipitation available to infiltrate or run off the landscape (Elliot 2010). Creation of canopy openings can alter rates of snow accumulation and alter the timing of snowmelt (Troendle and King 1985). Troendle et al. (2001) report that in coniferous forests in cold snow zones 25-35% of snow would be intercepted and sublimated or evaporated. Studies have shown that snow water equivalent and snow melt rates are higher in open areas than in forested areas (McCaughey and Farnes, 2001, Skidmore et al. 1994). In a study in northern Idaho, measured snow water equivalent was 200mm less under a canopy than in an open area (Hubbart 2007).

The effect of changes in upland vegetation on hydrologic function is dependent on the processes through which changes in vegetation cover affect water cycle components, including evapotranspiration, snow accumulation and melt rates, infiltration, and overland flow (Chamberlin et al. 1991). Removal of canopy cover through timber harvest, insect and disease outbreaks, or wildland fire alters the hydrologic cycle by reducing interception by vegetation, altering evaporation and transpiration. Removal of vegetation and organic matter from the forest floor can also increase watershed runoff, erosion, and sedimentation. Removal of leaf litter and other vegetation material from the forest floor also increase runoff and erosion and sedimentation processes (Robichaud et al. 1993). Removal of forested vegetation can also affect water yield and peak flows. Reduction in canopy cover interception and evapotranspiration can increase the amount of precipitation available and the timing of runoff and recharge to surface water systems (Goodell, 1965, Woods 1966). Effects to hydrologic process and function for timber harvest, die-off from insect and disease, and wildland fire are shown in Table 12.

Table 12. Affects to hydrologic processes from timber harvest, die-off from insect and disease outbreaks, and wildland fire (Adams et al. 2012).

Associated Change	Disturbance Type		
	Die-off	Harvest	Fire
Canopy Cover Loss	X	X	X
Soil Compaction from Vegetation Removal Activities	X (if salvaged)	X	X (if salvaged)
Heat-induced soil water repellency			X
Litter layer/understory burning			X
Water yield	X	X	X
Increased peak flows	X	X	X

Timber Harvest

Direct removal of vegetation through timber harvest can affect watershed processes including runoff, erosion, and sedimentation, water yield, and peak flows, however the infrastructure to support vegetation removal has the greatest impact to hydrologic processes and function. Furniss et al. (1991) concluded that forest roads contribute more sediment than all other forest activities combined on a per-unit area basis (Meehan 1991). The majority of sediment from timber harvest activities is related to road construction and increased use of existing roads (Lee et al. 1997, Chamberlain et al. 1991, Dunne and Leopold 1978).
Removal of trees through timber harvest can also affect water yield. Studies on the effects of vegetation removal on water yield show highly variable effects, and generally have not been undertaken on a scale greater than small watersheds (Ziemer 1987). At small scales, changes in water yield are easier to measure, while changes in runoff per unit area are hard to measure directly for larger areas because changes are too small for direct measurement (Huff et al. 2000). In conifer forests a reduction in forest cover less than 20%, resulted in no detectable increase in water yield (Bosch and Hewlett 1982; Stednick 1996). Megahan et al. (1995) found no significant increase in either annual or monthly streamflow in a paired catchment study in Idaho, where 23% of one watershed was clearcut through helicopter-logging and burned. A study on a clear-cut in 25% of the study basin in the Uinta Mountains of Utah found up to a 147mm (52%) increase in annual water yield with the largest increases in May-August. Increases in water yield persisted for the 20 years data was collected after harvest (Burton 1997). A 30-year study of watershed response to timber practices at the High Ridge evaluation area in the Northern Blue Mountain showed low-magnitude, short-term increases in water yield after clear cutting (Helvey et al. 1995).

The greatest relative increases in water yield and streamflow from vegetation removal in the Pacific Northwest are observed in the summer low-flow season, however larger overall increases occur during snowmelt (Harr 1979; Troendle et al. 2001; Brown et al. 2005). In a study in northwestern California, Keppeler and Ziemer (1990) found that relative water yields were greater during summer low-flow, than annual flows, with increases diminishing 5 years post-harvest.

Generally water yield increases in proportion to forest vegetation removed, with lower magnitude in response in dry regions (Stednick 1996; Brown et al., 2005). Water yield typically

increases in the first year following fire or logging, but slowly decreases to pre-disturbance levels as vegetation reestablishes (Hibbert 1967; Peterson et al. 2009). The magnitude of increases in water yield is dependent on precipitation patterns 2-3 years after disturbance as vegetation begins to recover. The duration of water yield and peakflow increases following vegetation removal or mortality is dependent on timing and intensity of precipitation and snowmelt rates (MacDonald 2000), and rate of vegetation recovery. Areas with high precipitation generally have vegetation regenerate resulting in the rapid return of streamflow to pre-disturbance state. However, these same higher-precipitation watersheds also have the most pronounced, yet short-lived increase in water yield (Stanley and Arp 2002). Therefore, short-term increases in water yield may be more pronounced on the eastern side of the CNF. Smaller magnitude increases in water yield would be expected in the drier western section of the CNF, however these effects may be longer in duration, as vegetation may take longer to reestablish.

While small scale studies show that water yield can be increased through focused forest management, the scale of treatment needed to increase water yield on NFS lands is constrained by a variety of factors. Only portions of areas on NFS lands can be economically treated based on physical, environmental, and political constraints (Ziemer 1987). Although it has not been studied locally, a 1983 study for NFS lands in the Sierra Nevada Mountains of California found that if multiple use/sustained yield guidelines were followed, water yield could be increased by 1% above current levels (Kattelmann et al. 1983). This increase would likely be undetectable from a water use perspective; US Geological Society stream gages usually have up to a 5% error (Rothacher 1970). In addition, most of the projected increases would occur during snowmelt in wetter years, rather than during summer low-flow and in drought years.

Vegetation removal also affects peak flows. In a compilation of paired and modeled watershed studies in western North America, the largest increases in peak flows were reported for small storms (<1 year recurrence interval), with increases in peak flows diminishing with higher magnitude storms (Grant et al. 2008). The largest peak flow increases were in watersheds that had been 100% clearcut, but there was no pattern between treatment type and magnitude of peak flow increase (Grant et al. 2008). While vegetation treatment type affects peak flow, other management treatment considerations including road density, hydrologic connectivity, and drainage efficiency (Wemple et al. 1996), and riparian buffer widths also influence peak flows (Grant et al. 2008). Increased erosion and runoff from forest roads generally have a greater influence on peak flows than vegetation removal (Wemple et al. 2001).

Potential effects of timber harvest and vegetation removal are mitigated through BMPs and implementation of forest plan standards and guidelines, including limiting the temporal and spatial scale of treatments, limiting vegetation treatment in riparian areas and other unstable areas, and properly locating skid trails, landings, and temporary roads to limit erosion. While implementation of BMPs is included in all alternatives, standards and guidelines for timber harvest and other vegetation management activities vary by alternative, and are discussed in the effects analysis section of this report.

Differences in land available for timber harvest, and the primary types of vegetation management activities and their potential effects are discussed in the Environmental Consequences section of this report. In addition, timber harvest and other vegetation treatments generally require additional access through roads (either temporary or system),

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therefore potential effects of increased creation and use of roads for vegetation management activities are also discussed in the effects analysis section of this report.

Wildland Fire

Wildland fire includes both unplanned and planned initiations (prescribed fire). Prescribed fire is initiated to achieve resource management objectives, primarily to reduce the risk of high severity fires. Wildland fire was once a common occurrence in forest lands across the CNF, however fire exclusion since the early 1900s has resulted in changes in forest structure and species composition resulting in increased risk of higher severity and intensity wildfires when they do occur (Hessberg and Smith 1999). Fire severity describes the effects of a fire to soil structure, infiltration capacity and biotic components and affects runoff and soil erosion potential from fire effects. Fire intensity describes fire effects to vegetative characteristics including tree mortality and consumption of understory vegetation and down wood (Debano et al. 1998) and affects runoff rates, peak flows, water yield, and riparian canopy cover.

Fire kills trees and decreases canopy cover, partially or completely burns ground cover, and may form water-repellant soils (hydrophobic) depending on burn intensity. Soil water storage, interception, and evapotranspiration are reduced when vegetation is removed or killed by fire and when organic matter on the soil surface is consumed by fire (DeBano et al. 1998; Neary et al 2005). Fire consumption of ground vegetation and hydrophobic soils increase overland flow and erosion and sedimentation risk. Burned areas are vulnerable to accelerated soil erosion which can increased post-fire sediment yield (Neary, et al., 2005). Increases in surface erosion following wildfire have been well documented (Helvey, 1980, Robichaud and Hungerford, 2000; Wondzell and King., 2003; and Neary et al., 2005); however effects are spatially variable based on soil condition, burn severity, and timing and magnitude of precipitation (Robichaud and Hungerford, 2000). Helvey et al. (1985) found that annual sediment yield increased as much as 180 times above pre-fire levels following a high-mortality wildfire in the Entiat experimental forest in the eastern Cascades of Washington. Water yields and peak flows can also increase from large fires due to loss of canopy cover and reduction in evapotranspiration (Helvey 1980). Effects of vegetation removal through timber harvest on water yield discussed in the previous section are similar to the effects of wildland fire.

Prescribed fire is used as a management tool to by itself or in conjunction with thinning to reduce fuel loading and the risk of uncharacteristically large fires (Mitchell et al. 2009). The most effective way to reduce fire severity is forest thinning in conjunction with prescribed burning (Covington et al. 1997, Graham et al. 1999). Most prescribed fires are ignited under conditions that limit the potential for high severity fires (Wondzell 2001), they have less of an effect on vegetative litter and soil organic structure, and result in a lower risk of erosion and changes in water yield and peak flows (DeBano et al. 1998).

Climate change is expected to alter fire return intervals as well as potential effects from increasingly large, severe fires. There is a close correlation with climate conditions and severity and extent of wildfires in the western U.S., and projected changes in temperatures and precipitation in the interior Pacific Northwest are expected to increase the risk of larger, more severe fires (Littell et al. 2010, Westerling et al. 2003).

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Potential effects to hydrologic processes from prescribed fire are mitigated through BMPs and standards and guidelines that limit fire intensity and severity, ground-disturbing activities (including firelines), and retain adequate groundcover. While more difficult to mitigate, effects from unplanned ignitions are mitigated through burned area emergency response (BAER) activities, and post-fire rehabilitation of firelines and other infrastructure. In addition, forest vegetation management in all alternatives focuses on increasing landscape resiliency to large-scale wildland fire.

Insects and Disease

Large-scale insect and disease outbreaks can have similar effects to hydrologic function as large scale wildland fire in the scale of disturbance and mortality of overstory vegetation (Wondzell 2001). Increase in dead trees may increase fuel loading and increase susceptibility to large fires (Hessberg et al. 1994). There are limited studies on the effects of die-off from insect and disease outbreaks on erosion and sedimentation, but indirect effects include increased inputs of litter to the forest floor, and increased large woody debris to the stream system and upland environment (Wondzell 2001). Die-off from insects and disease can also alter water yield and peak flows through the same processes discussed in the Timber Harvest and Wildland Fire sections of this report. Adams et al. (2012) hypothesize that in snowmelt-dominated watersheds, there would be decreases in evapotranspiration and increased flows if canopy cover from die-off exceeds 20%.

Vegetation Condition

The structure and composition of forest vegetation on the CNF has changed since Euro-American settlement (Wondzell 2001). Historic range of variability (HRV) analysis was used to evaluate existing forest structure condition for 5 vegetation types across the CNF and is discussed in detail in the Forest Vegetation Report (Day 2015). HRV describes the dynamic behavior and functioning of ecosystems before European settlement and provides a framework to determine changes between historic and current conditions (Aplet and Keeton 1999). When forest conditions move beyond the limits of HRV, they move into a state of disequilibrium making them more susceptible to disturbances, including insect and disease outbreaks and stand-replacing fires (Kaufmann et al. 1994). As discussed above, these large-scale episodic disturbances affect hydrologic and watershed function and processes and water quality.

Table 13. Historical range of variability percentage by vegetation type for 5 structure classes compared to current conditions. Values below HRV are shaded in black, values above HRV are shaded in gray (Day 2015).

	% CNF		Early %	Mid Open %	Mid Closed %	Late Open %	Late Closed %
Douglas-fir dry	39%	Current %	12	7	57	5	19
		Historical %	6-16	2-8	4-13	38-78	1-32
Northern Rocky Mountain mixed conifer	30%	Current %	19	4	65	1	11
		Historical %	9-25	1-3	18-30	4-6	44-60
Spruce / Subalpine fir	2%	Current %	21	0	60	0	19
		Historical %	4-24	0	7-27	0	55-83
Subalpine fir /	19%	Current %	33	4	49	2	13

Lodgepole pine		Historical %	45-65	0	33-53	0	3
Western hemlock / Western redcedar	10%	Current %	35	0	52	0	13
		Historical %	14-46	0	13-41	0	29-57

There is an abundance of mid-structural and a lack of late-stage structure across 4 of 5 vegetation types on the CNF. These stands have smaller tree sizes and greater canopy cover than would be expected historically, which is consistent with fire suppression and other changing land use patterns (Day 2015). The overabundance of stands in the mid-closed structural class makes them more susceptible to large-scale disturbance and increases the risk of effects to hydrologic and watershed function.

Livestock Grazing

Livestock grazing is one of the most widespread uses in the interior northwest, however grazing on the CNF is less widespread and intensive than on other forests east of the Cascades in Oregon and Washington. Livestock effects include trampling of vegetation, soil compaction, and loss of vegetative cover (Platts 1991), which can increase stream and channel instability and result in unstable banks and incised and widened stream channels (Marston 1994). However, the impact of grazing depends on timing, intensity and frequency as well as type of animals. (Heitschmidt and Stuth 1991). Although grazing can affect upland conditions, effects to hydrologic and aquatic function are most pronounced in riparian areas and areas with active water because these areas are most sensitive to livestock disturbance, and they are often where use is concentrated.

Livestock concentrate in riparian areas and trampling and overutilization of riparian vegetation by livestock has contributed to the decline of riparian ecosystem structure and composition across the interior Pacific Northwest (Lee et al. 1997; Johnson 1992). Riparian areas in the western US comprise approximately 1-2% of summer range, but provide 20% of forage available for livestock (Clary and Webster 1990).

The effects of grazing can be minimized with proper management of grazing, and implementation of practices that keep livestock out of streams and other aquatic features as well as riparian areas. Additional grazing protections were implemented following the establishment of INFISH guidelines in 1995. These guidelines were intended to provide protection for riparian areas to protect resident fish and water quality and move conditions toward attainment of Riparian Management Objectives (RMOs). Analysis of status and trend of stream channel variables is discussed in detail in MacDonald et al. 2015.

PIBO monitoring trend data indicate that since implementation of INFISH, several stream habitat attributes have improved, with macroinvertebrate communities, bank stability, bank angle, pool tail fines, and % pools showing positive, but not statistically significant trends. Substrate size (D50) has shown a negative though not statistically significant trend. Increases in large woody debris, pool depth, and % undercut banks show a statistically significant improving trend in most subbasins (Archer 2015). At most sites, PIBO trend data was calculated for two years of sampled data over a ten year period (each site sampled once every five years). Two data points generally do not provide enough data to make conclusions regarding long-term trends.

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The timeframe for measureable changes in stream channels may be decades or centuries and is often related to larger scale disturbance, such as floods and fires, making it difficult to isolate the effects of management on stream channel adjustments. With a longer record of data, trends may be detected. Other studies on changes in channel morphology following livestock exclusion support this conclusion. These studies have shown mixed improvement in stream channel condition and function because morphological change is often on a timescale longer than conducted studies, and is sensitive to processes at the watershed rather than reach scale (McDowell and Magilligan 1997; Medina and Martin1988; and Kondolf 1993).

Approximately 363,845 acres (33%) of the CNF are classified as capable for cattle grazing, and 448,160 acres (41%) are suitable for sheep grazing. There are a total of 58 allotments on the CNF; 42 are active, and 16 are not currently grazed. Of the 16 vacant allotments, 7 are likely to be used again in the foreseeable future. An animal unit month (AUM) is the amount of forage used by a cow and a calf pair, one horse, or five sheep or goats for one month. AUMs have fluctuated between approximately 28,000 and 33,000 over the past 10 years (Fletcher 2015), and forest plan alternatives do not propose changes to allotment boundaries, use, or AUMs. However, standards and guidelines pertaining to range management differ by alternative and are analyzed in the Environmental Consequences section of this report.

Roads

Roads have wide-ranging effects on hydrologic processes and watershed function. The compacted surface of roads lowers infiltration capacity, which alters and concentrates overland flow and increases erosion and delivery of sediment to the stream system, which can degrade water and habitat quality (Furniss 1991). Roads can also intercept subsurface flow and convert it to rapid surface runoff, extending channel networks and increasing watershed efficiency (Wemple et al. 1996). Roads reduce vegetative cover in streamside areas and accelerate delivery of water and increase erosion and sedimentation into streams (Megahan, 1983). Accelerated erosion, runoff, and sediment delivery from roads increases streambed fine sediment, which affects aquatic habitat and macroinvertebrates, and makes streambeds and banks more susceptible to erosion during high flow events (Cover et al. 2006). At crossings, excessive flow velocities and undersized culverts can alter stream channel function and increase the risk of channel and crossing instability at high flows (Furniss et al. 1998). Other road-related impacts include reduced potential large wood available for in-channel wood and shade from riparian areas. Meredith *et al.* (2014) found the presence of roads adjacent to streams reduced adjacent in-channel wood.

Slope position of roads is a critical factor in the interaction between roads and streams. Ridge-top roads can influence watershed hydrology by channeling flow into small headwater swales, accelerating channel development. Mid-slope roads can intercept subsurface flow, extend channel networks, and accelerate erosion (Gucinski et al., 2001). Roads adjacent to and crossing streams, or hydrologically connected to streams have the greatest influence on streamflow, streamside shade, and accelerated sediment delivery to the stream system (Croke et al 2005). Hydrologically connected roads (portions of roads that route water and/or sediment directly to the stream system) increase flow routing efficiency and can increase peak flows and sedimentation (Wemple et al. 1996). Roads also simplify adjacent channels and riparian and in-stream habitat, and prevent natural channel adjustments (Spence et al. 1996).

Several road metrics provide a means to assess the potential effects and risk of roads. Road density is often used as a measure of risk particularly in areas of active timber harvest (Lee et al. 1997, Sharma and Hilborn 2001). However, road density does not adequately assess the varying effects of roads across the landscape that are dependent on geology, precipitation, and location of roads in relation to the stream system (Lee et al. 1997). McCafferty et al. (2007) found a significant positive correlation between total road density, open road density, number of stream crossings, and fine sediment in streams. Traffic density on open roads can also present a larger erosion and sedimentation risk than closed roads. Reid and Dunne (1984) found that a heavily used road segment contributes 130 times as much sediment as a closed road.

The road indicator in WCF was calculated using open road density (road maintenance levels 2-5), proximity of roads to water, and the degree of road maintenance (Potyondy and Geier 2010). Results of the WCF for the roads and trails indicator show that roads are affecting hydrologic function across most of the CNF, with most SWSs rated as impaired for road indicators (Figure 12). In these SWSs the density and distribution of roads and trails indicate that there is a high probability that the timing, magnitude, duration, and spatial distribution of flows is altered by the road system.

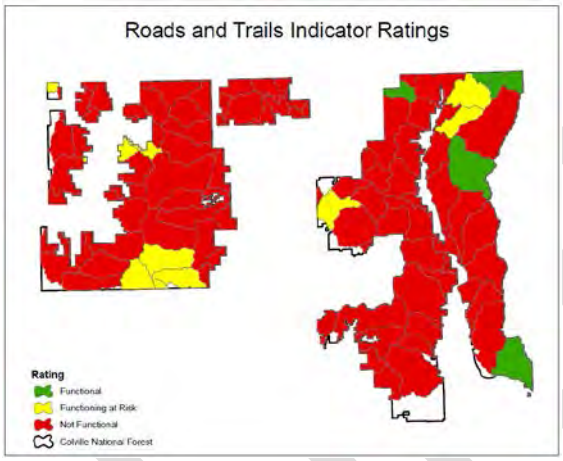

Figure 12. Results of the WCF analysis for the roads and trails indicator.

Additional metrics to assess the existing condition of the road system on the CNF are presented in this report. Total miles of road on the CNF, road density, riparian road density by subwatersheds, estimates of hydrologic connectivity, and number and relative risk of stream crossings are presented in this analysis. Calculations in this analysis were performed using all open and closed roads (ML 1-5) roads regardless of jurisdiction within the CNF administrative boundary. Decommissioned roads were also included in this analysis because spatial data does not include detail on the level of hydrologic decommissioning completed on decommissioned roads. Therefore, decommissioned roads are assumed to have a continued effect on the hydrologic system. Since they are used for one-time access as needed in a single timber sale or associated project, temporary roads were not included in this analysis. However, temporary roads can have an impact on hydrologic and aquatic function if they are not properly removed and stabilized following use.

Road density and mileage numbers presented in this report use the metrics that best represent the effects of roads and relative risk to the hydrologic system, and provide a more focused analysis of road condition and relative risk than the road and trails indicator ratings from the WCF. Road mileage and densities presented here may be different from those contained in other forest plan revision documents. Additional calculations of road density using different criteria are presented by management area and watershed in the effects analysis of this report. Calculation methodology for this road density metric is described when the data are presented.

Total miles of road on the CNF are shown in Table 14, and road miles by jurisdiction are shown in Table 15. There are total of 5,221 miles of roads under all jurisdictions within the CNF administrative boundary. Fifty-seven percent of roads are open, and 19% are non-forest system roads. Approximately 15% of the roads are located in RHCAs and 2/3 of the roads in RHCAs are open.

Table 14. Miles of road on the CNF.

Road Type	Miles	% of Total Road Miles	Miles in RHCAs	% of Total Road Miles
Total Existing Roads	5,221	100%	797	15%
Open	2,957	57%	547	10%
Closed	2,263	43%	250	5%

Table 15. Miles of road by jurisdiction on the CNF.

	NFSR	Non-NFSR	Total
Total	4,391	830	5,221
Open	2,353	604	2,957
Closed	2,037	226	2,263

Road density of open and closed roads was computed at the subwatershed scale for all subwatersheds with greater than 25% of land within the CNF administrative boundary. Road density and riparian road density in each subwatershed was categorized based on relative risk, where <1 mi/mi^{2}is good, 1-2.4 mi/mi^2 is fair, and >2.4 mi/mi^2 is poor condition (Potyondy and Geier 2010). Road density and road density in riparian areas is shown in Table 16. Road densities across subwatersheds on the CNF are generally in the “fair” to “poor” categories; only 5 subwatersheds have road density of <1 mi/mi^2, and 57% of subwatersheds have road densities >2.4 mi/mi^2. Road densities in riparian areas are higher than general road densities; 73% of SWS

have riparian road densities >2.4 mi/mi^2, and only 4 subwatersheds have riparian road densities <1 mi/mi^2.

Table 16. Subwatersheds categorized by road density and riparian road density.

Road Density Category		**Number of subwatersheds in each road density category**	
Road Density	**Road Density Condition Rating**	**Total Road Density**	**Riparian Road Density**
<1 mi/mi^2	Good	5	4
1-2.4 mi/mi^2	Fair	27	16
>2.4 mi/mi^2	Poor	43	55
Total		**75**	**75**

Hydrologically connected roads and crossings are a higher risk to the stream system than mid-slope and ridgetop roads because they deliver water and sediment directly to the stream system. Several tools and models can be used to assess the relative hydrologic risk of the road system, and determine the location of roads were risk could be minimized through focused restoration and road improvements. One tool is the field and model based Geomorphic Road Analysis and Inventory Package (GRAIP). Road sediment delivery data collected across four watersheds in the Pacific Northwest using GRAIP, including the NF Suislaw and NF John Day watersheds in Oregon and the Bear Valley and the MF Payette watersheds in Idaho, found that 2-10% of road drain points (depending on watershed) deliver 90% of sediment from the road to the stream system (Figure 13) (GRAIP 2014). Results of this analysis suggest that when the location and relative sediment production and delivery of high-risk roads is known, treatments can focus on a relatively small percentage of the road system to reduce hydrologic impacts.

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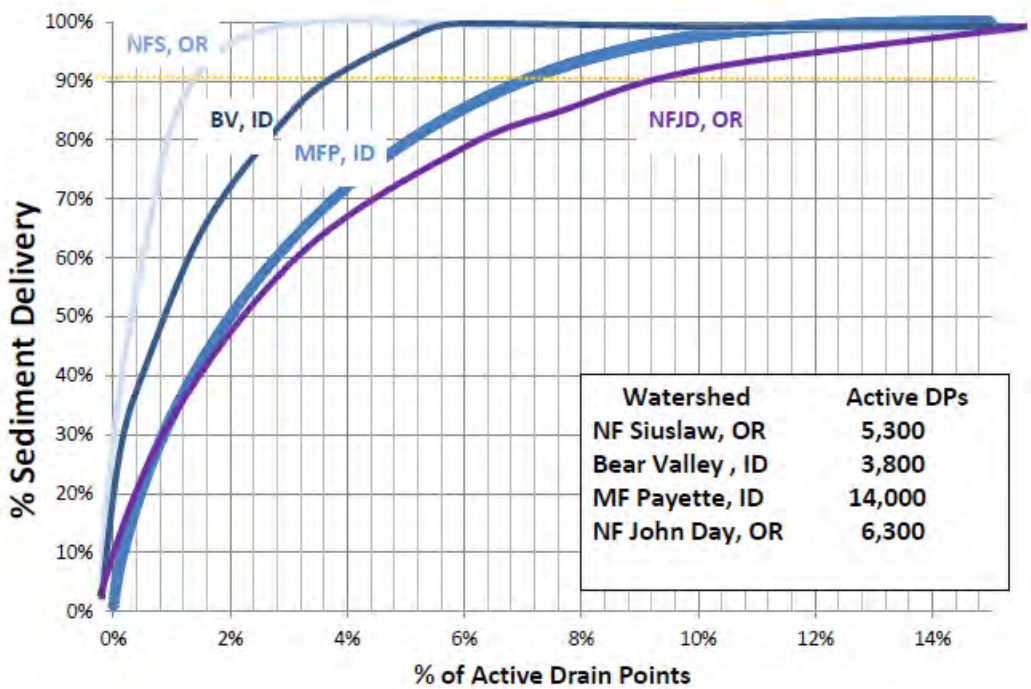

Figure 13. Road sediment delivery in four watersheds in the Pacific Northwest (GRAIP 2014).

There are an estimated 2,285 road/stream crossings across the CNF. Relative risk of sediment delivery to the stream system from the crossings was assessed using length and gradient of road on each side of the crossing approach. Number of crossings and relative risk are shown in Table 17. Fifty four percent of crossings on the CNF are at high risk for sediment delivery.

Table 17. Number of crossings and relative risk of sediment delivery.

# of Crossings	Crossing Risk
350	Low
694	Medium
1,241	High
2,285	**Total**

Crossings and roads within RHCAs were used to estimate hydrologic connectivity of the road system. There are an estimated 862 miles of hydrologically connected road across the CNF (17% of the road system). These roads have the highest risk of sediment delivery and other impacts to the stream system and are the primary focus of road treatments to improve hydrologic function and aquatic habitat across the CNF.

Some of the effects of roads to watershed function can be mitigated through road design and location (Furniss et al. 1991), implementation of BMPs, and treatments to reduce erosion and hydrologic connection of roads to the stream system. Treatments including road surfacing, improvement of road drainage through construction of waterbars or drainage dips, and seasonal closures to prevent road damage during wet weather can reduce erosion and sedimentation (Burroughs and King 1989, and Bilby et al. 1989). Hydrologic road decommissioning is also an

effective method to restore hydrologic function on roads that are no longer needed for access or forest management. While road decommissioning treatments have been found to reduce erosion and sedimentation, the technique does not eliminate all road related sediment delivery to streams (Madej 2001), and erosion and sedimentation may increase in the first two-three years after treatment (Luce et al. 2001). Other road maintenance activities can increase short-term sediment routing to streams through the exposure of additional soil, alteration of slope stability in cut and fill areas, removal of vegetation, and alteration of drainage patterns (Reid and Dunne 1984, Luce and Black 2001).

Effectiveness of road treatments is dependent on type of treatment, erosion rates, and timing and amount of precipitation. While road decommissioning is usually the most effective method to reduce road hydrologic risk, simply closing the entrance to a road does not reduce hydrologic risk. Full hydrologic decommissioning, including removal of culverts, de-compaction of road surface, and return to natural land contour (if needed) are the most effective treatments to reduce road hydrologic risk.

Effectiveness of hydrologic road decommissioning and storm damage risk reduction (SDRR) treatments was evaluated across the Pacific Northwest using GRAIP (Nelson et al. 2012; Cissel et al. 2014). Road decommission was monitored on 68km of road and hydrologic connectivity was reduced by 58%, and sediment delivery was reduced by 64%. SDRR treatments were monitored on 86 km of road and hydrologic connectivity was reduced by 9%, and sediment delivery was reduced by 51%. Post-storm inventories of decommissioned and control roads found that connectivity was reduced by 44% and fine sediment delivery was reduced by 80%. Roads treated through SDRR showed a 67% reduction in fine sediment delivery, but an 11% increase in hydrologic connectivity post storm.

While there are numerous treatments to mitigate the hydrologic effects of roads, not all effects of roads are preventable. A 1983 study in northwestern California showed that 24% of road-related erosion could have been prevented from conventional engineering techniques, with the remaining 76% of erosion caused by site condition and road location (McCushion and Rice 1983). Although this study was only on 344 miles of road, it illustrates the concept that the mere existence of roads increases erosion and sedimentation and supports the practice of full decommissioning of the road prism to minimize risk. GRAIP effectiveness monitoring shows that decommissioning treatments were more effective in reducing sediment delivery and road hydrologic connectivity than SDRR treatments (Nelson et al. 2012).

Watershed Restoration and Monitoring

Over the last two decades, watershed restoration and has become a larger focus of land management across the National Forest System. New direction on watershed restoration since the 1988 Land Management Plan is a primary need for change addressed in this forest plan revision.

INFISH

The 1988 Colville Forest Plan was amended by the Inland Native Fish Strategy (INFISH; USDA 1995) which provides additional direction intended to restore and maintain the ecological health of watersheds and aquatic ecosystems on National Forest lands for native resident fisheries.

INFISH was implemented in response to the potential listing of resident fish species under the Endangered Species Act (ESA). INFISH prescribed riparian management objectives (RMOs) and designated priority watersheds. RMOSs are discussed in greater detail in the fisheries analysis report. INFISH designated priority watersheds as those "Watersheds having excellent habitat or strong assemblages of inland native fish, particularly bull trout, or watersheds that provide for population distribution goals, or watersheds having a high restoration potential" (USDA FS, INFISH EA). Priority watersheds are a long-term, strategic network of watersheds that serve as strongholds for native fishes and provide high-quality water. Priority watersheds under INFISH were originally designated in 1995 and were amended in 2001. INFISH-designated priority subwatersheds for the Colville National Forest are shown in Table 18.

Table 18. INFISH Priority watersheds on the CNF designated at the subwatershed scale.

Subwatershed Name	Subwatershed Number
Cedar Creek	170102161003
East Branch Le Clerc Creek	170102160203
Exposure Creek-Pend Oreille River	170102160103
Harvey Creek	170102160303
Headwaters Sullivan Creek	170102160304
Headwaters South Salmo River*	170102160702
Middle Creek-Pend Oreille River	170102160301
North Fork Sullivan Creek-Sullivan Creek	170102160305
Outlet South Salmo River*	170102160704
Skookum Creek	170102160202
Slate Creek	170102160306
Sweet Creek-Pend Oreille River	170102160302
West Branch Le Clerc Creek	170102160202

*Based on watershed boundary changes since 1993 INFISH priority watershed designation, only a portion of subwatershed is designated as "priority" under INFISH.

Riparian habitat conservation areas (RHCA) widths in priority watersheds under INFISH are wider than RHCA widths in non-priority watersheds for non-fish bearing intermittent streams and wetlands <1 acre (Table 19). INFISH did not specify additional more-restrictive standards or guidelines for priority watersheds.

Table 19. Differences in RHCA widths for INFISH priority and non-priority watersheds.

	INFISH RHCA Designation for non-priority watersheds	INFISH Priority Watershed RHCA designation
Non-fish bearing intermittent	50	100
Wetland <1 acre	50	100

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Aquatic Restoration Strategy

The Region 6 Aquatic Restoration Strategy (ARS) was originally developed in 2005 to provide guidance for watershed and aquatic and riparian condition improvement at a regional scale through both passive and active restoration techniques (USDA Forest Service, 2005). Passive restoration is the broad-scale natural recovery of the aquatic ecosystem and includes coordination, analysis, planning, and design activities to maintain or improve habitat conditions while implementing projects across multiple resource areas (USDA Forest Service 2005). Examples include implementation of best management practices, designation of riparian habitat conservation areas (or riparian management areas), compliance with laws, regulations, permits, and plans, interagency coordination, monitoring, and adaptive management. Active restoration includes management actions with the specific goal of restoring the processes that improve aquatic and riparian habitat function. Active restoration is focused on a more limited scale than passive restoration.

ARS prioritized basins for aquatic restoration based on modeling of aquatic resource condition, watershed sensitivity, and sensitivity to management (USDA Forest Service, 2005). Through the basin prioritization process, the Upper Columbia basin was designated as high priority and the Pend Oreille and Spokane basins were designated as low priority basins. Since the prioritization of these basins, there is recognition that the basin scale is meaningful for planning at the regional scale, but it may not reflect restoration goals at the scale of individual forests (MacDonald, pers com).

Through the ARS, the CNF identified 3 focus watersheds to focus active restoration (Table 20). Focus watersheds were identified in 2008 based on the need for watershed restoration to improve aquatic habitat condition, function, and water quality, the presence or potential presence of native fish populations, partnership potential and planned or completed NEPA documentation for restoration.

Table 20. Focus 5th field watersheds on the CNF.

Watershed Name	Watershed Number
Le Clerc Creek-Pend Oreille River	1701021602
Upper Sanpoil River	1702000401
Chewelah Creek-Colville River	1702000301

In partnership with the Okanagan National Forest and the Colville Confederated Tribes, the CNF completed a watershed action plan (WAP) for the Upper and West Forks of the Sanpoil River in 2012 (SWAP 2012). The LeClerc Creek Watershed Action Plan (Hickenbottom et al. 2009) was completed in 2009. These watershed action plans describe limiting factors to structural and biological aquatic function and prioritize aquatic restoration projects for the improvement of water quality, watershed function, aquatic habitat, riparian function and structure (Hickenbottom et al. 2009, SWAP 2012). A WAP for the Chewelah Creek-Colville River watershed has not yet been completed.

Watershed Condition Framework

In 2010, National Forests throughout the U.S. were mandated to implement the Watershed Condition Framework (WCF) process, with the goal of identification of current conditions of subwatersheds on NFS lands. The results of the assessment were used to identify priority subwatersheds where focused management over a 5-10 year period could improve constituent elements that impair watershed function. The WCF process and results are discussed in greater detail in the Existing Condition section of this report. The CNF identified 3 priority watersheds through this process (Table 21), and completed watershed action plans outlining essential project to improve watershed condition for 3 priority watersheds, in 2011 and 2012, including West Branch LeClerc Creek, East Branch LeClerc Creek, and Ninemile Creek (CNF 2011, 2012(a and b)). Completion of essential projects within these subwatersheds is currently in progress. Essential projects in the East Branch LeClerc subwatershed are scheduled for completion in 2016. Once essential projects in existing subwatersheds are completed, additional priority subwatersheds would be identified.

Table 21. Priority Watersheds on the CNF.

Subwatershed Name	Subwatershed Number
West Branch LeClerc Creek	170102160202
East Branch LeClerc Creek	170102160203
Ninemile Creek	170200040107

Summary of Existing Priority Watersheds

The watershed hierarchy of existing focus and priority watersheds for restoration is shown in Table 22 and Figure 14.

Table 22. Existing priority and focus watersheds.

Focus Watershed Name (Designated through ARS)	Priority Subwatershed Name (Designated by INFISH and WCF)	INFISH Priority Subwatershed	WCF Priority Subwatershed
Chewelah Creek-Colville River	N/A		
Upper Sanpoil River	Ninemile Creek		X
Le Clerc Creek-Pend Oreille River	West Branch LeClerc Creek	X	X
	East Branch LeClerc Creek	X	X
	Cedar Creek	X	
	Exposure Creek-Pend Oreille River	X	
	Harvey Creek	X	
	Headwaters Sullivan Creek	X	
	Headwaters South Salmo River	X	
	Middle Creek-Pend Oreille River	X	
	North Fork Sullivan Creek-Sullivan Creek	X	

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	Outlet South Salmo River	X	
	Skookum Creek	X	
	Slate Creek	X	
	Sweet Creek-Pend Oreille River	X	

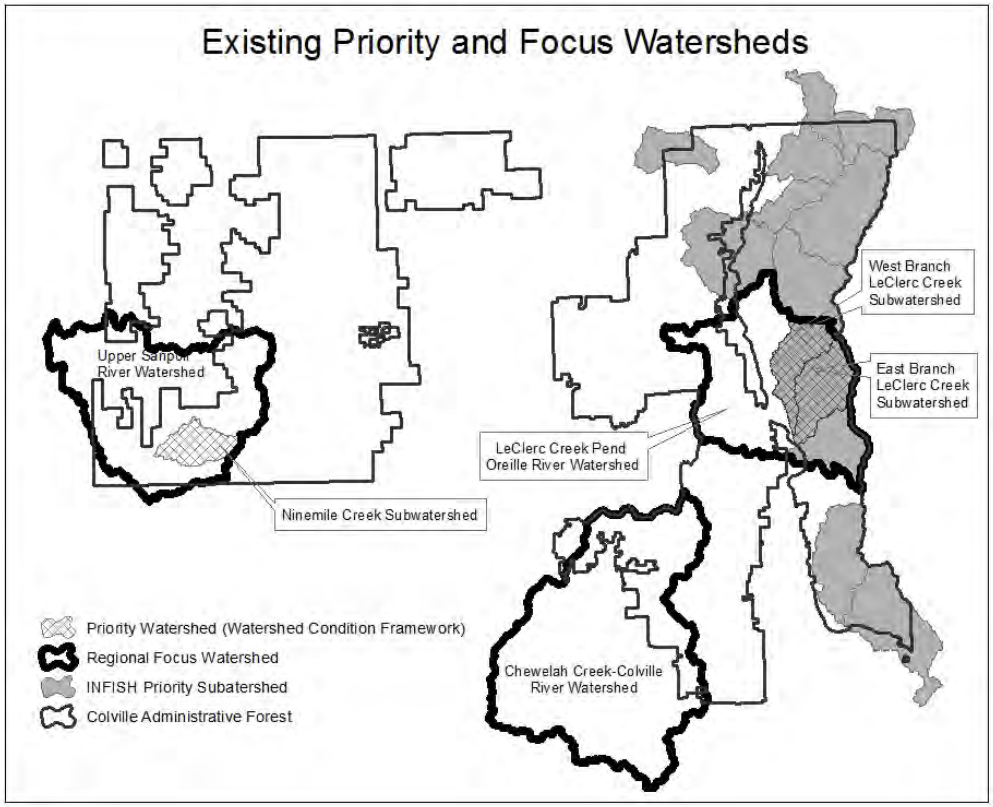

Figure 14. Focus and priority watersheds.

Aquatic and Riparian Conservation Strategy

The Aquatic and Riparian Conservation Strategy (ARCS) was developed by FS Region 6 in 2008 to consolidate management direction from the Northwest Forest Plan, PACFISH, INFISH, and ARS into a framework document to be used in forest plan revision. ARCS includes five elements including; designation of riparian management areas (RMAs), designation of a key watershed network, mid-scale analysis of watersheds, watershed restoration, and monitoring. The interaction of these five elements forms the basis for watershed, aquatic, and riparian ecosystem management and restoration (USDA Forest Service 2008).

Scientific studies completed after the initiation of the Northwest Forest Plan, PACFISH, and INFISH support their assumptions and general framework, however there was a need for a unified aquatic conservation strategy that incorporated new science and addressed and clarified issues identified through more than a decade of field-level implementation (Naiman and Bilby 2000, Spence et al. 1996, Reeves 2006, Heller and McCammon 2004). Providing refinement to earlier strategies is the primary basis for the development of ARCS. ARCS includes better recognition of

the role of disturbance in building ecosystem resiliency, consideration of scale effects on ecosystem processes, confirmation of the value of watershed-scale analysis, the need for better monitoring, and better establishment of the linkage between management intent and aquatic strategy.

Most alternatives in this forest plan revision use ARCS as the framework for management of hydrologic and aquatic resources, however ARCS-modified plan components are included in alternatives R and P.

ARCS-Modified

The ARCS supports forests adding specificity and local detail to tailor management of watersheds and riparian resources to local systems and conditions. As forests work through a public and internal collaborative process, plan components may be added to those provided in ARCS that are forest-specific and science-based (USDA Forest Service 2008).

Based on public and internal comments, best available science, and new policies on Forest Service management of aquatic and riparian resources, including the Watershed Condition Framework, plan components in ARCS were updated in alternatives P and R. The updated plan components are referred to as “ARCS modified” in the DEIS. ARCS-modified plan components were updated based on discussions with the Forest Plan interdisciplinary team, resource specialists in the Pacific Northwest regional office, and other reviewers of the draft forest plan.

Most of the updates made to ARCS plan components ARCS-modified add clarity to individual plan components (ie. guidelines worded properly as guidelines, standards worded as standards). The IDT also considered operational constraints in the evaluation of each standard and guideline within ARCS. Specific differences between ARCS and ARCS-modified are discussed in the effects section of this report.

During the forest plan revision process, the terms “ARCS: and “ARCS-modified” are used to distinguish differences in aquatic and riparian direction between alternatives. Once a revised forest plan decision is signed, the terms “ARCS” and “ARCS-modified” would no longer be used. The plan components and aquatic direction within ARCS would become part of the revised forest plan.

Water Quality, Quantity, and Uses

Water quality and water uses on the CNF are managed cooperatively with other State and Federal agencies responsible for preservation and management of water quality, and quantification and management of water rights and uses. In Washington, Water Resources Inventory Areas (WRIAs) are the administrative and planning boundaries used by State agencies as the basis and scale for management of water quality, water uses and rights, and management of fish and wildlife. WRIAs were formalized under WAC 173-500-040 and authorized under the Water Resources Act of 1971, RCW 90.54. The Washington Department of Ecology (Ecology) has the responsibility for development and management of designation and management of WRIA administrative and planning boundaries (WADoE 2014(d)). There are 7 WRIAs that contain the CNF administrative boundary. Generally WRIAs follow subbasin boundaries, however, the Franklin D. Roosevelt subbasin is divided into the Upper Lake Roosevelt and Middle Lake Roosevelt WRIAs (Table 23).

Table 23. Crosswalk between subbasins and WRIAs on the CNF administrative forest.

Subbasin	WRIA Name	WRIA Number
Pend Oreille River	Pend Oreille	62
Upper Columbia River—FDR Lake	Upper Lake Roosevelt	61
	Middle Lake Roosevelt	58
Colville River	Colville	59
Kettle River	Kettle	60
Sanpoil River	Sanpoil	52
Upper Spokane	*Little Spokane	55

*There is no CNF ownership within the Little Spokane WRIA.

Water Quality

Water produced on the CNF is generally of high quality; research on the effects of land management has shown that water quality in undisturbed forests is usually good. In managed watersheds, water quality is affected by land-use practices (USDA FS, 2000). The most widespread pollutants of concern on the CNF are fecal coliform bacteria and temperature. High summer air temperatures during summer low-flows and reduction in stream shading can increase summer stream temperature. Fecal coliform levels are elevated from both native mammals and livestock grazing both on and off NFS lands. Dissolved oxygen and pH are also pollutants of concern but are not as widespread as fecal coliform and temperature.

Sediment is also considered a pollutant if high levels of fine sediment accumulation are affecting aquatic habitat and channel function. Fine sediment accumulation is a natural channel function and varies based on geology, streamflow, and channel gradient (Montgomery and Buffington 1997). Accumulation of fine sediment is evident in some streams on the CNF from localized bank erosion and roads.

Best Management Practices

Preventing water quality impacts is more effective than restoring damage from management activities. Implementation and monitoring of Best Management Practices (BMPs) is the fundamental basis of the Forest Service water quality management program to protect, restore, or mitigate water quality impacts from activities on NFS lands (USDA Forest Service 2012). BMPs are methods, measures, or practices to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19). Site-specific BMPs are implemented at the project level using WA forest practices rules (222 WAC), regional guidance (USDA FS 1988), forest plan direction, and national BMP guidance.

Implementation and effectiveness monitoring of BMPs has been completed across project activities on the CNF since the development of regional BMPs, however monitoring completed at the project scale was not integrated into a larger program of consistent BMP monitoring and reporting. The Forest Service's national BMP program was established in 2012 to establish consistent direction for BMP implementation to control non-point source pollution on NFS lands to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources and meet the intent of State and Federal water quality laws and regulations, Executive Orders, and USDA and Forest Service directives. The national BMP program also establishes a consistent

process to monitor, evaluate, and report implementation and effectiveness of BMPs in the protection of water quality at multiple scales (USDA Forest Service 2012).

BMP implementation and effectiveness has been systematically monitored across National Forest Lands in California since 1992, using protocols similar to the more recent national BMP protocols. From 2008-2010, randomized monitoring showed 91% of BMPs were implemented, and 80% of implemented BMPs were rated effective. BMPs for timber harvests, fuels treatments, and vegetation management were consistently highly effective, while BMPs for other activities, including roads, range management, recreation, and mining, were less effective (USDA Forest Service 2013). At sites where BMPs were not implemented or effective the monitoring program includes a strong feedback loop to take corrective action on non-compliance scenarios.

BMP monitoring completed on the CNF since 2012, using the national BMP protocol indicate that most projects monitored were implemented correctly, and that BMPs were generally effective in protecting water quality. When BMPs were not implemented correctly, monitoring provided the feedback to implement corrective actions where needed to improve future BMP implementation and effectiveness (Colville National Forest 2013).

Water quality across streams in the CNF has improved in recent years as a result of changes in management from INFISH direction, implementation of best management practices (BMPs), direction from the Regional Aquatic Restoration Strategy, fish recovery plans, and increased emphasis on watershed restoration and partnerships. The CNF has been working on grazing allotments to implement BMPs including off-stream watering, and riparian exclusion fencing. In addition the Forest has worked to restore riparian areas, stabilize stream banks, and implemented measures to prevent off-highway vehicle use near streams and wetlands (CNF 2013).

Beneficial Uses and the Clean Water Act

The principal law governing pollution in the nation's streams, lakes, and estuaries is the Federal Water Pollution Control Act (P.L. 92-500, enacted in 1972), commonly known as the Clean Water Act (CWA). The CWA is the primary federal law that protects the nation’s waters, including lakes, rivers, aquifers and coastal areas from point and non-point source pollution. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters through regulation of point and non-point source water pollution.

Through the CWA, each state is required to provide guidance and direction for the protection and restoration of water bodies (40 CFR 131.12). In Washington, the United States Environmental Protection Agency (EPA) has designated authority for compliance with the CWA to The Washington Department of Ecology (WADoE). As required under the CWA, Ecology identified beneficial uses and developed water quality standards to protect beneficial uses. Water quality standards for the primary pollutants on streams and rivers across the CNF are shown in Table 24. Designated beneficial uses established for national forests, wilderness areas, and national parks in Washington include (WAC 173-201A-200; Baldwin 2006):

- Salmon and trout spawning, core rearing and migration
- Extraordinary primary contact recreation
- Domestic, industrial, and agricultural water supply

- Stock watering
- Wildlife habitat
- Harvesting (fish, etc)
- Commerce and navigation
- Boating
- Aesthetic values

Table 24. Water quality standards for waters of the CNF (WAC 173-201A-200)

Parameter	Standard
Temperature	16°C (60.8°F) (7 day average of daily maximum temperature)
pH	6.5-9.0*
Fecal Coliform	geometric mean above 50 colonies per 100 milliliters with the 90th percentile of the samples not exceeding 100 colonies per 100 milliliters
Dissolved Oxygen	9.5 mg/L (lowest 1-day minimum)
Total Dissolved Gas	Shall not exceed 110% of saturation at any point of sample collection
+Turbidity	5 NTU over background when background is 50 NTU or less. A 10% increase in turbidity when background turbidity is more than 50 NTU.

*Based on naturally occurring dissolved calcite from regional limestone geology, the upper range of the standard for pH was raised from 8.5 to 9.0 (Whiley and Baldwin 2005).

+ Sediment in water bodies fits into two categories; suspended sediments (measured and regulated by the turbidity standard), and bedded sediments. There is no approved water quality standard for sediment in Washington. Bedded sediments are difficult to regulate and implement without site specificity on background erosion rates (Seeds and Foster 2010).

Section 303(d) of the Clean Water Act and EPA regulation (40 CFR 130.2(J), and 130.7), delegates the authority to list waters that do not meet water quality standards or beneficial uses to individual states. Washington determines its 303(d) list through the water quality assessment (WQA) process. Once a water body is listed as impaired on the 303(d) list, it is Ecology's responsibility to develop a Total Maximum Daily Load (TMDL) for each pollutant of concern. A TMDL is a quantitative plan and analysis procedure for attaining and maintaining water quality standards and specifies the total load of pollutant a waterbody can carry and still meet beneficial uses. The TMDL and associated Water Quality Implementation Plan (WQIP) outline the process through which beneficial uses can be met through the identification of sources of pollutants, and actions that lead to improved water quality (40 CFR 130.2(H)).

A 2000 Memorandum of Agreement (MOA) between Ecology and Region 6 of the U.S. Forest Service designates the USFS as the management agency for meeting CWA requirements on NFS lands. Through this MOA the FS is responsible for ensuring that all waters on NFS lands meet or exceed water quality laws and regulations and that activities on NFS lands are consistent with protections provided in Washington Administrative Code and relevant state and water quality requirements (USDA FS and WADoE, 2000). The MOA recognizes the contribution of existing FS

direction, including the Interior Columbia Basin Ecosystem Management Project (ICBEMP), INFISH, and BMPs in meeting water quality laws and regulations, and states that the Forest service and Ecology will collaborate to address 303(d) listings through the development of TMDLs and WQIPs (USDA Forest Service and WADoE, 2000). While the 2000 MOA has not been updated, the CNF and Ecology continue to manage CWA compliance under MOA.

The 2008 Water Quality Assessment (WQA) and 303(d) list was approved by EPA Dec. 21, 2012 (US EPA 2012). The 2008 WQA and 303(d) list is considered the '2012 Water Quality Assessment' to reflect when the assessment was approved rather than when the assessment was scheduled for completion (WADoE 2014(b)). The 2012 WQA 305(b) list and 303(d) list contains 42 stream reaches on the CNF that do not meet water quality standards and includes all impaired stream segments added to the 303(d) list since 2004 that are not under an approved TMDL (WADoE 2014(a,b, and f)). Impairment pollutants include fecal coliform bacteria, dissolved oxygen, pH and temperature. Portions of Big Muddy Creek, Brown's Creek, Buck Creek, Middle and North Fork Calispell Creek, Cedar Creek, Cee Cee Ah Creek, Cottonwood Creek, East Deer Creek, Exposure Creek, Fisher Creek, Halfmoon Creek, Harvey Creek, Lambert Creek and an unnamed tributary, East, West, Middle, and main stem LeClerc Creek, North Fork and main stem Lone Ranch Creek, Lost Creek, McAhee Creek, Meadow Creek, Mill Creek, Pend Oreille River, Ruby Creek, Sandwich Creek, North Fork, South Fork, and main stem Sherman Creek, South Fork and main stem Skookum Creek, Slate Creek, Smackout Creek, North Fork St. Peter Creek, North Fork and main stem Sullivan Creek, Tacoma Creek, and Wilson Creek are on the 2008 303(d) list. Bead Lake is the only lake on the CNF on the 303(d) list and is listed for PCBs and dioxins found in fish tissue samples.

To meet the goals outlined in the MOA and comply with the CWA, Ecology began working with the CNF in 2002 on a TMDL for temperature, bacteria, pH, and dissolved oxygen and Water Quality Implementation Plan (WQIP) (WADoE 2006) for waters across the Forest on the 1998 303(d) list. EPA approved the TMDL and WQIP for fecal coliform on 8 waterbody segments and temperature on 4 segments from the 1998 303(d) list as well as 41 temperature-impaired waterbody segments added to the 303(d) list during the TMDL development process in 2005 (EPA, 2005, Whiley and Baldwin 2005). The TMDL for pH and dissolved oxygen was not approved at this time because the submittal report lacked some of the required components in the dissolved oxygen and pH analysis (Baldwin 2006). EPA also approved a TMDL for the Colville River and its tributaries for fecal coliform in 2003 (Coots 2002, Murray and Coots 2003, Baldwin 2005). There are several stream segments on the CNF included in the Colville River TMDL.

Although water bodies added to the 303(d) list since TMDLs and WQIPs were finalized are not included in the TMDLs, they are included in monitoring plans on the CNF (discussed below). Miles of stream by pollutant by subbasin covered under TMDLs and WQIPs, and not covered under TMDLs and WQIPs are shown in Table 25.

Table 25. Miles of stream by pollutant by subbasin on the Colville National Forest under an approved TMDL and WQIP, and miles of stream on the current 303d list not specifically covered under at TMDL and WQIP (WADoE 2014(a)).

	Pollutant by Miles of Streams Covered under a TMDL and WQIP (*Category 4a)	Pollutant by Miles of Streams not Specifically Covered under a TMDL or WQIP (*Category 5)

Subbasin	Bacteria	Temperature	Bacteria	Temperature	pH	DO
Colville	8.5	2	.2	1.4	0	0
Franklin D Roosevelt Lake	2.0	0	0	7.5	2.4	.6
Kettle	2.0	0.8	0.8	2.8	1.4	1.3
Pend Oreille	0	2.2	2.2	3.3	11.0	20.1
Sanpoil	0	0	0	0	0	0
Little Spokane	0	0	0	0	0	0

* Category 4a waters have known pollution problems that have an approved TMDL being actively implemented. Category 5 waters are classified as polluted waters that require a TMDL or WQI plan and are traditionally known as the 303(d) list.

The CNF is working to reduce fecal coliform bacteria from varied sources, including recreation and livestock grazing. Outhouses in developed campgrounds have been replaced and sealed vault toilets have been installed at select dispersed recreation sites further from surface waters (Baldwin 2005). Work also continues to improve BMPs on active grazing allotments, including installation of off-stream watering and fencing (WADoE 2013(a)). In compliance with the WQIP, the CNF has monitored thirteen streams annually for fecal coliform bacteria following procedures described in the Quality Assurance Project Plan in the TMDL (Baldwin 2006). A 2013 assessment of ten years of fecal coliform monitoring results determined that six streams continually met the fecal coliform standard, and one stream met standards most years. These seven streams were removed from the monitoring program, and a 2014 request was made to remove these streams from the TMDL. Nine additional monitoring sites were added across the CNF in 2013 (WADoE 2013(a)).

In 2013, Ecology concluded that the CNF has made significant progress in the last eight years toward meeting the requirements of the bacteria TMDL and improving water quality on the Colville National Forest. Based on monitoring and restoration progress toward meeting fecal coliform standards, the final target date to reduce bacteria concentrations to meet water quality standards has been extended from October 2013 to October 2018 (Colville National Forest 2014). Monitoring and restoration activities will continue with the goal of meeting the fecal coliform standard by 2018.

The CNF is also working to monitor and improve temperature in impaired stream reaches. The WQIP and TMDL requires temperature monitoring and compliance at 37 sites by 2056. The CNF has temperature data for 78 streams with varying years of data. A subset of these 78 temperature monitoring sites are on temperature-impaired streams. Progress continues to increase temperature monitoring sites and to improve the processes that impair stream temperature.

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The majority of waterbodies across the CNF meet water quality standards and support designated beneficial uses, however the current 303(d) list and TMDLs do not necessarily include all the streams across the CNF where water quality may be impaired. Many streams do not have the monitoring data to determine if water quality is impaired. Protection measures for activities with the potential to impact water quality, including BMPs and forest plan standards and guidelines that focus on riparian areas and other vulnerable areas ensure that waters of the CNF will continue to be of high quality. Focused restoration activities to improve hydrologic processes will continue to preserve and improve water quality where needed. Those waterbodies that do not meet these goals are monitored, and WQIPs and TMDLs are in place to improve conditions.

Water Quantity and Uses

In the Columbia River basin, an estimated 38% of water yield originates from National Forest lands (Sedell et al. 2000). This water is valued from ecological, economic, social, and cultural purposes. Water from National Forests is used for both consumptive and non-consumptive uses for defined purposes recognized by federal and state agencies. This section describes both consumptive and non-consumptive water uses across the CNF.

Instream Flows

The Washington Department of Fish and Wildlife (WDFW) is responsible for recommending instream flows for watershed planning, administration of water rights, and protection of fish and wildlife (WAC 75), and Ecology is required to maintain instream flows sufficient to protect and preserve beneficial uses (RCW, 90.54 and 90.22). Instream flows are defined by Ecology as a specific streamflow level (cfs) at a specific location on a given stream. Instream flows change from month to month and protect a quantity of streamflow for instream resources (WADoE 2013(b)). WDFW more narrowly describes instream flow as flows needed to protect stream habitat (Wald 2009). Generally, in-stream flow requirements are set only when a potential or existing project affects flow in a river system, the impacts of altered flow on instream resources is evaluated using accepted instream flow study guidelines (WDFW and WDoE 2004). WDFW recommends, requests, or requires, as applicable minimum instream flows that:

A. Protect full fish and wildlife potential;
B. Maintain riparian and instream wildlife habitat;
C. Manage water use and allocation to provide channel forming and maintaining flows;
D. Protect hyporheic flows;
E. Maintain fish passage and safe downstream fish migration;
F. Provide mitigation for, or enhancement of adversely affected fish and wildlife habitat to ensure “no net loss” of function and value
G. Provide habitat for desirable aquatic non-game wildlife species, even in streams without populations of fish;
H. Preserve future enhancement and/or compensation options where potential fish habitat is unused because of barriers to immigration;
I. Avoid adverse impacts on estuarine and marine habitats; and
J. Provide connectivity of channel processes such as movement of sediment and debris.

WDFW also recognizes the importance of high flows for providing geomorphic conditions for fish migration and spawning, including transport of sediment and organic matter, maintenance of channel geometry, formation of new channels, and creation of meanders, and side channels (Wald 2009).

Source Water Protection Areas

Source water is untreated water from streams, rivers, lakes, or underground aquifers that is used to provide public drinking water, and to supply private wells used for human consumption (US EPA 2012). A source water protection area is the land area contributing to a public water system where potential contamination could affect drinking water supply.

Many communities in northeast Washington rely on water from the CNF for drinking. The Safe Drinking Water Act (SDWA) is the 1974 federal law that sets standards for drinking water quality. The law requires actions to protect drinking water and its sources, and sets national standards for drinking water to protect against naturally occurring and man-made contaminants (US EPA 2012). A 1996 amendment to the SDWA requires each state to implement Source Water Assessment Programs (SWAP). The SWAP program in Washington is administered by the state Department of Health Office of Drinking Water (ODW). There are four requirements under the SWAP program: 1) Delineation of source water protection areas (SWPAs) that serve greater the 25 individuals for each source, 2) Inventory each SWPA for potential contaminant sources, 3) Conduct a susceptibility assessment for each drinking water source, and 4) Make the findings available to interested parties (WA Dept of Health).

The SWAP program designates both surface and groundwater source water protection areas and classifies water systems as Group A and B. Group A is a designation specific to Washington and includes public use water systems large enough to be regulated by the SDWA (those serving > 25 individuals). Group B public water systems serve < 25 individuals (WA Dept of Health).

<u>Surface sourcewater protection areas</u>

Surface source water protection areas are delineated by the upstream watershed that contributes to the point of use (WA Dept of Health). Waters of the CNF are upstream of surface water systems that service; Cusick, Grand Coulee, Kettle Falls, Metaline, Metaline Falls, Orient, and Riverbend. Designated surface source water protection areas have also been delineated for water systems for Grand Coulee Dam, Forty Nine Degrees North Ski resort, and Columbia Cedar (Surface Water Protection spatial data). All surface water protection areas on the CNF provide water to Group A water systems and are shown in Figure 14.

<u>Groundwater sourcewater protection areas</u>

There are 31 Group A and 51 Group B water systems that are groundwater-sourced within the CNF administrative boundary. One, 5, and 10-year time of travel wellhead protection areas are delineated by WA Dept of Health for all group A groundwater systems, and a 600-foot fixed radius is used as the wellhead protection boundary for group B systems. Wellhead locations of groundwater sourcewater protection areas are shown in Figure 14; wellhead protection areas are not shown in this figure.

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Forest Service Drinking Water Systems

The CNF manages 15 drinking water systems across the Forest at campgrounds and administrative sites (Figure 15). These include Noisy Creek, Lake Leo, Mill Pond, Swan Lake, Pierre Lake, Gillette, Panhandle, Sullivan Lake, Edgewater, Long Lake, South Skookum Lake, Pioneer Park, and Sherman Overlook campgrounds, Batey-Bould trailhead, and the Bead Lake boat launch.

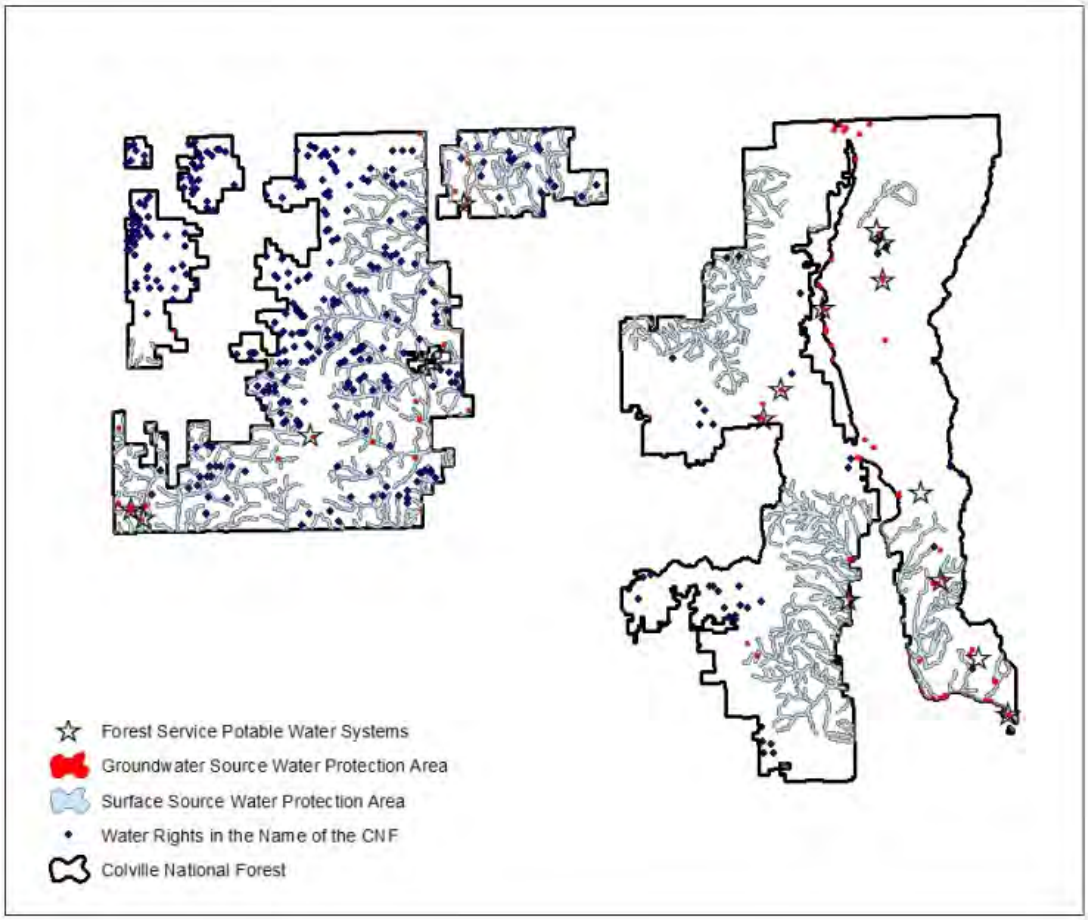

Figure 15. Water rights and uses on the CNF.

Water Rights

A water right is a legal authorization to use a certain amount of water for a specific purpose of use. Water rights in Washington are managed by Ecology. There are three types of water rights documents:

1) A “claim” is a claim to use water that predates the state’s water permitting system, the validity of which must be confirmed through judicial processes;
2) A “permit” is permission by the state to develop a water right and gives the permit-holder permission to proceed with construction of a water system to put water use;

3) A "certificate" is issued when all conditions of the permit have been met—and is a legal record of the water right. Certificates are appurtenant to the land on which the water is used (WADoE 2013(c)).

Data on water rights was summarized from spatial data obtained from Ecology. Figures presented in this analysis are estimates only. There are approximately 115 certificated water rights and 356 points of diversion in the name of the USDA Forest Service on the CNF. The CNF does not have any current claims, applications, or permits for which a certificate has not been issued. The primary purpose of use for consumptive rights on the CNF is livestock (Table 26), with only 8 certificates for other uses. Total certificated storage volume is 477 acre-feet per year; certificated diversion volume is 4.55 cfs. A total of 17 irrigated acres also have certificated water rights. Water rights are concentrated in the drier western portion of the CNF.

Table 26. Certificated water rights and points of diversion in the name of the Colville National Forest* by purpose of use and volume.

Purpose of Use	# of Certificates	# of Points of Diversion	Certificated storage volume (acre-feet)	Certificated diversion (cfs)	Irrigated Acres
Livestock	107	348	447	3.7	
Domestic single/Irrigation	1	1		0.01	1
Domestic multiple	1	1		0.05	
Domestic multiple/irrigation	2	2	19	0.54	15
Domestic multiple/recreation beautification	1	1	1	0.01	
Domestic multiple/fire protection/recreation beautification	1	1		0.1	
Domestic multiple/fire protection/irrigation	1	1	4	0.1	1
Domestic multiple/fire protection	1	1	6	0.035	
Total	115	356	477	4.55	17

*Several certificates are in the name of the Kaniksu National Forest, but are located within and managed by the CNF.

There are approximately 536 certificated water rights in the name of others within the CNF administrative boundary (Table 27). The largest consumptive uses within the CNF administrative boundary by volume are for domestic use, municipal use, irrigation, and power generation. Storage rights in the name of others within the CNF administrative boundary total 111,193 acre-feet. A total of 6,114 irrigated acres also have certificated water rights.

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Table 27. Certificated water rights within the CNF administrative boundary in the name of others.

	Applications	Claims	Permits	Certificates
Total Number	11	712	61	536
Storage Volume (acre-feet) unless otherwise noted	1700 gpm	316,314	33,802	111,193
Irrigated Acres	480	36,327	98	6,114

Certificated water rights for consumptive uses in the name of the Forest Service within the CNF administrative boundary constitute <1% of both storage volume and irrigated acres of total certificated rights. The majority of water volume certificated for consumptive uses within the CNF boundary are in the name of others. Certificated water rights within the CNF administrative boundary are small in comparison to water yield from the CNF and consumptive uses downstream of the CNF. Water availability on lands off-forest are discussed in the Cumulative Effects section of this report

Dams

The CNF currently administers four dams including the West Branch LeClerc Creek Dam, Little Twin Lakes Dam, and Big Meadow Lake Dam, Bayley Lake Dam. There are an additional five dams within the administrative boundary of the CNF that are owned by public utilities or local governments. Additional details on dams on the CNF are shown in Table 28. Management of these dams does not vary by forest plan alternative, and management and mitigation of effects of these dams is expected to continue under all alternatives.

Table 28. Dams on the CNF.

Dam Name	Owner	Subasin	Stream/River Name	Notes
Little Twin Lakes Dam	CNF	Colville	Camp Creek	70-acre reservoir maintained for recreation and fish and wildlife
Big Meadow Lake Dam	CNF	Franklin D Roosevelt Lake	Meadow Creek	83-acre reservoir maintained for recreation and fish and wildlife
Bayley Lake Dam	CNF	Colville	Bayley Creek	Impounds Bayley Lake, a 17-acre reservoir, located on the Little Pend Oreille Wildlife Refuge. Lake is

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Dam Name	Owner	Subasin	Stream/River Name	Notes
				maintained for recreation and fish and wildlife. Dam is on the CNF.
West Branch LeClerc Creek Dam	CNF	Pend Oreille	West Branch LeClerc Creek	Log crib dam that does not create impoundment; filled with fine sediment. Removal is an essential project in the WB LeClerc Watershed Action Plan
Metaline Falls Municipal Water Dam	Metaline Falls	Pend Oreille	Tributary to Sullivan Creek	Diversion dam supplying water to the Community of Metaline Falls
Boundary Dam	Seattle City Light	Pend Oreille	Pend Oreille	See text
Mill Pond Dam	Pend Oreille PUD	Pend Oreille	Sullivan Creek	Scheduled for removal in 2019
Sullivan Lake Dam	Pend Oreille PUD	Pend Oreille	Harvey Creek/Outlet Creek	Dam enhances the natural lake. Managed by Pend Oreille PUD for recreation, and water supply for interbasin transfers.
Box Canyon Dam	Pend Oreille PUD	Pend Oreille	Pend Oreille	See text

Hydroelectric Dams

There are 3 hydropower projects on the CNF, including Boundary Dam, the Sullivan Creek Water Supply Project, and Boundary Dam. In addition, though not within the CNF administrative boundary, all of the waters of the CNF eventually drain into Lake Roosevelt, on the Columbia River. Lake Roosevelt is impounded by the Grand Coulee dam—the largest power supplying dam in the United States. The Grand Coulee Dam generates 21 billion kilowatt-hours of electricity per year, supplying power to WA, OR, ID, MT, WY, CO, CA, NV, NM, UT, AZ, and Canada (USBR, 2014).

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The Federal Energy Regulatory Commission (FERC) regulates all operating non-federal dams that generate electrical energy. FERC licenses these projects and permits the dam owner to use public waters for energy generation. The license specifies the conditions for construction, operation, and maintenance of the project, is enforceable by FERC through fines or injunctions, and may be revoked for non-compliance (FERC Licensing, 2014). Settlement agreements signed in conjunction with issuance of FERC licenses for Box Canyon Dam, Boundary Dam, and the surrender of the hydropower license for the Sullivan Creek Water Supply project provide funds and comprehensive plans for restoration of hydrologic and aquatic resources on the CNF to mitigate effects from hydropower production.

Box Canyon Dam

Opened in 1956, the Box Canyon Dam is a gravity-type hydroelectric dam on the Pend Oreille River operated by the Pend Oreille PUD. The dam is 62 ft high, 160ft long, and creates the Box Canyon Reservoir which stretches 55 miles to Albeni Falls Dam near the Idaho border. The dam impounds water draining an area of 24,900 mi^2 and has a surface area between 7,000 and 9,000 acres depending on pool elevation. The dam is capable of producing 62 MW of power. The Box Canyon Dam operates "run of river"—flows released from the project approximate the flows released upstream from the Albeni Falls Dam (Public Utility District No. 1 of Pend Oreille County). The Box Canyon Dam project occupies 190 acres on the CNF (Public Utility District No. 1 of Pend Oreille County).

The Box Canyon Dam was relicensed in 2005. Under the settlement agreement signed in 2010, the Pend Oreille PUD committed to a variety of treatments to improve hydrologic and aquatic function, and fisheries in tributaries of the Box Canyon reservoir. Most of these tributaries are on the CNF, and projects under this settlement agreement on CNF lands will be completed in collaboration with the PUD and other state and federal partners (Public Utility District No. 1 of Pend Oreille County).

Boundary Dam

The Boundary Dam on the Pend Oreille River is a concrete arch gravity-type hydroelectric dam that supplies more than one third of Seattle City Light's Power and began operations in 1967. The dam is 340 ft high from its bedrock foot and is 740 ft long. The reservoir created by the dam is 17.5 miles long and extends to the base of the Box Canyon Dam. The reservoir created by the dam is 1,794 acres and drains an area of 25,200 mi^2 (FERC 2011). The dam has the capacity to produce 1040MW at peak output—40% of the Seattle's electricity demands (Seattle City Light, 2014(1)). The Boundary Dam project occupies 609 acres on the CNF (City of Seattle).

Sullivan Creek Water Supply Project

The Sullivan Creek Water Supply Project includes the Sullivan Dam, and Mill Pond Dam. The Sullivan Dam enhances the existing Sullivan Lake to a surface area of 1,240 acres. The area impounded by Mill Pond Dam covers a 63-acre area. The project occupies 522 acres on the CNF and will be operated under a special use permit with the CNF once mitigations in the settlement agreement for the surrender of the license of the project are complete. The Pend Oreille PUD purchased the project in 1959 including water rights, and obtained a FERC license (FERC 2011).

The application to relicense the Boundary Project was filed in 2009. In 2010 a joint offer of settlement for the Boundary Dam and Sullivan Creek water supply project was filed that proposed consolidation of the relicensing of the Boundary project and Pend Oreille PUD's surrender of license for the Sullivan Creek Project. The joint settlement agreement was signed by the City of Seattle, Pend Oreille PUD, the Kalispel Tribe, several state and Federal Agencies (including the CNF), and two non-governmental organizations. FERC issued a 42-year license in 2013. As part of the settlement agreement, Seattle City Light committed $60 million to a 42-year program of watershed improvements including evaluation and improvement of passage for resident salmonids, improvement of aquatic habitat, fish stocking, groundwater well decommissioning, acquiring and managing land for wildlife, recreation enhancement, and enhancement and protection of cultural resources (FERC 2011; Seattle City Light 2014(b)). The FERC license for the Sullivan Creek project was surrendered and a settlement for the project was reached in 2010. The settlement agreement included changes in the timing of flow release of Sullivan Lake, an increase in lake elevation, installation of a cool water release pipe to allow colder water from the bottom of the lake to discharge into Sullivan Creek and the removal of Mill Pond Dam in partnership with Seattle City Light (WADoE 2014(d)).

Environmental Consequences

Methodology

This section describes the analysis process to determine the environmental consequences to watershed function, water quality, and water uses from implementation of 6 forest plan alternatives. Environmental consequences are not site-specific at the broad-scale of forest planning, therefore several indicators will be discussed in qualitative terms based on best available science, and professional judgment. Quantitative analysis of potential effects is presented where appropriate and applicable.

This land management plan provides a programmatic framework that guides site-specific actions, but does not authorize or mandate site-specific projects or ground-disturbing activities, therefore site-specific direct effects to watershed function, water quality, and water uses are not predictable until further project-specific NEPA analysis is completed. This section discusses the broad-scale environmental consequences and relative trends and provides a means to compare the potential effects of alternatives.

Assumptions

- In estimation of effects of alternatives at the forest plan level, it is assumed that the kinds of management activities allowed under the prescriptions would occur to achieve the goals and objectives of each alternative. The actual location and design of treatments is not known, and would be determined through project-level, site-specific NEPA decisions. Therefore, this analysis refers to potential effects that could occur, but cannot be applied to specific locations. Effects analysis at the forest plan scale is useful for comparing alternatives, but cannot be applied to specific locations other than at the broad scale of management areas and ecological regions.

- Data representing forest-wide conditions many not represent site-specific water quality, quantity, or watershed function. Additional site-specific analysis is needed at the project scale during implementation of this forest plan.
- Measurable objectives for water resources, key and priority watersheds, and RMAs identify priority treatment activities, extent (ie. miles, acres, number of crossings improved), and timing of completion were developed in the forest plan revision process. Effects of meeting these objectives through the life of this forest plan are based on the assumption that forest budgets will remain relatively constant, but would vary from year to year. The actual rate of improvement of watershed condition is dependent on internal and partner financial contributions, and staffing levels.
- Forest plan guidelines provide guidance for carrying out projects and activities to achieve desired conditions and objectives. Guidelines do not force action, but provide design criteria that should apply when an action is being taken. Standards are mandatory constraints on project activities and are established to achieve desired conditions, mitigate or avoid undesirable effects, and meet applicable legal requirements. Standards provide strict design criteria, allowing no variation, whereas guidelines allow variation if the result would be equally effective to move toward achievement of desired conditions. Therefore, standards provide a greater assurance of specific protections than guidelines.
- Issues addressed in this analysis are those identified through the scoping process for the forest plan revision, and issues specific to hydrologic resources.
- Previously decommissioned roads were included in road calculations because full hydrologic closure of these roads is not certain. At the scale of the CNF, total mileage of previously decommissioned road makes up <1% of NFS roads.
- Estimates of primary vegetation management tools used in all alternatives are based on modeling of treatment by vegetation type (described in Day 2015). For each alternative, an estimated acres of treatment type per year by vegetation type is presented based on modeling. These figures are used as means to compare alternatives, and are not assumed to represent actual acres that would be treated. Vegetation management is not authorized under this document, and treatments would be evaluated in subsequent project-specific treatment. Differences in primary vegetation management tools used in each vegetation type vary by alternative and potential effects are broadly discussed by alternative. Since there is little variation in treatment type by alternative, potential indirect effects of vegetation treatments by alternative are discussed in terms of estimated (modeled) acres of treatment, and the acreage within each management area where vegetation treatment is authorized.

Methods of analysis

Key indicators/issues, and evaluation criteria for analysis of effects of alternatives on hydrologic resources are shown in Table 29.

Table 29. Issues, indicators, and analysis criteria for analysis of effects of alternatives on hydrologic resources.

Issue	Indicators/Evaluation Criteria
Riparian and Aquatic Resource Management	• Acres of RHCAs and RMAs • Riparian and aquatic resource goals, objectives, standards, and guidelines (plan components)*

Issue	Indicators/Evaluation Criteria
	• Acres of INFISH priority watersheds or key watersheds • Watershed and aquatic restoration: Number of key and priority watersheds where condition is improved, number of crossings improved, and other restoration activities
Access (Roads)	• Acres within active management areas that authorize road building activities • Road density desired conditions • Road management plan components*
Old Forest Management, Timber Production, and Upland Vegetation Condition	• Active vegetation management (acres) • Primary vegetation management tools • Historic range of variability (Number of structure classes within HRV) • Vegetation management plan components* • Grazing plan components*

*Appendix B shows differences between aquatic and riparian plan components between alternatives.

Spatial and Temporal Context for Effects Analysis

The spatial bound for analysis of indirect effects is all lands within the CNF ownership boundary, and within the 5 subbasins with CNF ownership for cumulative effects. The temporal boundary of indirect and cumulative effects is 15 years, the estimate amount of time management would continue under the revised forest plan. Vegetation condition was modeled for 100 years. Climate change analysis to inform cumulative effects analysis uses projections for the 2040s and 2080s.

Summary of Effects Common to All Alternatives

Restoration Priority and Focus Watersheds

Priority and focus watersheds are discussed on page 36 of this report and are shown in Figure 13 and are the same across alternatives. Essential projects outlined in watershed action plans in priority and focus watershed would continue in all alternatives, however restoration activities would be prioritized based on key watershed objectives in the proposed action and alternatives R, P, and O.

Water Quality

The CNF would continue to comply with the Clean Water Act in all alternatives. The CNF would continue to work with Ecology to implement the CNF TMDL and the TMDL for the Colville River through monitoring of fecal coliform and water temperature. As new streams on the CNF are added to the 303(d) list, they would be included, as funding and strategic project planning allows in the CNFs fecal coliform and temperature monitoring program. The memorandum of agreement (MOA) between Ecology and the CNF recognizes the contribution of existing FS direction, including ICBEMP, INFISH, and BMPs in meeting water quality laws and regulations,

and states that the Forest service and Ecology would collaborate to address 303(d) listings through the development of TMDLs and WQMPs (USDA Forest Service and WADoE, 2000).

Potential indirect effects of implementation of this forest plan on water quality vary by alternative, based on differences in goals, objectives, standards, and guidelines and are discussed in effects analysis by alternative.

Grazing

There are no proposed changes in the location or boundaries of permitted range allotments or type of livestock across alternatives**.** Boundaries, AUMs, and management of allotments are expected to change over time based on site-specific analysis through the NEPA and allotment management planning process, however this does not vary by alternative. Grazing standards and guidelines differ by alternative and grazing practices may vary based on differences in standards and guidelines in each alternative. Potential differences are discussed in the effects analysis of this report.

Best Management Practices

Implementation of best management practices (BMPs) would continue to be one of the primary mechanisms to ensure that aquatic and hydrologic function are preserved in all alternatives. Project-level monitoring of implementation and effectiveness of BMPs using nationally-consistent protocols would continue under all alternatives. BMP monitoring would be used to identify and implement corrective actions to address site-scale problems with BMP implementation and effectiveness. Adaptive management would be used to correct systematic, programmatic-level issues (i.e. lack of transfer of BMPs from planning to project implementation, project design criteria specified in NEPA not included into contract provisions, etc.). Accountability for addressing lack of effectiveness and implementation of BMPs is a critical component of water resource protection and compliance with the CWA.

Water Uses

Water uses across the CNF are expected to be the same across all alternatives. Standards protecting key watersheds from certain uses differ by alternative and are discussed in effects analysis.

No Action Alternative: Existing Management Direction

The no action alternative follows the current Colville Forest Plan as amended by INFISH. Current aquatic direction under INFISH is intended to restore and maintain the ecological health of watersheds, aquatic ecosystems, and water quality. The current Colville Forest Plan includes amended by INFISH includes riparian management objectives (RMOs), goals, standards, and guidelines (with no distinction between standards and guidelines) to restore and maintain riparian and aquatic resources, and hydrologic function. INFISH also designates riparian habitat conservation areas (RHCAs), and a priority watershed network.

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Indirect Effects

Riparian and Aquatic Resource Management

Acres of RHCAs and management and protection of RHCAs

Present management of riparian areas under INFISH (USDA Forest Service 1995) includes designation of riparian habitat conservation areas (RHCAs) where riparian-dependent resources receive primary emphasis and additional standards and guidelines apply to management. RHCAs overlay approximately 150,692 (13%) of the CNF. RHCAs are mapped, but actual locations of RHCAs may be changed and updated based on project level planning and reconnaissance. RHCA widths vary by water body type and intermittent streams and wetlands <1 acre receive a wider buffer in INFISH priority watersheds than these features in non-INFISH priority watersheds (see Table 19). RHCA widths and acreages are shown in Table 30.

Table 30. RHCA width and acreages on the CNF in the no action and alternative B.

Stream and water body classification	Riparian Habitat Conservation Area (RHCA) width	Total Acres
Fish bearing streams	300 ft slope distance on each side (600 ft total)	35,427
Permanently flowing non-fish bearing streams	150 ft slope distance on each side (300 ft total)	49,075
Ponds, lakes, reservoirs and wetlands greater than 1 acre	150 feet slope distance around feature	23,261
Seasonally flowing or intermittent streams, wetlands less than 1 acre	100 ft slope distance in priority watersheds, 50 ft slope distance in non-priority watersheds.	42,929
Total		150,692

RHCAs are intended to protect desired riparian functions, including sediment filtration, stream temperature moderation, production of fine organic matter and large woody material, and stream bank stability. Research on the effectiveness of riparian protection measures suggests that a width of one site-potential tree is sufficient to protect riparian function in most systems (Wenger 1999). Pollock and Kennard (1998) found that buffer widths of 50-250 ft were sufficient to preserve riparian function in eastern Washington, with differences in effective widths dependent on soils, slope, and vegetation.

Riparian and Aquatic Plan Components

Riparian and aquatic plan components including objectives, standards, and guidelines in the no action alternative are from INFISH (See Appendix B for comparison of plan components across all alternatives). INFISH includes riparian goals rather than desired conditions, and riparian management objectives (RMOs) that define numeric stream habitat objectives for width to depth ratio, bank stability, bank angle, large woody debris, stream temperature, percent fine sediment , dominant substrate, and pool frequency, that describe high quality habitat. RMOs were developed from existing stream habitat data and were designed to provide benchmarks for evaluation of current stream conditions. Although RMOs have been widely applied, analysis of

their usefulness or applicability across ecoregions has not been widely researched. Criticisms of numeric stream habitat objectives including the failure to account for variability and recognition of the difficulty of separation of land use effects from natural disturbance. (Kershner and Roper 2010). RMOs are discussed in greater detail in the fisheries report of this DEIS (MacDonald et al 2015).

INFISH includes standards and guidelines (with no differentiation between standards and guidelines) for RHCAs that constrain management within RHCAs to achieve riparian management objectives (RMOs). Standards and guidelines address activities including timber management, livestock grazing management, recreation management, mineral management, fire and fuels management, lands, general riparian area management, watershed and habitat restoration, and fisheries and wildlife restoration. RHCA widths may be increased or decreased when necessary to attain RMOs when site-specific data and watershed analysis supports the change.

Acres in INFISH Priority Watersheds

INFISH priority watersheds on the CNF were originally designated in 1998 and updated in 2001. INFISH designated as "priority" watersheds "having excellent habitat or strong assemblages of inland native fish, particularly bull trout, or watersheds that provide for population distribution goals, or watersheds having a high restoration potential" (USDA Forest Service 1995a). There are 214,283 acres (19% total CNF ownership) in INFISH priority watersheds under CNF ownership in the no action alternative (Table 31 and Figure 16).

Table 31. INFISH priority watersheds (designated at the subwatershed scale).

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Administrative Forest Acres	CNF Ownership Acres
170102160201	*Exposure Creek-Pend Oreille River	41224	23376	14463
170102160202	Skookum Creek	31811	31728	14192
170102160301	*Middle Creek-Pend Oreille River	23209	21760	5066
170102160302	West Branch Le Clerc Creek	21672	21672	15099
170102160303	*East Branch Le Clerc Creek	26663	26651	11145
170102160401	*Harvey Creek	32999	32991	27554
170102160402	*Headwaters Sullivan Creek	45516	45510	45417
170102160403	*North Fork Sullivan Creek-Sullivan Creek	12709	12703	11259
170102160702	*Headwaters South Salmo River	20697	12475	12472
170102160704	Outlet South Salmo River	14013	3469	3460
170102160902	Sweet Creek-Pend Oreille River	41832	33477	28890
170102160903	Slate Creek	20195	19911	19907
170102161003	*Cedar Creek	17209	7074	5359
Total Acres		349747	292795	**214,283**

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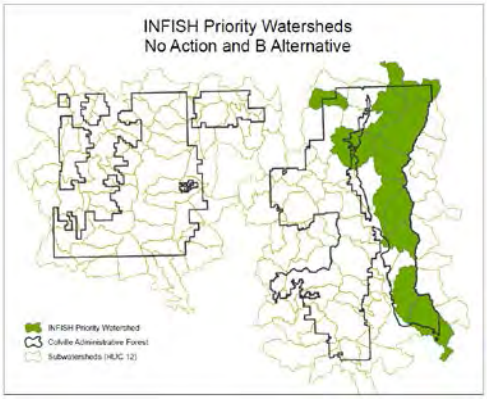

Figure 16. INFISH priority watersheds

There are no standards, guidelines, goals, or measurable objectives specific to INFISH priority watersheds in the no action alternative. However, the intent of INFISH is for priority watersheds in good condition to serve as anchors for the potential recovery of depressed aquatic populations, and provide colonists for adjacent watersheds with degraded habitat. Priority watersheds with lower habitat are the focus of restoration activities to improve habitat quality and function.

Watershed and Aquatic Restoration

Based on the original intent of the short time period for implementing INFISH, a restoration strategy was not included in this amendment. The intent of INFISH was for forests to use watershed analysis to determine restoration strategies and projects, with INFISH priority watersheds being the highest priority for restoration. Historically, aquatic restoration across the INFISH priority network has not accelerated since this watershed network was designated in 1995 (and expanded in 2001) on the CNF, except in a select number of subwatersheds. Instead, the pace of restoration was increased through designation of focus watersheds identified through ARS and priority subwatersheds identified through WCF. Investment in watershed restoration to improve aquatic habitat and hydrologic function has and would continue to occur in several subwatersheds within the INFISH priority network, including the East and West Branches of LeClerc Creek, and the Headwaters and North Fork of Sullivan Creek, but there are no specific plans to accelerate the pace of restoration in other subwatersheds in the INFISH priority network under the no action alternative. Therefore, restoration in INFISH priority watersheds would continue at the current pace under the no action alternative.

Watershed and aquatic restoration would focus on completion of essential projects outlined in watershed action plans in focus (Sanpoil, LeClerc, and Chewelah Creek watersheds) and national priority watersheds (East and West Branch LeClerc Creek, and Ninemile Creek subwatersheds). In addition, opportunistic restoration would continue across the CNF based on partnerships, funding from FERC relicensing, Vision 20/20 (see MacDonald 2015 for specific projects), and completed NEPA for vegetation management, grazing, and recreation projects.

Based on current restoration plans in place under the no action alternative for the next 15 years, treatment is expected on 51 miles of road, 15 crossings to improve aquatic organism passage, 54 miles of stream channel, 70 acres of rangeland infrastructure, and 75-150 acres in RHCAs to move toward HRV. Improvement in watershed condition class is estimated in 7 subwatersheds.

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Roads/Access

Acres of management areas where road building activities are permitted

Approximately 218,266 acres (20% of CNF) in the no action alternative are in management areas where construction of new roads is prohibited (Table 32).

Road density desired conditions

Road density desired conditions range from 0.4 to 2 mi/mi^2 of open road (ML 2-5) and are dependent on species or resource in need of protection. Since road density desired conditions do not consider closed ML 1 roads, they do not adequately address the potential impacts of the road system on hydrologic and aquatic function and habitat.

Road management plan components

Standards and guidelines, and BMPs specific to road construction focus on minimizing erosion and sediment risk from the road system to attain RMOs and minimize adverse effects to inland native fish. In INFISH priority watersheds, watershed analysis is required before certain road activities and construction of new recreation facilities are permitted in RHCAs, and there are specific protections against increased sedimentation through prioritization of road treatments in priority watersheds.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Existing management areas (MAs) and authorization of road building and timber production by MA are shown in Table 32. Timber production is allowed in MA-3A (Recreation), MA-5 (Scenic/Timber), MA-6 (Scenic/ Winter Range), MA-7 (Wood/ Forage), and MA-8 (Winter Range). These management areas cover 80.7 % of the Forest, the largest land base available for active vegetation management of all alternatives. Actual acres treated per year are constrained by forest budgets and additional constraints at the project level.

Table 32. Existing management areas and authorization of road building and timber production by MA.

Management Area	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Caribou Habitat	30,306	N	N
Downhill Skiing	2,026	N	N
No Management Area Assigned	19	N	N
Old Growth Dependent Species Habitat	32,859	N	N
Private Lands Originally	1,262	N	N
Recreation	43,153	Y	Y
Recreation/Wildlife	12,474	N	N
Research Natural Area	4,707	N	N

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Management Area	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Scenic Timber	216,525	Y	Y
Scenic/Winter Range	76,128	Y	Y
Semi-Primitive, Motorized Recreation	13,571	N	N
Semi-Primitive, Non-Motorized Recreation	86,880	N	N
Water	2,365	N	N
Wilderness Management	31,450	N	N
Winter Range	126,207	Y	Y
Wood/Forage	423,305	Y	Y
*RHCAs	150,692	Y, within standards and guidelines	N, except where needed to maintain or meet RMOs

*MA overlays other management area and is not included in total acreage calculations.
**Acres are approximate and vary due to GIS methodology

Primary Vegetation Management Tools

Partial harvest would be the primary vegetation management tool in the Douglas-fir dry MAs where harvest is authorized with 500 acres of treatment estimated per year. Thinning, regeneration harvest, and mechanical fuels treatments are used in the northern Rocky Mountain mixed conifer vegetation type. Regeneration harvest would be the primary tool in the subalpine fir/lodgepole pine vegetation type with 388 acres of treatment per year estimated. Mechanical fuels treatments would also be used in this vegetation type. Prescribed fire would be used in Douglas-fir dry, northern Rocky Mountain conifer, and subalpine fir/lodgepole pine vegetation types and is estimated on 4,879 acres. A total of 1,096 acres of mechanical fuels treatments per year are estimated under the no action alternative.

Historic Range of Variability

Six out of nineteen structure classes are within HRV after 100 years of land management under the no action; the no action alternative has the least number of structure classes within HRV (Table 33). Eight structure classes are below HRV, and 5 are above. Late open and closed structure conditions show the greatest departure from HRV. Levels of disturbance and management do not occur across enough acres over 100 years under the no action to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2015). Greater susceptibility of forest stands to disturbances including large fires and insect and disease outbreak increases the risk to hydrologic function from disturbance.

Table 33. Vegetation and structure type within HRV modeled after 100 years of management under the no action alternative.

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Douglas-fir dry	@	-	+	-	+

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Northern Rocky Mountain mixed conifer	-	-	+	-	@
Western hemlock/ Western redcedar	-	n/a	-	n/a	+
Subalpine fir / Lodgepole pine	@	n/a	@	n/a	@
Spruce/ Subalpine fir	-	n/a	@	n/a	+

@=within HRV; -=below HRV; +=above HRV; and n/a=structure class does not exist within this vegetation type

Vegetation Management Plan Components

INFISH provides stricter standards and guidelines for vegetation management activities than the Forest Plan it amended. Timber harvest and fuelwood cutting in RHCAs is prohibited under INFISH except in the event of safety, catastrophic events, or if watershed analysis indicates that vegetation treatment is needed to move toward attainment of RMOs. In addition INFISH includes standards and guidelines that minimize roads and landings in RHCAs. Standards and guidelines and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under the no action alternative.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under the no action alternative. INFISH provides stricter standards and guidelines than the Forest Plan it amended on grazing to move toward attainment of RMOs. These standards and guidelines apply primarily in RHCAs and would continue to be implemented under the proposed action. It is assumed that allotment management under the proposed action would meet guidelines for grazing in RHCAs, and that changes in grazing management to attain RMOs would be implemented through project-level NEPA, and allotment management plans. There are no specific numeric guidelines for grazing in RHCAs in INFISH and the no action alternative. Standards and guidelines and BMPs are the primary mechanisms to protect water quality and riparian function from grazing under the no action alternative. PIBO monitoring indicates that stream conditions across the CNF are improving (see MacDonald 2015 and discussion of PIBO data discussed previously in this report) under INFISH standards and guidelines, however most stream channel parameters are outside of reference conditions.

Summary of Effects and Comparison to Other Alternatives

The no action alternative provides less protection to the processes that improve or preserve hydrologic function than the proposed action and alternatives R, P, and O. The no action alternative would provide a slower pace of recovery of hydrologic function through passive and active restoration than the proposed action and alternatives R, P, and O. Effects of the no action alternative in relation to other alternatives include:

- The no action alternative does not address the need for change in this forest plan revision; the pace of watershed restoration is not increased from current levels, watershed and riparian direction is not integrated. Specific watershed and riparian objectives in the proposed action, and alternatives R, P, and O should increase the pace

and scale of watershed restoration, and improve resiliency to the potential hydrologic effects of climate change more effectively than the plan components in the no action and alternative B.

- Narrower RHCA widths along intermittent streams, lakes, and ponds are less restrictive than RMA widths in the proposed action, and alternatives R, P, and O and may not improve or preserve hydrologic and riparian function as well as wider RMA widths.
- There are fewer acres of priority watersheds in the no action alterative than in the key watershed network in the proposed action and alternatives R, P, and O. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in the proposed action and alternatives R, P, and O and specific restoration objectives in key watersheds would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network.
- The no action alternative does not accelerate improvement in watershed condition as much as the proposed action and alternatives R, P, and O. The INFISH priority network would remain and there are not specific plans to accelerate the pace of restoration across the INFISH priority watershed network. There are no measureable objectives for the INFISH priority watershed network other than essential projects outlined in watershed action plans for focus watersheds designated through ARS, and priority watersheds designated through WCF.
- RMOs would continue to be used as benchmarks for evaluation of current stream conditions, even though they may not adequately account for natural variability or separate land use effects from natural disturbance.
- The no action alternative manages toward 8 riparian goals, the proposed action and alternatives R, P, and O focus on the attainment of desired conditions for aquatic and riparian function and watershed condition.
- Approximately 20% of CNF land base is in management areas where construction of new roads is prohibited. Construction of new roads is prohibited in a higher percentage of the CNF in all other alternatives including the proposed action. Road density desired conditions range from 0.4 to 2 mi/mi^2 of open road (ML 2-5) and are depend on species or resource in need of protection. Unlike the prosed action and alternatives R, P, and O, road density desired conditions include ML 1-5 roads. Inclusion of ML 1 (closed) roads in road density calculations provides a better metric for improvement in aquatic and riparian function because closed roads have an effect on hydrologic processes.
- Approximately 80% of the CNF land base is available for timber production; all other alternatives have less land open to these activities.
- Standards and guidelines in the no action alternative do not effectively address contemporary issues of watershed function, including protection of streambank and floodplain integrity from livestock grazing, and reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in the no action alternative may not protect watershed function and water quality as effectively as the proposed action, and alternatives R, P, and O.
- Standards for development of hydroelectric and other water use developments are less stringent in the no action alternative than the proposed action and alternatives R, P, and O.
- Six out of nineteen vegetation structure classes are within HRV after 100 years of land management under the no action. Forests that are departed from HRV generally are at greater risk for large fires and insect and disease outbreaks which can impact hydrologic function and aquatic ecosystems.

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- The no action alternative does not increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change; infrastructure upgrades would continue at the current pace.

Proposed Action

The proposed action was released to the public in June 2011, and reflects current management policies of the Forest and meets the intent of recovery plans for terrestrial and aquatic threatened and endangered species, based on science that has evolved since the existing Colville Forest Plan was published in 1988. An emphasis on management that applies landscape ecology concepts to provide for ecological resilience to disturbances, including the effects of climate change, has also been added based on current scientific knowledge. Management areas (MAs) in the proposed action are designated where management intent is similar.

Direction for management of aquatic resources is based on the Region 6 Aquatic and Riparian Conservation Strategy (ARCS) (USDA Forest Service 2008) and provides a comprehensive core set of plan components (desired conditions, objectives, standards, and guidelines) to maintain and restore the ecological health of watersheds and aquatic ecosystems across the Forest. ARCS also designates riparian management areas (RMAs) and a key watershed network.

Indirect Effects

Riparian and Aquatic Resource Management

Riparian Management Areas (RMAs)

Riparian and aquatic resource direction included in the proposed action is based on the Region 6 Aquatic and Riparian Conservation Strategy (ARCS) (USDA Forest Service 2008), which is a refinement of earlier strategies including the Northwest Forest Plan (USDA Forest Service and USDI BLM, 1994), PACFISH (USDA and USDI 1995), INFISH (USDA Forest Service 1994c and 1995), and the R6 Aquatic Restoration Strategy (ARS) (USDA Forest Service 2005). The proposed action includes designation of riparian management areas (RMAs), which include portions of watersheds where aquatic and riparian-dependent resources receive special management. RMAs overlay approximately 179,236 (16%) of the CNF, compared to 13% under the no action and B alternatives. RMAs are mapped, but actual locations of RMAs may be changed and updated based on project level planning and reconnaissance. RMA widths vary by water body type and are shown in Table 34.

Table 34. RMA widths and total acreage for the proposed action and alternatives R, P, and O.

Stream and water body classification	Riparian Management Area (RMA) width	Acres
Fish bearing streams	300 ft slope distance on each side (600 ft total)	34,840
Permanently flowing non-fish bearing streams	150 ft slope distance on each side (300 ft total)	48,791
Lakes and natural ponds	300 ft slope distance around feature	10,138

Stream and water body classification	Riparian Management Area (RMA) width	Acres
Constructed ponds and reservoirs, and wetlands greater than 1 acre	150 ft slope distance around feature	15,844
Seasonally flowing or intermittent streams; wetlands, seeps, and springs less than 1 acre, and unstable or potentially unstable areas	100 ft slope distance from stream (200 ft total), 100 ft slope distance around wetland, seep, spring, or unstable or potentially unstable area	69,623
Total		179,236

An increase in total acres of RMAs from the no action alternative gives greater protection to riparian function and structure than the no action and the B alternative at lakes and natural ponds (where riparian distance is increased from 150 to 300ft), and intermittent streams and wetlands, seeps, and springs less than 1 acre (where riparian distance is increased from 50ft in non-INFISH priority watersheds to 100ft across the CNF). There is no research to indicate that riparian reserve widths under the Northwest Forest Plan provide more protection than necessary to meet riparian desired conditions and objectives (Everest and Reeves 2007). This finding supports the expansion of RMA widths from INFISH RHCA widths to be more consistent with Riparian Reserve widths from the Northwest Forest Plan.

Riparian and Aquatic Resource Plan Components

The proposed action includes objectives, standards, and guidelines specific to RMAs. Objectives for RMAs include:

- Modification of grazing practices in RMAs to move toward desired conditions
- Restoration of riparian processes at dispersed recreation sites
- Consolidation of user-created access routes in RMAs
- Provide upstream fish passage at road stream crossings

Standards address activities including chemical application, fuel containment, fuel wood cutting, road and stream crossing construction and reconstruction, location of livestock handling and watering facilities, location of mine waste, pump screening, fire suppression, fuel chipping, new and existing special uses, and development of new hydroelectric facilities. Guidelines address activities including, RMA function, water drafting, hazard tree retention, harvest and thinning, road and stream crossing construction and re-construction, livestock grazing, recreation facilities, mineral development, fire suppression, and watershed restoration project design. There are 28 guidelines and 17 standards for RMAs in the proposed action. These standards and guidelines and BMPs form the primary mechanisms of protection of riparian and aquatic function under the proposed action.

Key Watersheds

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Key watersheds are one of the primary elements within the proposed action that maintain and improve hydrologic and aquatic function. Key watersheds are a network of watersheds that serve as strongholds for important aquatic resources or have the potential to do so through focused restoration (USDA Forest Service 2008). Key watersheds are designated at the subwatershed scale and were selected based on population condition of focal aquatic species (interior redband trout, westslope cutthroat trout, and bull trout), and aquatic habitat condition and function (see fisheries report for description of this methodology). Management in key watersheds minimizes risk and maximizes restoration of preservation of ecological health. The key watershed network in the proposed action was identified in 2011 and expands the INFISH priority network in the proposed action with the addition of 13 additional subwatersheds. Four subwatersheds in the INFISH priority network were not included in the key watershed network for the proposed action because they did not have the aquatic habitat conditions or focal species population necessary for designation as a key watershed under Reiss et al (2008).

There are 371,943 acres of key watersheds under CNF ownership (34% of total CNF ownership) in the proposed action (Table 35 and Figure 17). Existing miles and road density of NFS roads in RHCAs within the CNF ownership boundary in key watersheds are shown in Table 33. Key watersheds are included in the focused restoration, backcountry, backcountry motorized, research natural area, recommended wilderness (RW), and wilderness management areas. The Winchester Creek SWS is the only key watershed located in the general restoration MA in the proposed action. Subwatershed names, numbers, and boundaries have changed since the creation of management areas in the proposed action, and inclusion of Winchester Creek in the general restoration MA is a legacy of these changes.

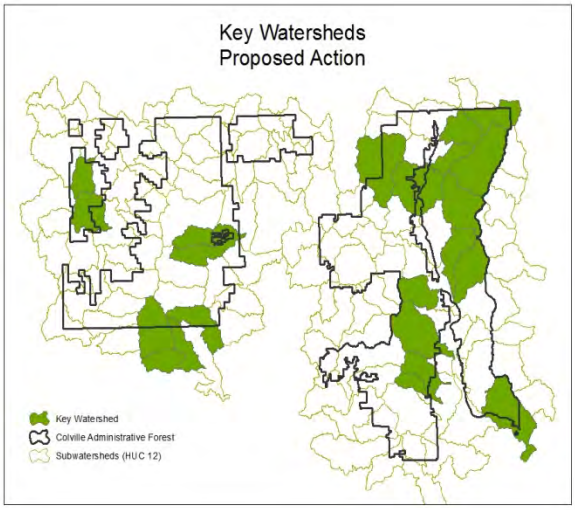

Figure 17. Proposed action key watersheds

Table 35. Key watersheds in the proposed action.

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	CNF Ownership Acres	Riparian Road Miles	Riparian Road Density
170102160102	Winchester Creek	10482	5627	10.7	4.2
170102160103	Exposure Creek-Pend Oreille River	41223	14462	9.7	1.7
170102160106	Smalle Creek	17753	11058	9.9	1.9
170102160109	Tacoma Creek	39519	27182	25.1	2.7
170102160202	West Branch Le Clerc Creek	21671	15098	5.6	0.9
170102160203	East Branch Le	26662	11145	11.0	2.7

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	CNF Ownership Acres	Riparian Road Miles	Riparian Road Density
	Clerc Creek				
170102160204	Ruby Creek	19597	18385	13.1	2.2
170102160302	Sweet Creek-Pend Oreille River	41831	28890	16.5	2.1
170102160303	Harvey Creek	32998	27553	17.6	1.9
170102160304	Headwaters Sullivan Creek	45516	45417	45.1	3.9
170102160305	North Fork Sullivan Creek-Sullivan Creek	12708	11258	1.8	0.6
170102160306	Slate Creek	19911	19907	10.5	2.3
170102160307	South Salmo River	22271	15932	0.1	0
170200010104	North Fork Deep Creek	49256	26633	15.7	2.2
170200010306	Barnaby Creek	23107	14299	9.1	2.4
170200010401	Upper Hall Creek	31648	13785	3.7	1.0
170200010402	Sitdown Creek	14484	0	0	0
170200010403	Middle Hall Creek	15480	1927	0.9	0.8
170200020401	Trout Creek	23434	14121	10.7	3.6
170200020501	Tonata Creek	14453	13780	16.2	5.9
170200020608	North Fork Deadman Creek	13449	13185	8.8	1.1
170200020609	Deadman Creek	26518	22299	10.7	2.6
Total		563,971	**371,943**		

Watershed and Aquatic Restoration

The proposed action prioritizes watershed restoration through measureable objectives in key watersheds, and additional RMA objectives to improve aquatic and hydrologic condition and function and move toward desired conditions. Plan components specific to key watersheds, including measureable objectives are discussed in this section.

Key watersheds where restoration would be prioritized were identified based on limiting factors to hydrologic and aquatic function that could be improved through focused restoration projects identified in the WCF and AEC processes (see MacDonald et al. 2015). Measurable objectives for key watersheds that are priorities for active restoration would contribute to the maintenance and restoration of desired conditions in key watersheds. Desired conditions for key watersheds include:

- Key watersheds are networks of watersheds with good habitat and functionally intact ecosystems that contribute to and enhance recovery of threatened and endangered species;
- Roads do not present risk to aquatic resources;
- Key watersheds have high watershed integrity

Future projects in key watersheds would focus on achieving key watershed-specific, RMA, and aquatic and riparian system desired conditions. While watershed improvement treatments are not expected on every acre of key watershed through the life of this forest plan, specific measurable objectives for key watersheds where restoration is focused are expected to accelerate the pace of aquatic restoration across the key watershed network.

Specific objectives for key watersheds were developed that are intended to achieve desired conditions. Objectives for the key watershed network under the proposed action include:

- **Key watershed objective 1 *Watershed Restoration Prioritization***: Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of forest plan implementation. Key watersheds that are a priority for restoration include:

  East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, and Tonata Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate through the life of the plan.
- **Key watershed objective *Road Treatments***: Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 78 miles of hydrologically connected road within 15 years of forest plan implementation.
- Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 36 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of Forest plan implementation through culvert replacement or crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
- **Key watershed objective *Range Infrastructure Improvements***: Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 250 acres within 15 years of plan implementation.
- **Key watershed objective *Riparian Vegetation Structure***: Move upland vegetation within riparian management areas in key watersheds toward HRV on 1,200 acres within 15 years of plan implementation.
- **Key watershed objective *Stream Restoration***: Restore hydrologic, geomorphic, and riparian process and function on 76 miles of stream within 15 years of forest plan implementation through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

Objectives for key watersheds and estimates of restoration work that would be completed through the life of this plan in key watersheds that are priorities for active restoration are shown in Table 36.

Table 36. Objectives for key watersheds that are a priority for restoration.

Key Watershed Prioritization	Road Treatments		Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement	Stream Restoration (miles)
	Road Improvement	Aquatic Organism			

	(miles)*	Passage Improvement (# of crossings)		(acres)	
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Barnaby	5	5	30	75-150	4
Harvey Creek	10	2	0	0	4
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	3	1	0	0	0
Sullivan Creek	15	6	0	0	20
Tonata Creek	4	4	50	75-150	3
Ruby Creek	3	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds)	12	6	30	75-150	10
Total for the life of the plan (essential projects completed for 12 key watersheds)	**68 miles**	**36 crossings**	**240 acres**	**450-900 acres**	**70 miles**

*Existing riparian road miles and road density are shown in Table 35.

The following standards were developed for key watersheds in the proposed action:

- There shall be no net increase at any time in the mileage of Forest roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition;
- Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations;
- New hydroelectric facilities and water developments shall not be located in a key watershed.

Through the life of this revised forest plan, completion of essential projects in 12 key watersheds is estimated. Treatments to achieve this goal include; 68 miles of reduction in road hydrologic connectivity through decommissioning and storm damage risk reduction treatments, improvement of aquatic organism passage at 36 crossings, 240 acres of range infrastructure improvements, 450-950 acres of riparian vegetation improvements to move upland vegetation in riparian areas toward HRV, and 70 miles of improvement of hydrologic and geomorphic channel function through in-stream channel improvements.

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Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 291,096 acres (26% of CNF) in the proposed action are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Road Density Desired Conditions

Road densities of <1 mi/mi^2 with no valley bottom roads are considered low enough to support proper watershed and aquatic function (Potyondy and Geier 2010). Road densities of 1 to 2.4 mi/mi^2 are considered functional at risk, and road densities >2.4 mi/mi^2 are considered not functional. While road density provides a broad-scale metric to assess watershed condition, the location, type, and condition of roads provides a better approximation for potential effect of the road system on hydrologic and aquatic function.

While road densities vary across the management areas, a road density desired condition of no greater than 2 mi/mi^2 of ML1-5 roads is included in the focused restoration management area (257,157 acres, 23% of CNF), and no greater than 3 mi/mi^2 in the general restoration management area (533,891 acres, 48% of CNF). Existing road densities calculated by management area at the 5th field watershed scale for the focused and general restoration management areas are shown in Table 37. There are no watersheds within the focused restoration MA where existing condition meets the road density desired condition of 2 mi/mi^2. There are 8 watersheds within the general restoration MA that meet the road density desired condition of 3 mi/mi^2, and 9 watersheds that do not meet road density desired conditions.

Table 37. Existing road density by 5th field watershed for the focused and general restoration management areas under the proposed action.

Focused Restoration MA		
5th field Watershed Name	**Road Density (mi/mi^2).**	**Meets Road Density Desired Condition of 2 mi/mi^2?**
Boulder Creek-Kettle River	3.3	N
Curlew Creek	2.6	N
Deep Creek	3.7	N
Hall Creek-Franklin D Roosevelt Lake	5.3	N
Le Clerc Creek-Pend Oreille River	2.1	N
Sherman Creek-Franklin D Roosevelt Lake	2.8	N
Sullivan Creek-Pend Oreille River	3.7	N
Tacoma Creek-Pend Oreille River	3.1	N
Vulcan Mountain-Kettle River	3.9	N
General Restoration MA		
5th field Watershed Name	**Road Density**	**Meets Road Density Desired Condition of 3**

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	(mi/sq mi)	mi/mi^2?
Boulder Creek-Kettle River	3.0	Y
Chewelah Creek-Colville River	4.3	N
Curlew Creek	3.6	N
Deep Creek	3.4	N
Hall Creek-Franklin D Roosevelt Lake	4.3	N
Le Clerc Creek-Pend Oreille River	2.6	Y
Little Pend Oreille River	3.3	N
Mill Creek	2.7	Y
Onion Creek-Franklin D Roosevelt Lake	2.8	Y
Sherman Creek-Franklin D Roosevelt Lake	2.8	Y
Stensgar Creek-Colville River	3.0	Y
Sullivan Creek-Pend Oreille River	3.0	Y
Tacoma Creek-Pend Oreille River	4.1	N
Toroda Creek	2.5	Y
Upper Sanpoil River	3.2	N
Vulcan Mountain-Kettle River	4.6	N
West Fork Sanpoil River	3.7	N

Road Management Plan Components

A specific objective for reduction in road hydrologic connectivity and sediment delivery through treatment of an estimated 68 miles of hydrologically connected road through the life of the plan would improve hydrologic and aquatic function and reduce road risk and density. Roads that are hydrologically connected to the stream system are the focus of restoration activities because watershed-scale road analyses across the Pacific Northwest have shown that <10% of road segments deliver 90% of road-generated sediment to the stream system. Therefore, treatment of the highest risk hydrologically connected road has the greatest potential to reduce the risk of roads to aquatic habitat and hydrologic function (GRAIP 2014).

In addition to specific road density desired conditions for the general and focused restoration management areas, desired conditions for aquatic and riparian systems, RMAs, and key watersheds focused on minimizing hydrologic interruption, erosion, and sedimentation from the road system are included in the proposed action. Projects implemented under the proposed action would be designed with the goal of achieving these desired conditions.

The proposed action includes standards for sidecasting, fill placement, and avoidance of hydrologic flow paths during road construction, maintenance, and reconstruction. Also included in the proposed action is a standard for reconstructing stream crossings to accommodate 100-year flows, avoid diversion of streamflow onto roads in the event of crossing failure, and provide fish passage for all species and life stages. Guidelines in the proposed action include avoidance of road construction in RMAs, wetlands, and unstable areas, construction or reconstruction of stream crossings to allow for riparian-dependent species passage, and retention of fish passage barriers where they restrict access by non-native fish species. Standards, guidelines, BMPs, and restoration objectives to minimize hydrologic impacts from the road system are the primary mechanisms to protect water quality and riparian function from roads under the proposed action.

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Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber production is allowed in both Focused and General Restoration management areas which cover 790,987 acres (71% of the Forest). This is less than the no action and B alternatives, similar to alternatives P and O and more than alternative R. Acres treated are constrained by forest budgets, and project-level considerations. BMPs are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Variable density thinning would be the primary tool for active commercial vegetation management in the focused and general restoration MAs in the proposed action in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types in the proposed action with an estimated (modeled) treatment of 4,050 acres per year. Mechanical fuels treatments are estimated on 5,000 acres per year in these vegetation types. Mixed and light severity prescribed fire would be used in open-canopy stands on a 20 year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types with treatment modeled for 3,839 acres per year. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type with an estimated (modeled) 950 acres of treatment per year. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type with an estimated treatment of 1040 acres per year. There are no modeled vegetation treatments in the Western redcedar/Western hemlock and spruce/subalpine fir vegetation types.

Acres of CNF lands by management area and activities authorized in each management area are shown in Table 38.

Table 38. Proposed action management areas and activities authorized in each management area that can affect the hydrologic resource.

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Focused Restoration	257,157	Y 2 mi/mi^2	Y
General Restoration	533,892	Y 3 mi/mi^2	Y
Backcountry	90,846	N	N
Backcountry Motorized	61,726	N	N
Research Natural Area	5,703	N	N
Scenic byways	19,564	Y	N
Recommended Wilderness (RW)	101,385	N	N
Congressionally Designated (CD) Wilderness	31,436	N	N

DRAFT

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
*RMAs	179,236	Y—within standards and guidelines	N—vegetation management can be used as a tool to meet or maintain desired conditions, goals and objectives
Total Acres	1,101,709		

*MAs overlay other management area and are not included in total acreage calculations.
**Acres are approximate and vary due to GIS methodology

Historic Range of Variability

Six out of nineteen structure classes are within HRV after 100 years of land management under the proposed action (Table 39). The same number of structure classes are within HRV for the no action, proposed action, and alternatives P, and B. Six structure classes are below HRV, and 7 are above. The late closed forest structure would be above HRV in 3 of 5 vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under the proposed action to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2015).

Table 39. Vegetation and structure type within HRV modeled after 100 years of management under the proposed action.

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Douglas-fir dry	@	@	+	-	+
Northern Rocky Mountain mixed conifer	-	+	+	@	@
Western hemlock/ Western redcedar	-	n/a	-	n/a	+
Subalpine fir / Lodgepole pine	+	n/a	-	n/a	@
Spruce/ Subalpine fir	-	n/a	@	n/a	+

@=within HRV; -=below HRV; +=above HRV; and n/a=structure class does not exist within this vegetation type

Vegetation Management Plan Components

Standards for fuel wood cutting, application of herbicides and other pesticides, and fuel chipping are included in the proposed action. Guidelines are included for hazard tree felling, timber harvest and thinning in RMAs, location of landings, skid trails, and staging, decking, and yarding activities in RMAs. Standards, guidelines, and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under the proposed action.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under the proposed action. Plan components in the proposed action provide stricter guidelines than INFISH to attain goals, objectives, and desired conditions. A guideline with stricter criteria for minimizing streambank

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alteration, decreasing vegetation utilization, and increasing stubble height should move toward desired conditions in a shorter timeframe than the no action alternative. Specific guidelines within greenline vegetation area adjacent to all watercourses include:

- Do not exceed 20% streambank utilization
- Do not exceed 40% utilization of mean annual vegetation production on woody vegetation
- Maintain at least 4-6 inches or do not exceed 40% utilization of mean annual vegetative production of herbaceous vegetation.

Standards, guidelines, BMPs, and restoration objectives to mitigate the impact of grazing on hydrologic function and water quality are the primary mechanisms to preserve water quality and hydrologic function under the proposed action.

Summary of Effects and Comparison to Other Alternatives

The proposed action provides more protection for preservation and restoration of hydrologic function, water quality, and water uses than the no action and B alternatives. The proposed action does not provide as much protection for preservation and restoration of hydrologic function, water quality, and water uses as the R, P, and O alternatives. Effects of the proposed action in relation to other alternatives include:

- The proposed action addresses the need for change more effectively than the no action, and alternatives B, and O. Through plan components and principles from ARCS, and specific objectives for restoration in key watersheds, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in the proposed action. The proposed action does not address the need for change as effectively as alternatives P and R.
- Wider RMA widths along intermittent streams, lakes, and ponds than the no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in the no action and alternative B.
- There are more acres of key watersheds in the proposed action than in the INFISH priority network in the no action and alternative B. There are fewer acres of key watersheds in the proposed action than in the R, P, and O alternatives. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in the proposed action would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in the no action and alternative B.
- The proposed action would accelerate improvement in watershed condition faster than the no action and alternative B. Measurable objectives in key watersheds would accelerate restoration and preservation of hydrologic function. There are fewer subwatersheds in the proposed action key watershed network than in the key watershed network for alternatives R, P, and O.
- Desired conditions are identified for general aquatic riparian and watershed condition; The no action and alternative B focus on general riparian goals rather than desired conditions.
- Approximately 26% of CNF land base is in management areas where construction of new roads is prohibited. 23% of the CNF land base is within the focused restoration MA where desired condition for road density is 2 mi/mi^2.
- Approximately 71% of CNF land base is in management areas where active vegetation management is authorized. This is less than the no action and alternative B, similar to alternatives P and O, and greater than alternative R.

DRAFT

- Six out of nineteen vegetation structure classes are within HRV after 100 years of land management under the proposed action. Departure from HRV in the proposed action is the same as the no action, and alternatives P, and O.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in the proposed action should protect watershed function and water quality more effectively than the no action and alternative B. Standards and guidelines in the proposed action are less restrictive than in alternatives R, and P.
- There is a greater emphasis on grazing standards and guidelines in the proposed action, A guideline with numeric criteria for streambank alteration, herbaceous and woody utilization, and stubble height should be more effective in moving toward desired conditions in RMAs in grazing allotments than the no action and alternative B. Standards and guidelines for grazing in the proposed action are not as restrictive as in alternatives R and P.
- Standards for development of hydroelectric and other water use developments are more stringent in the proposed action and alternatives R, P, and O than in the no action and B alternative.
- Measureable objectives and focused restoration activities in key watersheds in the proposed action would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change. Since the key watershed network is smaller in the proposed action than alternatives R, P, and O, the proposed action would be less effective in increasing resiliency to climate change than alternatives R, P, and O.

Alternative R

Alternative R responds to public comments that the proposed action does not provide watershed, aquatic, and riparian resource protections that are as effective as current forest plan direction. Aquatic direction and plan components in alternative R are based on a modified version of ARCS (referred to throughout this plan as ARCS-modified), which adds clarification to desired conditions, objectives, standards, and guidelines to address issues specific to the CNF. Changes from ARCS to ARCS-modified were based on public and internal comments, best available science, and new policies on Forest Service management of aquatic and riparian resources, including the Watershed Condition Framework. ARCS-modified plan components were updated based on discussions with the Forest Plan interdisciplinary team, resource specialists in the Pacific Northwest regional office, and other reviewers of the draft forest plan.

Most of the updates made to ARCS plan components in ARCS-modified add clarity to individual plan components Operational constraints were also considered in the evaluation of each standard and guideline within ARCS.

Alternative R includes three new guidelines related to aquatic invasive species, one new guideline addressing fuel storage in RMAs, a new standard to limit hydrologic impacts from roads, trails, and developed recreation sites, and 5 standards that were guidelines in the proposed action. RMAs are the same as the proposed action and alternatives P and O. There are more subwatersheds within the key watershed network than in the proposed action.

DRAFT

Indirect Effects

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and acreages are the same as the proposed action and alternatives P and O.

Riparian and Aquatic Plan Components

Alternative R includes desired conditions, objectives, standards, and guidelines for general water resources and RMAs. Desired conditions for general water resources, key watersheds, and RMAs have been updated and clarified in alternative R. An additional desired condition addressing roads in RMAs is included in alternative R. A desired condition was also added to alternative R to address the existing condition in focus and priority watersheds. RMA and general water resources objectives address limiting factors to hydrologic, aquatic, and riparian function, and focus on improving watershed condition through the life of the plan and are discussed in detail in the watershed and aquatic restoration section of this report.

Standards in alternative R address activities including chemical application, fuel containment, fuel wood cutting, road and stream crossing construction and reconstruction, location of livestock handling and watering facilities, location of mine waste, pump screening, fire suppression, fuel chipping, new and existing special uses, and development of new hydroelectric facilities. Guidelines under the proposed action that address activities including, RMA function, water drafting, hazard tree retention, harvest and thinning, road and stream crossing construction and re-construction, livestock grazing, recreation facilities, mineral development, fire suppression, and watershed restoration project design are standards in alternative R. Alternative R has a greater emphasis on standards than the proposed action; there are 27 guidelines and 21 standards for general water resources, key watersheds, and RMAs in the proposed action. Standards, guidelines, and BMPs are the primary mechanisms to protect hydrologic, aquatic, and riparian function in alternative R.

Key Watersheds

The key watershed network is expanded in alternative R based on updated fish distribution data, improved data on aquatic habitat function, and changes in boundaries, names, and numbers of subwatersheds since designation of the key watershed network for the proposed action (Figure 18). Five subwatersheds were added to the key watershed network in the proposed action. Additionally, 3 subwatersheds were removed from the proposed action key watershed network because they contain less than 25% CNF ownership.

The expanded key watershed network is shown in Table 40 and Figure 18. There are 451,525 acres of key watersheds under CNF ownership (41% of total CNF ownership) in alternative R. Under alternative R, key watersheds are included in the late forest structure, backcountry, backcountry motorized, research natural area, recommended wilderness, and wilderness management areas. While watershed improvement treatments are not expected on every acre of key watershed through the life of this forest plan, specific measurable objectives for key watersheds are expected to accelerate the pace of aquatic restoration across the key watershed network. Water quality and hydrologic function are expected to improve from restoration projects to meet specific objectives outlined in the forest plan.

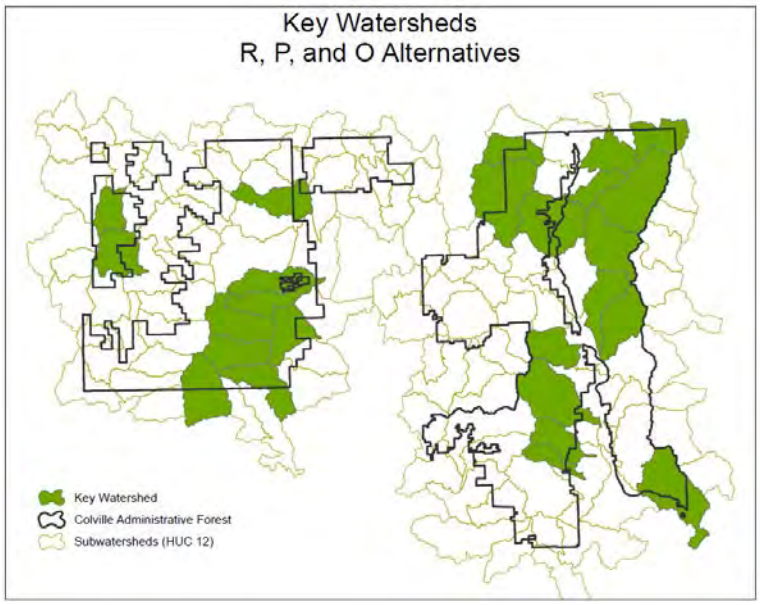

Figure 18. Key watersheds (subwatershed scale) in alternatives R, P, and O.

Table 40. Key watersheds (subwatershed scale) for alternatives R, P, and O.

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	CNF Ownership Acres	Riparian Road Miles	Riparian Road Density
170102160102	Winchester Creek	10482	5628	10.7	4.2
170102160103	Smalle Creek	17754	11058	9.9	1.9
170102160201	Exposure Creek-Pend Oreille River	41224	14463	9.7	1.7
170102160206	Tacoma Creek	39519	27182	25.1	2.7
170102160302	West Branch Le Clerc Creek	21672	15099	5.6	0.9
170102160303	East Branch Le Clerc Creek	26663	11145	11.0	2.7
170102160304	Ruby Creek	19597	18385	13.1	2.2
170102160401	Harvey Creek	32999	27554	17.6	1.9
170102160402	Headwaters Sullivan Creek	45516	45417	45.1	3.9
170102160403	North Fork Sullivan Creek-Sullivan Creek	12709	11259	1.8	0.6
170102160702	Headwaters South Salmo River	20697	12472	0.1	0
170102160902	Sweet Creek-Pend Oreille River	41832	28890	16.5	2.1
170102160903	Slate Creek	20195	19907	10.5	2.3
170102161003	Cedar Creek	17209	5359	1.4	1.2
170200011004	North Fork Deep Creek	49257	26634	15.7	2.2
170200011301	South Fork Sherman Creek	22004	21899	11.6	2.3
170200011302	Upper Sherman Creek	26381	26260	15.4	2.8
170200011303	Lower Sherman Creek	20987	15998	6.7	6.7
170200011306	Barnaby Creek	23108	14299	9.1	2.4
170200011401	Upper Hall Creek	31648	13786	3.7	1.0
170200021301	Trout Creek	23435	14122	10.7	3.6
170200021701	Tonata Creek	14453	13781	16.2	5.9
170200021907	East Deer Creek-Kettle River	23385	15443	4.2	1.5
170200022002	North Fork Deadman Creek	13450	13185	8.8	1.1
170200022003	Deadman Creek	26518	22300	10.7	2.6
	Total	642692	**451,525**		

Three desired conditions for key watersheds in alternative R are similar to the proposed action, but have been updated for clarity. These desired conditions address riparian composition, key riparian processes, and livestock grazing, which are the same in alternative R and the proposed

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action. Standards for key watersheds are similar to the proposed action with clarification in the description of the "no net increase in road miles" standard.

Watershed and Aquatic Restoration

Identification of key watersheds that are a priority for restoration and objectives for key watersheds are the same as the proposed action, except Upper Sherman Creek and South Fork Sherman Creek were added as restoration priorities in alternative R. Key watersheds that are priorities for restoration and projected restoration completed through the life of this forest plan are shown in Table 41. Key watershed objectives include:

- **FW-OBJ-WR-05. *Key Watershed Restoration Prioritization***: Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of forest plan implementation. Key watersheds that are a priority for restoration include:

  East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, Upper Sherman Creek, South Fork Sherman Creek, and Tonata Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate through the life of the plan.

- **FW-OBJ-WR-06. *Key Watershed Road Treatments***: Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 78 miles of hydrologically connected road within 15 years of forest plan implementation.
- Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 50 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of Forest plan implementation through culvert replacement or crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
- **FW-OBJ-WR-07. *Key Watershed Range Infrastructure Improvements***: Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 250 acres within 15 years of plan implementation.
- **FW-OBJ-WR-08. *Upland Vegetation Structure in RMAs in Key Watersheds***: Move upland vegetation within riparian management areas in key watersheds toward HRV on 1,200 acres within 15 years of plan implementation.
- **FW-OBJ-WR-09. *Stream Restoration in Key Watersheds***: Restore hydrologic, geomorphic, and riparian process and function on 76 miles of stream within 15 years of forest plan implementation through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

DRAFT

Table 41. Key watersheds that are priorities for restoration and projected restoration activities based on key watershed objectives that would be completed through the life of alternative R.

Key Watershed Prioritization	Road Treatments		Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
	Road Improvements (miles)*	Aquatic Organism Passage Improvement (# of crossings)			
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Upper Sherman Creek	5	5	0	75-150	2
South Fork Sherman Creek	5	9	0	75-150	4
Barnaby Creek	5	5	30	75-150	4
Harvey Creek	10	2	0	0	4
Tonata Creek	4	4	50	75-150	3
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	3	1	0	0	0
Sullivan Creek	15	6	0	0	20
Ruby Creek	3	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds over 15 years)	12	6	30	75-150	10
Total for the life of the plan (essential projects completed for 14 subwatersheds)	**78 miles**	**50 crossings**	**240 acres**	**600-1200 acres**	**76 miles**

*Existing riparian road miles and road density are shown in Table 40.

Objectives for restoration in RMAs are expanded and clarified in alternative R from those included in the proposed action. In addition, alternative R includes an objective for management of upland vegetation in RMAs to move toward HRV. Two RMA objectives apply to subwatersheds outside of key watersheds, since key watershed objectives address the same activities within key watersheds. Objectives for RMAs in alternative R include:

- **MA-OBJ-RMA-01**. ***Improve Riparian Function at Dispersed and Developed Recreation Sites***: Over the next 15 years, restore riparian processes and balance need for occupancy and access to water at 50 dispersed and developed recreation sites, through

education, enforcement, and engineering where recreational use results in bank damage, reduction in water quality, and/ or a reduction in stream shade.

- **MA-OBJ-RMA-02.** ***Restoration of Riparian Habitat and Processes on Roads:*** Restore hydrologic and riparian habitat function within RMAs in non-key watersheds by reducing road-related impacts on 30 miles of road within 15 years.
- **MA-OBJ-RMA-03.** ***Restoration of Late Forest Structure:*** Move upland vegetation within riparian management areas outside of key watersheds toward HRV on 500 acres within 15 years of plan implementation.

Alternative R also includes general water resources objectives, not included in the proposed action:

- **FW-OBJ-WR-01.** ***Aquatic Invasive Species:*** Within the next 15 years, implement aquatic invasive species prevention measures at all developed recreation sites providing direct and/or indirect access to water bodies, such as boat ramps and other campgrounds, resorts and day use areas that provide portal zones for hand carried watercraft. Implement aquatic invasive species prevention measures as part of all aquatic survey and inventory procedures and other management activities that pose high potential for invasion vectors to occur.
- **FW-OBJ-WR-02.** ***Aquatic Invasive and Non-Native Species:*** Within the next 15 years, implement aquatic invasive species control and eradication at 10 sites where such invasions have become established and prevent attainment of listed fish recovery plan goals and/or effects to social, economic and ecological systems are determined to be unacceptable.
- **FW-OBJ-WR-03.** ***General Watershed Function and Restoration:*** Within the next 15 years, decrease sediment delivery from management activities on 1,000 acres including but not limited to roads, livestock, illegal ORV use, vegetation management, and dispersed and developed campsites. Restore hydrologic, aquatic and riparian processes through activities that stabilize stream bank erosion, and other accelerated channel destabilizing processes (i.e., headcutting), improve lateral and vertical hydrologic connectivity, and improve stream channel and floodplain function on 10 miles of streams.
- **FW-OBJ-WR-04.** ***Fish Passage Improvement:*** Restore aquatic organism passage at 45 road/stream crossings and man-made instream structures including water diversions and dams outside of key watersheds for all native species, seasons, flows, and life stages within 15 years of forest plan implementation, through culvert replacement or installation and improvement of hydrologic and aquatic habitat function and resiliency to a range of flows through natural channel design and other acceptable treatment measures.
- **FW-OBJ-WR-10.** ***Watershed Restoration in Focus and Priority Watersheds:*** Over 15 years, implement the watershed condition framework through completion of essential projects outlined in watershed action plans in existing focus and priority watersheds to improve watershed condition class. Focus watersheds designated at the 5th field watershed scale include, Upper Sanpoil, Chewelah Creek-Colville River, and LeClerc Creek-Pend Oreille River watersheds. Priority watersheds designated at the subwatershed scale include Ninemile Creek, East Branch LeClerc Creek, and West Branch LeClerc Creek subwatersheds.

DRAFT

Appendix C includes details on how water resources and RMA objectives were calculated. The water resources and RMA objectives included in alternative R provide additional direction and a stronger focus on aquatic restoration than the proposed action.

Measurable objectives for key watersheds are similar as the proposed action, however the specific key watersheds that are priorities for active restoration where these objectives apply are expanded from the proposed action in alternative R. Specific objectives were developed in alternative R for the subwatersheds added to the key watershed network.

Completion of essential projects in 14 key watersheds, and 1 priority watershed is estimated under alternative R. Treatments to achieve this goal include; 78 miles of reduction in road hydrologic connectivity through decommissioning and storm damage risk reduction treatments, improvement of passage at 44 crossings, 240 acres of range infrastructure improvements, 600-1200 acres of riparian vegetation improvements to move upland vegetation in RMAs toward HRV, and 76 miles of improvement of hydrologic and geomorphic channel function through in-stream channel improvements. Completion of projects outside of key and priority watersheds is expected to improve hydrologic, aquatic and riparian function through the treatment of erosion at 50 dispersed recreation sites, 30 miles of road in RMAs, 1,000 acres where erosion problems are identified. In addition, control or eradication of aquatic invasive species at 10 sites, 500 acres of improvement of upland vegetation in RMAs, improvement of aquatic organism passage at 45 crossings and man-made in-stream structures, and 10 miles of stream restoration would also improve hydrologic, aquatic, and riparian function.

Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 271,931 acres (25% of CNF) in alternative R are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Road Density Desired Conditions

While existing road densities vary across the management areas, road density desired condition of ML1-5 roads is no greater than 1 mi/mi^2 in the late forest structure management area (565,565 acres, 51% of CNF), and no greater than 2 mi/mi^2 in the general restoration management area (245,110 acres, 22% of CNF). Existing road densities calculated by management area at the 5th field watershed scale for the late forest structure and general restoration management areas are shown in Table 42. There are no watersheds within the general restoration MA where existing condition meets the desired condition of 2 mi/mi^2. There are no watersheds within the late forest structure MA that meet the desired condition of 1 mi/mi^2. Objectives for treatment of roads to decrease sediment delivery should move toward meeting road density desired conditions through the life of this forest plan.

Table 42. Existing road density by 5th field watershed for the focused and general restoration management areas in alternative R.

General Restoration MA		
5th field Watershed Name	**Road Density mi/mi^2**	**Meets Road Density**

		Desired Condition of 2 mi/mi^2?
Boulder Creek-Kettle River	4.5	N
Chewelah Creek-Colville River	6.5	N
Curlew Creek	4.0	N
Deep Creek	6.4	N
Hall Creek-Franklin D Roosevelt Lake	9.0	N
Le Clerc Creek-Pend Oreille River	4.6	N
Little Pend Oreille River	*14.5	N
Mill Creek	3.8	N
Onion Creek-Franklin D Roosevelt Lake	*36.2	N
Sherman Creek-Franklin D Roosevelt Lake	4.9	N
Sullivan Creek-Pend Oreille River	3.9	N
Tacoma Creek-Pend Oreille River	5.3	N
Toroda Creek	4.5	N
Upper Sanpoil River	3.5	N
Vulcan Mountain-Kettle River	4.0	N
West Fork Sanpoil River	5.3	N
Late Forest Structure MA		
5th field Watershed Name	**Road Density (mi/sq mi)**	**Meets Road Density Desired Condition of 1 mi/mi^2?**
Boulder Creek-Kettle River	3.6	N
Chewelah Creek-Colville River	5.1	N
Curlew Creek	4.2	N
Deep Creek	4.8	N
Hall Creek-Franklin D Roosevelt Lake	6.1	N
Le Clerc Creek-Pend Oreille River	4.4	N
Little Pend Oreille River	4.6	N
Mill Creek	3.4	N
Onion Creek-Franklin D Roosevelt Lake	3.6	N
Sherman Creek-Franklin D Roosevelt Lake	3.9	N
Stensgar Creek-Colville River	3.2	N
Sullivan Creek-Pend Oreille River	5.0	N
Tacoma Creek-Pend Oreille River	4.5	N
Toroda Creek	4.8	N
Upper Sanpoil River	7.2	N
Vulcan Mountain-Kettle River	4.6	N

*Low land area included in road density calculation may make road density calculations appear high.

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Road Management Plan Components

In addition to road density desired conditions for the general and focused restoration management areas, desired conditions for aquatic and riparian systems, RMAs, and key watersheds focused on minimizing hydrologic interruption, erosion, and sedimentation from the road system are included in alternative R. Road treatment project through the life of this forest plan under alternative R would move toward desired conditions.

Standards and guidelines to protect aquatic and riparian resources are in the RMA standards and guidelines section of the forest plan. Alternative R includes standards for restriction of sidecasting, placement of fill, or plowed snow in RMAs or other hydrologically connected areas, and avoidance of hydrologic flow paths during road construction, maintenance, and reconstruction. Also included in alternative R is a standard for reconstructing stream crossings to accommodate 100-year flows, avoiding diversion of streamflow onto roads in the event of crossing failure, and providing fish passage for all species and life stages at crossings. Guidelines in alternative R include construction or reconstruction of stream crossings to allow for riparian-dependent species passage, and retention of fish passage barriers where they restrict access by non-native fish species. Two road guidelines in the proposed action were changed to standards in alternative R, including a no net increase in system roads in RMAs (avoidance of road construction in RMAs guideline in the proposed action), and minimizing hydrologic connectivity and sediment delivery from the road system. Standards, guidelines, BMPs, and restoration objectives to minimize hydrologic impacts from the road system are the primary mechanisms to protect water quality and riparian function from roads under alternative R.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber production would be allowed in General Restoration areas, comprising 245,110 acres (22% of the Forest). Alternative R has the least amount of MAs allocated to active vegetation management. Acres treated are constrained by forest budgets, and project-level considerations. BMPs, standards, and guidelines are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Partial harvest, variable density thinning, and shelterwood with reserves would be the primary tools for active commercial vegetation management with an estimated (modeled) treatment of 975 acres per year under alternative R. Mixed severity prescribed fire would be used in open-canopy stands on a 20 year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type.

Acres of CNF lands by management area and roadbuilding and timber production authorized by management area are shown in Table 43.

Table 43. Alternative R management areas and activities authorized in each management area that can affect the hydrologic resource.

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Late Forest Structure	565,565	Y 1 mi/mi^2 desired condition for road density	Y
General Restoration	245,110	Y 2 mi/mi^2 desired condition for road density	Y
Backcountry	20,230	N	N
Backcountry Motorized	6,698	N	N
Research Natural Area	5,704	N	N
Scenic Byways	19,109	Y	
Wilderness – Recommended	207,800	N	N
Wilderness-Congressionally Designated	31,437	N	N
*RMAs	179,236	Y—within standards and guidelines	N—vegetation management can be used as a tool to meet or maintain desired conditions, goals and objectives
Total	1,101,717		

*MAs overlay other management area and are not included in total acreage calculations.
**Acres are approximate and vary due to GIS methodology

Historic Range of Variability

Four out of nineteen structure classes are within HRV after 100 years of land management under alternative R (Table 44). Alternative R has the least number of structure and vegetation types within HRV of all alternatives. Seven structure classes are below HRV, and 8 are above. Late open structure conditions show the greatest departure from HRV. The late closed forest structure would be above HRV in 4 out of 5 vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under alternative P to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2015).

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Table 44. Vegetation and structure type within HRV modeled after 100 years of management under alternative R.

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Douglas-fir dry	@	+	+	-	+
Northern Rocky Mountain mixed conifer	-	+	@	-	@
Western hemlock/ Western redcedar	-	n/a	-	n/a	+
Subalpine fir / Lodgepole pine	+	n/a	-	n/a	+
Spruce/ Subalpine fir	-	n/a	@	n/a	+

@=within HRV; -=below HRV; +=above HRV; and n/a=structure class does not exist within this vegetation type

Vegetation Management Plan Components

Standards for fuel wood cutting, chemical application of herbicides and pesticides, and fuel chipping are included in alternative R. A guideline is included for hazard tree felling. Three guidelines in the proposed action addressing timber harvest and thinning in RMAs to move upland vegetation toward HRV, location of landings, skid trails, and staging and decking areas, and yarding activities in RMAs were changed to standards in alternative R. Standards, guidelines, and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under alternative R.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative R. Alternative R includes a stricter guideline for stubble height in greenline areas to reflect best available science, and two guidelines in the proposed action are standards in alternative R. These changes provide the framework to better manage grazing in areas critical to aquatic and riparian function toward attainment of desired conditions. Specific objectives for rangeland improvements in key watersheds that are priority for active restoration should also accelerate the pace of improvement of range infrastructure and management in RMAs. Comparison of grazing components between alternative R and other alternatives are shown in Table 45.

Table 45. Comparison of grazing plan components that are different between alternative R and other alternatives (not under INFISH).

Proposed Action and Alternative O	Alternatives R and P
RMA Guideline GM Within green-line vegetation area adjacent to all watercourses: • Do not exceed 20 percent streambank alteration; • Do not exceed 40% utilization of mean annual vegetative production on woody vegetation; • Maintain at least 4-6 inches or do not exceed 40% utilization of mean annual vegetative production on herbaceous vegetation	**MA-GDL-RMA-09** ***Recreational and permitted grazing management – green-line vegetation areas*** Within green-line vegetation area adjacent to all watercourses: • A 25 percent stream bank alteration shall not be exceeded; • A 40 percent utilization of available mean annual vegetative production on woody vegetation shall not be exceeded; • Maintain at least 6-8 inches residual stubble height and utilize no more than 40% of mean annual vegetative production

Proposed Action and Alternative O	Alternatives R and P
	on deep rooted herbaceous vegetation.
RMA Guideline GM During allotment management planning consider removal of existing livestock handling or management facilities from RMAs	**MA-STD-RMA-13*Recreational and permitted grazing management – allotment management planning*** During allotment management planning, impacts from existing livestock handling or management facilities located within riparian management areas shall be minimized or eliminated.
RMA Guideline GM Generally avoid trampling of federally listed threatened or endangered fish redds by livestock	**–MA-STD-RMA-14** ***Recreational and permitted grazing management – fish redds*** Prohibit livestock access to federally-listed threatened or endangered fish redds.

Standards, guidelines, BMPs, and restoration objectives to minimize the impact of grazing on hydrologic function and water quality are the primary mechanisms to preserve water quality and hydrologic function under alternative R.

Summary of Effects and Comparison of Other Alternatives

Alternative R provides the best protection for preservation and restoration of hydrologic function, water quality, and water uses of all alternatives. Effects of alternative R in relation to other alternatives include:

- Alternative R addresses the need for change more effectively than the no action, the proposed action, and alternatives B, and O. Through plan components and principles from ARCS-modified, and specific objectives for restoration of general watershed function across the forest, and restoration in key watersheds and RMAs, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative R.
- Wider RMA widths along intermittent streams, lakes, and ponds than the no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in the no action and alternative B.
- There are more acres of key watersheds in alternative R than in the INFISH priority network in the no action and alternative B, and the key watershed network in the proposed action. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative R would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in the no action and alternative B and the smaller key watershed network in the proposed action.
- Alternative R would accelerate improvement in watershed condition faster than the no action proposed action, and alternative B. Measurable objectives for water resources, RMAs and the expanded key watershed network would accelerate restoration and preservation of hydrologic function.
- Desired conditions are identified for general aquatic riparian and watershed condition; DCs are not identified in the no action and alternative B.
- Approximately 25% of CNF land base is in management areas where construction of new roads is prohibited. 51% of the CNF land base is within the focused restoration MA where desired condition for road density is 1 mi/mi^2.

- Approximately 22% of the CNF land base is in areas where active vegetation management is authorized; this is the least amount of acres designated for this use among all alternatives.
- Four out of nineteen structure classes are within HRV after 100 years of land management under alternative R . Alternative R has the least number of structure and vegetation types within HRV of all alternatives.
- There is a greater emphasis on grazing standards in alternative R (and alternative P), and stricter numeric criteria for stubble height in MA-GDL-RMA-09 should be more effective in moving toward desired conditions in RMAs in grazing allotments than the no action, proposed action, and alternatives B and O.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Alternative R has a stronger emphasis on standards than the proposed action, which should protect watershed function and water quality more effectively than the no action, proposed action, and alternatives B and O.
- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than in the no action and B alternative.
- Measureable objectives and focused restoration activities in alternative R would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change faster than the proposed action, and alternative B.

Alternative P

Alternative P addresses public concern that wilderness designation may result in lower revenue to local economies due to reduced recreational opportunities. Alternative P has less RW than the proposed action. Forest plan direction for watershed, aquatic, and riparian resources is the same as the R alternative.

Indirect Effects

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and acreages are the same as the proposed action and alternatives R, P, and O.

Riparian and Aquatic Plan Components

Desired conditions, objectives, standards, and guidelines are the same as alternative R.

Key Watersheds

Acres, management, and objectives in key watersheds are the same as alternative R.

Watershed and Aquatic Restoration

The pace and scale of watershed and aquatic restoration is the same as alternative R.

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Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 283,119 acres (26% of CNF) in alternative P are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Road Density Desired Condition

While existing road densities vary across management areas, desired condition for road density of ML1-5 roads is no greater than 1 mi/mi^2 in the focused restoration management area (306,092 acres, 28% of CNF), and no greater than 2 mi/mi^2 in the general restoration management area (493,267 acres, 45% of CNF). Existing road densities calculated by management area at the 5th field watershed scale for focused and general restoration management areas are shown in Table 42. There are no watersheds within the focused restoration MA where existing condition meets the desired condition of 1 mi/mi^2. There are no watersheds in the general restoration MA that meet the desired condition of 2 mi/mi^2. Measureable objectives in key watersheds and desired conditions for water resources, key watersheds, and RMAs would contribute toward reduction in road densities within the focused restoration MA, through treatment of hydrologically connected road segments (Table 46).

Table 46. Existing road density by 5th field watershed for the focused and general restoration management areas in alternative P.

Focused Restoration MA		
5th field Watershed Name	**Road Density mi/mi^2**	**Meets Road Density Desired Condition of 1 mi/mi^2?**
Boulder Creek-Kettle River	3.0	N
Curlew Creek	2.6	N
Deep Creek	3.7	N
Hall Creek-Franklin D Roosevelt Lake	5.2	N
Le Clerc Creek-Pend Oreille River	2.1	N
Sherman Creek-Franklin D Roosevelt Lake	2.8	N
Sullivan Creek-Pend Oreille River	3.7	N
Tacoma Creek-Pend Oreille River	3.2	N
Vulcan Mountain-Kettle River	3.9	N
General Restoration MA		
5th field Watershed Name	**Road Density mi/mi^2**	**Meets Road Density Desired Condition of 2 mi/mi^2?**
Boulder Creek-Kettle River	3.1	N
Chewelah Creek-Colville River	4.2	N

DRAFT

Curlew Creek	3.5	N
Deep Creek	3.4	N
Hall Creek-Franklin D Roosevelt Lake	4.3	N
Le Clerc Creek-Pend Oreille River	2.6	N
Little Pend Oreille River	3.3	N
Mill Creek	2.7	N
Onion Creek-Franklin D Roosevelt Lake	2.8	N
Sherman Creek-Franklin D Roosevelt Lake	2.8	N
Stensgar Creek-Colville River	3.0	N
Sullivan Creek-Pend Oreille River	3.0	N
Tacoma Creek-Pend Oreille River	3.9	N
Toroda Creek	2.5	N
Upper Sanpoil River	3.0	N
Vulcan Mountain-Kettle River	3.0	N
West Fork Sanpoil River	3.7	N

Road Management Plan Components

Desired conditions, objectives and standards and guidelines for roads are the same as alternative R.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber production would be allowed in management areas Focused and General Restoration areas, comprising 799,359 acres (72% of the Forest). This is less than the no action and B alternatives, similar to the proposed action and alternative O and more than alternative R. Acres treated are constrained by forest budgets, and project-level considerations. BMPs, standards, and guidelines are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Variable density thinning would be the primary tool for active commercial vegetation management in the focused and general restoration MAs in alternative P in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types in the proposed action with an estimated (modeled) treatment of 4,050 acres per year. Mechanical fuels treatments are estimated on 5,000 acres per year in these vegetation types. Mixed and light severity prescribed fire would be used in open-canopy stands on a 20 year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types with treatment modeled for 3,839 acres per year. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type with an estimated (modeled) 950 acres of treatment per year. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type with an estimated

treatment of 1040 acres per year. There are no modeled vegetation treatments in the Western redcedar/Western hemlock and spruce/subalpine fir vegetation types.

Acres of CNF lands by management area and roadbuilding and timber production authorized by management area are shown in Table 47.

Table 47. Alternative P management areas and activities authorized in each management area that can affect the hydrologic resource.

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Focused Restoration	306,134	Y 1 mi/mi^2 desired condition for road density	Y
General Restoration	493,282	Y 2 mi/mi^2 desired condition for road density	Y
Backcountry	123,055	N	N
Backcountry Motorized	54,577	N	N
Research Natural Area	5,707	N	N
Scenic Byways	19,356	Y	
*Special Interest Area	82,800	N	N
Wilderness – Recommended	68,333	N	N
Wilderness-Congressionally Designated	31,447	N	N
*RMAs	179,236	Y—within standards and guidelines	N—vegetation management can be used as a tool to meet or maintain desired conditions, goals and objectives
Total	1,101,890		

*MAs overlay other management area and are not included in total acreage calculations.
**Acres are approximate and vary due to GIS methodology

Historic Range of Variability

Number of structure classes departured from HRV is the same as the proposed action.

Vegetation Management Plan Components

Standards and guidelines for vegetation management are the same as alternative R.

Grazing

Current allotment boundaries and AUMs would continue under alternative P. Standards and guidelines for grazing management and potential indirect effects are the same as alternative R.

DRAFT

Specific objectives for rangeland improvements in key watersheds that are priority for active restoration are the same as alternatives R and O.

Summary of Effects and Comparison of Other Alternatives

Alternative P is similar to alternative R in providing protections for preservation and restoration of hydrologic function, water quality, and water uses. Alternative P would be slightly less effective than alternative R, and more effective than the no action, proposed action, and alternatives O and B.

- Similar to alternative R, alternative P addresses the need for change more effectively than the no action, the proposed action, and alternatives B, and O. Through plan components and principles from ARCS, and specific objectives for restoration of general watershed function across the forest, and restoration in key watersheds and RMAs, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative P.
- Wider RMA widths along intermittent streams, lakes, and ponds than the no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in the no action and alternative B.
- There are more acres of key watersheds in alternative P than in the INFISH priority network in the no action and alternative B, and the key watershed network in the proposed action. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative P would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in the no action and alternative B and the smaller key watershed network in the proposed action.
- Alternative P would accelerate improvement in watershed condition faster than the no action proposed action, and alternative B. Measurable objectives in the expanded key watershed network would accelerate restoration and preservation of hydrologic function.
- Desired conditions are identified for general aquatic riparian and watershed condition; DCs are not identified in the no action and alternative B.
- Approximately 26% of CNF land base is in management areas where construction of new roads is prohibited. 28% of the CNF land base is within the focused restoration MA where desired condition for road density is 2 mi/mi^2. This is less than in alternative R, and higher than in the proposed action.
- Approximately 72% of the CNF land base is in MAs where timber production is authorized. This is similar to the proposed action and alternative O, less than the no action and alternative B, and greater than alternative R.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in alternative P are more restrictive, and should protect watershed function and water quality more effectively than the no action, proposed action, and alternatives B and O.
- Six out of nineteen vegetation structure classes are within HRV after 100 years of land management in alternative P. Departure from HRV in alternative P is the same as the no action, the proposed action, and alternative B.

DRAFT

- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than in the no action and B alternative.
- Measureable objectives and focused restoration activities in key watersheds in alternative P would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change. Since the key watershed network is expanded from the proposed action in alternative R, this alternative would be more effective in increasing resiliency to climate change than the no action, the proposed action, and alternative B.

Alternative B

Alternative B combines feedback from diverse interest groups and incorporates management strategies supported by the Northeast Washington Forestry Coalition. Alternative B addresses the concerns of multiple constituencies in one alternative by designating restoration and timber management zones, recommending the highest level of wilderness designation and the least amount of area for backcountry management and backcountry motorized use.

Forest plan direction for watershed, aquatic, and riparian resources would remain the same as the no action alternative.

Indirect Effects

Riparian and Aquatic Resource Management

Acres of RHCAs

Acreage, management, and protection of RHCAs are the same as in the no action alternative.

Riparian and Aquatic Resource Plan Components

Riparian goals, riparian management objectives, standards, and guidelines are the same as the no action alternative.

INFISH Priority Watersheds

Acres and management in INFISH priority watersheds is the same as the no action alternative.

Watershed and Aquatic Restoration

The pace and scale of watershed and aquatic restoration is the same as the no action alternative.

Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 268,921 acres (24% of CNF) in alternative B are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Road Density Desired Conditions

This alternative caps total miles of National Forest System roads at the current level, about 4,000 miles, and uses a standard that would require at least one mile of road to be decommissioned when adding a mile to the system. There are no specific road density desired conditions in MAs in alternative B.

Road Management Plan Components

Desired conditions, objectives and standards and guidelines for roads are the same as the no action alternative.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber production would be allowed in the Active Management and Restoration areas, comprising 815,345 acres (74% of the Forest).

Primary Vegetation Management Tools

In alternative B, variable density thinning and shelterwood with reserves would be the primary vegetation management tools in all vegetation types with the exception of the spruce/subalpine fir type, which has no anticipated vegetation management. Prescribed fire of varying intensity is expected in the Doug-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/ lodgepole pine (wilderness only) vegetation types. Timber harvest of 2,250 acres per year is estimated (modeled) under alternative B. Mechanical fuels treatments and prescribed fire are estimated (modeled) at 2,501, and 3,839 acres per year, respectively.

Acres of management areas and roadbuilding and timber production authorized by management area are shown in Table 48.

Table 48. Alternative B management areas and activities authorized in each management area that can affect the hydrologic resource.

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Active Management Area	476,804	Y	Y
Restoration	338,541	Y	Y
Backcountry	4,835	N	N
Backcountry Motorized	6,606	N	N
Research Natural Area	5,713	N	N
Scenic Byways	17,614	Y	N
Wilderness –Recommended	220,330	N	N
Wilderness-Congressionally Designated	31,448	N	N
*RHCAs	179,236	Y, within standards and guidelines	N, except where needed to maintain or

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
			meet RMOs
Total	1,101,880		

**Acres are approximate and vary due to GIS methodology

Historical Range of Variability

Six out of nineteen structure classes are within HRV after 100 years of land management under alternative B (Table 49). The same number of structure classes are within HRV for the no action, proposed action, and alternative P. Five structure classes are below HRV, and 8 are above. The late closed forest structure would be at or above HRV in all vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under alternative B to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2015).

Table 49. Vegetation and structure type within HRV modeled after 100 years of management under alternative B.

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Douglas-fir dry	+	+	+	-	+
Northern Rocky Mountain mixed conifer	@	+	@	-	@
Western hemlock/ Western redcedar	-	n/a	@	n/a	+
Subalpine fir / Lodgepole pine	+	n/a	-	n/a	@
Spruce/ Subalpine fir	-	n/a	@	n/a	+

@=within HRV; -=below HRV; +=above HRV; and n/a=structure class does not exist within this vegetation type

Vegetation Management Plan Components

Standards and guidelines for vegetation management are the same as the no action alternative.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative B. Standards and guidelines for grazing management and potential indirect effects are the same as the no action alternative.

Summary of Effects and Comparison of Other Alternatives

Effects to hydrologic function, water quality, and water uses in alternative B is similar to the no action alternative and provides less protection to the processes that improve or preserve hydrologic function than the proposed action and alternatives R, P, and O. Alternative B would provide a slower pace of recovery of hydrologic function through passive and active restoration

DRAFT

than the proposed action and alternatives R, P, and O. Effects of alternative B in relation to other alternatives include:

- Alternative B does not adequately address the need for change in this forest plan revision; the pace of watershed restoration is not increased from current levels, watershed and riparian direction is not integrated. Specific watershed and riparian objectives in the proposed action, and alternatives R, P, and O should increase the pace and scale of watershed restoration, and improve resiliency to the potential hydrologic effects of climate change more than the no action and alternative B.
- Narrower RHCA widths along intermittent streams, lakes, and ponds are less restrictive than RMA widths in the proposed action, and alternatives R, P, and O and may not improve or preserve hydrologic and riparian function as well as wider RMA widths.
- There are fewer acres of priority watersheds in alternative B than the proposed action and alternatives R, P, and O. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in alternative B.
- Alternative B does not accelerate improvement in watershed condition; the INFISH priority network would remain and there are not specific plans to accelerate the pace of restoration in the INFISH priority watershed network. There are no measureable objectives for the INFISH priority watershed network in alternative B.
- RMOs would be used as benchmarks for evaluation of current stream conditions, even though they may not adequately account for natural variability or separate land use effects from natural disturbance.
- Desired conditions are not identified for general aquatic, riparian, and watershed condition.
- Approximately 20% of CNF land base is in management areas where construction of new roads is prohibited. The cap on existing road mileage in alternative B is not as protective as the 2 mi/mi^2 objective for the focused restoration and late forest structure MAs in the proposed action and alternatives R and P.
- Six out of nineteen vegetation structure classes are within HRV after 100 years of land management under alternative B. Departure from HRV in alternative B is the same as the no action, proposed action and alternative P.
- Standards and guidelines would not address contemporary issues of watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in alternative B may not protect watershed function and water quality as effectively as the proposed action, and alternatives R, P, and O.
- Standards for development of hydroelectric and other water use developments are less stringent in alternative B than the proposed action and alternatives R, P, and O.
- Alternative B does not increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change.

Alternative O

This alternative comes from a series of public, collaborative meetings run by the Forest Service that focused on motorized recreation, wilderness recommendations, and vegetation management and reflects areas of general agreement among participants in those meetings. The

Forest Service fully developed this alternative using the proposed action to fill in the gaps not addressed in the collaborative process.

Forest plan components, including general goals, objectives, and standards and guidelines are the same as the proposed action. RMAs are the same as the proposed action and alternatives R and P. The key watershed network, and objectives specific to key watersheds are the same as the R and P alternatives.

Indirect Effects

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and acreages are the same as the proposed action and alternatives R and P.

Riparian and Aquatic Resource Plan Components

Desired conditions, objectives, standards, and guidelines are the same as the proposed action.

Key Watersheds

Acres in key watersheds are the same as alternative R. The priority key watershed network and measureable objectives for key watersheds are the same as alternatives R and P. Standards and guidelines for key watersheds are the same as the proposed action.

Watershed and Aquatic Restoration

The pace and scale of watershed and aquatic restoration in key watersheds is the same as the proposed action. However, like the proposed action, there are no measureable objectives for general water resources, and RMA objectives are the same as the proposed action.

Roads/Access

Acres of Management Areas Where Road Building Activities are Permitted

Approximately 268,921 acres (24% of CNF) in alternative B are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Road Density Desired Conditions

There are no specific road density desired conditions in MAs in alternative O. Road direction is the same as alternative B; road miles are capped at their current level (approximately 4,000 miles).

Road Management Plan Components

Desired conditions, objectives, and standards and guidelines for roads are the same as the proposed action, however there are no specific road density desired conditions in MAs in

alternative O. Similar to the proposed action, and alternatives R and P, alternative O includes FW-STD-WR-03 which states that there would be no net increase in mileage of NFS roads in key watersheds at any time, unless doing so improves watershed condition.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber production could occur in both the Responsible Management Area and the Restoration Zone, comprising 801,124 acres (72% of the Forest).

Primary Vegetation Management Tools

Anticipated vegetation management tools and estimated (modeled) acres of treatment per year in alternative O are the same as alternative B. Acres of CNF by management area and roadbuilding and timber production authorized by management area in alternative O are shown in Table 50.

Table 50. Alternative O management areas and activities authorized in each management area that can affect the hydrologic resource.

Management Areas	Acres**	New roadbuilding authorized?	Timber Production Authorized?
Backcountry	174,311	N	N
Backcountry Motorized	53,734	N	N
Research Natural Area	5,713	N	N
Restoration	369,053	Y	Y
Responsible	431,562	Y	Y
Scenic Byways	19,607	Y	N
*Special Interest Area	99,000	N	N
Wilderness –Recommended	15,955	N	N
Wilderness-Congressionally Designated	31,436	N	N
*RMAs	179,236	Y, within standards and guidelines	N—vegetation management can be used as a tool to meet or maintain desired conditions, goals and objectives
Total	1,101,370		

*MA overlays other management area and is not included in total acreage calculations.
**Acres are approximate and vary due to GIS methodology

Historic Range of Variability

Eight out of nineteen structure classes are within HRV after 100 years of land management under alternative O; this is the most structure classes within HRV of all alternatives (Table 51).

Four structure classes are below HRV, and 7 are above. Late and mid-open structure conditions show the greatest departure from HRV. The late closed forest structure would be at or above HRV in all vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under alternative O to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistance to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2015).

Table 51. Vegetation and structure type within HRV modeled after 100 years of management under alternative O.

Vegetation Type	Early Structure	Mid-open Structure	Mid-closed Structure	Late Open Structure	Late Closed Structure
Douglas-fir dry	+	+	+	-	+
Northern Rocky Mountain mixed conifer	@	+	@	-	@
Western hemlock/ Western redcedar	-	n/a	@	n/a	+
Subalpine fir / Lodgepole pine	@	n/a	@	n/a	@
Spruce/ Subalpine fir	-	n/a	@	n/a	+

@=within HRV; -=below HRV; +=above HRV; and n/a=structure class does not exist within this vegetation type

Vegetation Management Plan Components

Standards and guidelines for vegetation management are the same as the proposed action.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative O. Standards and guidelines to move streams and RHCAs toward attainment of RMOs and indirect effects are the same as the proposed action. Specific objectives for rangeland improvements in key watersheds that are priority for active restoration are the same as alternatives R and P.

Summary of Effects and Comparison of Other Alternatives

Alternative O is similar to the proposed action in providing protections for preservation and restoration of hydrologic function, water quality, and water uses. Alternative O would be less effective than alternatives R and P, and more effective than the no action and alternative B. Effects of alternative O in relation to other alternatives include:

- Similar to the proposed action, alternative O addresses the need for change more effectively than the no action, and alternative B. Through plan components and principles from ARCS, and specific objectives for restoration in key watersheds, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative O. Alternative O does not address the need for change as effectively as alternatives P and R.
- Wider RMA widths along intermittent streams, lakes, and ponds than the no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in the no action and alternative B.

DRAFT

- There are more acres of key watersheds in alternative O than in the INFISH priority network in the no action and alternative B, and the key watershed network in the proposed action. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative O would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in the no action and alternative B and the smaller key watershed network in the proposed action.
- Alternative O would accelerate improvement in watershed condition faster than the no action, proposed action, and alternative B. Measurable objectives in the expanded key watershed network would accelerate restoration and preservation of hydrologic function.
- Desired conditions are identified for general aquatic riparian and watershed condition; DCs are not identified in the no action and alternative B.
- Approximately 26% of CNF land base is in management areas where construction of new roads is prohibited. The cap on existing road mileage in alternative O is not as protective as the 2 mi/mi^2 objective for the focused restoration and late forest structure MAs in the proposed action and alternatives R and P.
- Eight out of nineteen vegetation structure classes are within HRV after 100 years of land management under alternative O. Alternative O has the most structure classes within HRV of all alternatives.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in alternative O should protect watershed function and water quality more effectively than the no action and alternative B. Standards and guidelines in alternative O are less restrictive than in alternatives R, and P.
- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than in the no action and B alternative.
- Measureable objectives and focused restoration activities in key watersheds in alternative O would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change. Since the key watershed network is expanded from the proposed action in alternative O, this alternative would be more effective in increasing resiliency to climate change than the no action, the proposed action, and alternative B.

Comparison of Key Indicators between Alternatives

Table 52. Comparison of key indicators between alternatives.

Element	No Action	Proposed Action	Alternative R	Alternative P	Alternative O	Alternative B
RHCA/RMA acreage	150,692 acres	179,236 acres	179,236 acres	179,236 acres	179,236 acres	150,692 acres
Acres CNF ownership of Priority/Key watersheds	214,283 acres; 19% CNF ownership	371,943 acres; 34% CNF ownership	451,525 acres; 41% CNF ownership	451,525 acres; 41% CNF ownership	451,525 acres; 41% CNF ownership	214,283 acres; 19% CNF ownership
Estimated miles of road treated	51 miles	68 miles	108 miles	108 miles	68 miles	51 miles
Estimated number of	15 crossings	36 crossings	95 crossings*	95 crossings*	36 crossings	15 crossings

Element	No Action	Proposed Action	Alternative R	Alternative P	Alternative O	Alternative B
crossings where passage is improved						
Estimated miles of in-stream channel improvements	54 miles	70 miles	86 miles*	86 miles*	70 miles	54 miles
Estimated acres of range infrastructure improvement	70	240	240*	240*	240	70
Estimated acres of treatment of upland vegetation in RMAs to move toward HRV	75-150	450-950	600-1,200*	600-1,200*	450-950	75-150
Number of subwatersheds where conditions are improved	7	12	15*	15*	12	7
Acres where road building is prohibited	218,266 acres 20% CNF ownership	291,096 acres; 26% CNF ownership	271,931 acres; 25% CNF ownership	283,199 acres; 26% CNF ownership	268,921 acres; 24% CNF ownership	268,921 acres; 24% CNF ownership
Acres with 1 mi/mi^2 road density objective	n/a	n/a	565,565 acres; 51% CNF ownership	306,092 acres; 28% CNF ownership	n/a	n/a
Acres with 2 mi/mi^2 road density objective	n/a	257,157 acres; 23% CNF ownership	245,110 acres; 22% CNF ownership	493,267; 45% CNF ownership	n/a	n/a
Acres with 3 mi/mi^2 road density objective	n/a	533,892 acres; 48% CNF ownership	n/a	n/a	n/a	n/a
Other road restrictions	Road density desired conditions for ML 2-5 range from 0.4-2 mi/mi^2. No desired conditions for ML 1 roads	No net increase in NFS road mileage in key watersheds	No net increase in NFS road mileage in key watersheds No net increase in NFS road miles in RMAs in a subwatershed	No net increase in NFS road mileage in key watersheds No net increase in NFS road miles in RMAs in a subwatershed	No net increase in NFS road mileage in key watersheds; Cap on existing road mileage	Cap on existing road miles
Acres where active mechanical vegetation management is authorized	885,318 acres; 80% CNF ownership	790,987 acres; 71% CNF ownership	245,110 acres; 22% CNF ownership	799,359 acres; 72% CNF ownership	801,124 acres; 72% CNF ownership	815,345 acres; 74% CNF ownership
Number of vegetation structure classes within HRV after 100 years	6	6	4	6	8	6

*Total includes estimates from water resource objectives for both key watersheds, and non-key watersheds.

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Cumulative Effects

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The five subbasins with CNF ownership also have private, federal, tribal, state, or county ownership outside of the CNF boundary. Many of the impacts to hydrologic function and water quality on the CNF are from activities occurring on lands under other ownership. Impacts include roads, grazing, mining, development, timber management, dams and diversions, hydropower production and development. All alternatives would maintain or improve hydrologic function, water quality, and water uses, which helps mitigate the effects of off-forest activities.

Past management activities and disturbance on CNF lands including timber harvest, grazing, road building and wildland fire can have cumulative effects on the hydrologic system. Impacts to hydrologic function and water quality from past management includes soil compaction, erosion and sedimentation in stream banks and channels, alteration of riparian vegetation, channel widening and incision, and loss of stream channel complexity and function. Upland and stream channel recovery from disturbance takes decades, and sometimes centuries to recover to a properly functioning condition, however changes in aquatic management across Region 6 have improved conditions (Archer 2014). Aquatic direction in INFISH was intended to reverse aquatic and riparian degradation from management activities, and significantly changed the management of aquatic resources on NFS lands in the Pacific Northwest (Heller and McCammon 2004).

Active partnerships with state, county, federal, tribal and non-profit organizations would continue, and restoration of hydrologic and aquatic function on off-forest lands would continue.

Water Availability

Water availability is discussed at the subbasin scale in this analysis because the water provided by the CNF is an important component of water availability for more intensive downstream uses, and downstream water uses can cumulatively impact water uses and availability on the Colville National Forest. While consumptive uses in the name of the CNF are a small percentage (<1%) of uses at the subbasin scale, water uses as well as the water supplied from the CNF is upstream of more intensive consumptive uses. Ecology released analyses on the availability of water for the 5 major subbasins (6 WRIAs) on the CNF in 2012 that provide general information on the availability of water for new consumptive uses.

Below is a general discussion of water availability in each subbasin, including adjudications, surface water source limitations (SWSLs), other factors affecting water availability and the issuance of new water rights. Adjudication is a legal process to determine who has a valid water right, how much water can be used, and who has priority during shortages. The adjudication process accounts for water needed for resource use, protection and planning, and transfer of water rights (WADoE 2014(e)). SWSLs are recommended by Department of Fish and Wildlife to protect flows to maintain fish populations and can either specify that the limitations apply at low-flow or that waters are closed to new uses (RCW 77.57.020). Adjudications and surface water limitations in each WRIA are shown in Table 52 and Figure 19.

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Table 53. Adjudications and surface water limitations for WRIAs on the CNF.

WRIA Name and Number	Adjudications*	Low Flow Surface Water Source Limitations	Surface Water Source Limitations Closure
Colville 59	Bulldog Creek, Chewelah Creek, Deer Creek, Hoffman Creek, Jumpoff Joe Creek/Lake, Narcisse Creek, Sherwood Creek, Spring Creek, and Thomason Creek		
Kettle 60	Twin Creek and Myers Creek	All of the WRIA not closed by SWSL	Curlew Creek, Goosmus Creek, Lambert Creek, Little Goosmus Creek, Sand Creek; portions of Tonasket Creek, Torada Creek, and Toulou Creek
Middle Lake Roosevelt 58	Alder Creek, Corus Creek, Cheweka Creek, Jennings Creek, Harvey Creek, Magee Creek, O-Ra-Pak-En Creek, Quilisascut Creek, Stranger Creek	All of the WRIA not closed by SWSL	Ninemile Creek, North Fork of Hall Creek
Pend Oreille 62	Renshaw Creek, Little Calispel Creek, Marshall Creek/Lake	All of the WRIA not closed by SWSL	Davis Creek, Harvey Creek, Indian Creek, Maitlen Creek, and Skookum Creek and portions of Bracket Creek and East Fork of Smalle Creek
Sanpoil 52		All of the WRIA	
Upper Lake Roosevelt 61	Pingston Creek	All of the WRIA not closed by SWSL	Deep Creek, Onion Creek, and Williams Lake

*Generally most of the water has been appropriated in adjudicated basins, and new appropriations are not available (WADoE 2012(d)).

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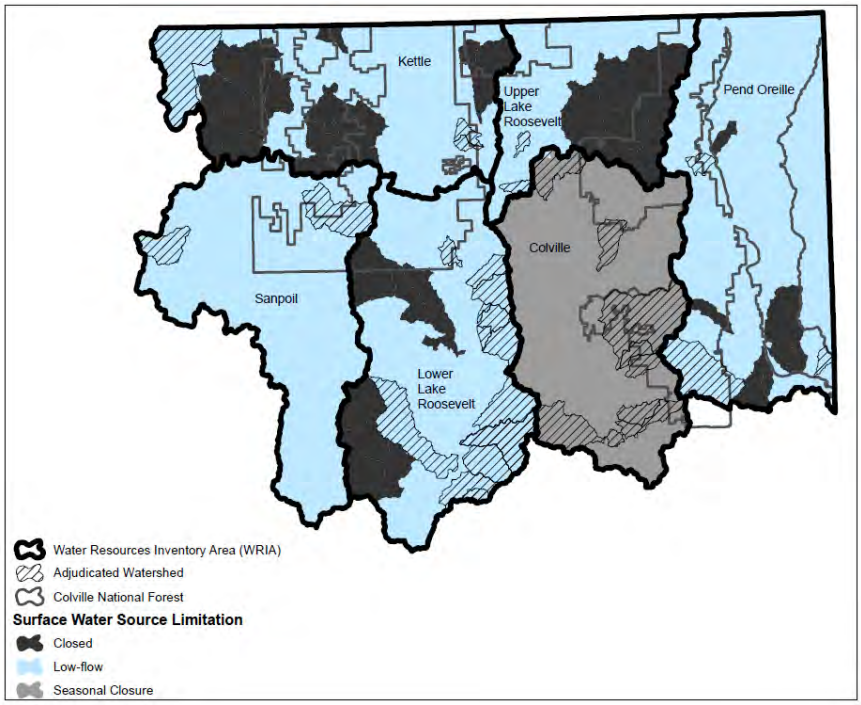

Figure 19. Surface water source limitation areas and adjudicated watersheds on and within subbasins with CNF ownership.

Across subbasins on the CNF, the majority of precipitation occurs during the winter months, when demand is lowest. In summer, rain is infrequent and streams are dependent on groundwater to maintain low or baseflows. Groundwater availability and yield is limited by both climate and geology—only 3% of streams across the CNF are considered groundwater systems (Reidy-Liermann et al, 2012), and groundwater-dependent ecosystems including seeps and springs make up considerably less than 1% of CNF lands (NHD spatial data). Therefore surface water is least available when demand for water is highest (WADoE 2012(a-f)).

Within the Pend Oreille WRIA Ecology is in the process of considering the establishment of streamflow requirements in areas of the WRIA that are restricted or closed to new uses or are expected to experience increased pressure based on population growth and climate change. Flow studies have been initiated on the South Fork of Kalispell and Indian Creek (WADoE 2012(d)). The Kalispel Indian Reservation is located in this WRIA, and there are tribal concerns about maintaining flows for fish habitat. Federally Reserved Rights have not been quantified in this WRIA, therefore the legal availability of this water has not been determined (WADoE 2012(d)).

The Colville WRIA has an instream flow regulation establishing base flows to protect beneficial uses and protect senior water rights (WAC 173-559-030). Tributaries of the Colville River are closed to further consumptive appropriation except for reservoir storage, from November 1 through May 31 and in-house single domestic supply if an alternative source is not available (WADoE 2012(a)). The Upper and Lower Colville River is closed to further consumptive appropriation from July 16-September 30.

The WRIA 59 (Colville River) Water Resource Management Board, which consists of local citizens, local, state, and federal agencies (including the CNF) has been working on watershed planning activities in the Colville River Watershed over the past 15 years. Key activities of the Water Resource Management Board include development of a watershed implementation plan, an instream flow study, and research on water storage projects to meet future water needs.

While the Middle Lake Roosevelt is not closed to new water uses, the majority of water is appropriated, and new uses are subject to SWSLs. Adjudicated basins within this WRIA have annual water shortages (WADoE 2012(c)).

The Sanpoil WRIA is not closed to new water uses, however the majority of water is appropriated, and new uses are subject to SWSLs. There are no adjudicated watersheds in the Sanpoil WRIA (WADoE 2012(e)). Federally Reserved Rights are not quantified in the Sanpoil WRIA, however it is likely new appropriations in the lower Sanpoil River would impact Federal Reserved Water Rights of the Colville Indian Tribe (which owns the majority of the lower subbasin). Future surface water applications for single domestic or stockwatering may be approved if there is no alternative source of water supply, and the use would not affect existing Federal Reserved Rights (WADoE 2012(e)). The doctrine of reserved water rights has evolved to ensure that Indian reservations and other federal lands would have sufficient water to fulfil the purpose for which they were established. Federal reserved rights have a priority date of when the lands were set aside, in contrast to state-based appropriative rights which have a priority date of when the water was first put to beneficial use.

The Draft Forest Plan addresses water availability primarily through increasing ecological function and resiliency. Forest practices that increase and preserve watershed and riparian function, including best management practices, forest plan components (desired conditions, objectives, standards, and guidelines), and vegetation management activities that increase resiliency to disturbance are expected to improve landscape resiliency to low flows.

The revised forest plan includes components to improve and restore hydrologic function, which allows the landscape to hold water longer and release water slower in the summer months when streamflow is low. Desired conditions for water resources provide the framework for hydrologic function, and implementation of the revised forest plan would move the CNF toward these desired conditions. Watershed restoration objectives outline specific activities that would improve landscape function and resiliency. In addition, the revised forest plan includes a robust set of standards and guidelines for protection of water resources and riparian management areas.

Water Rights

Applications, claims, certificates, and permits for WRIAs with CNF administrative forest ownership are shown in Table 53. Within the 6 WRIAs, the majority of consumptive certificated water rights are located off the CNF.

Table 54. Number of applications, claims, certificates, and permits for WRIAs within the CNF.

WRIA Name and Number	Applications	Claims	Permits	Certificates
Colville 59	56	2,728	50	1,495

WRIA Name and Number	Applications	Claims	Permits	Certificates
Kettle 60	13	1,067	21	656
Middle Lake Roosevelt 58	9	742	16	657
Pend Oreille 62	11	1,049	72	691
Sanpoil 52	16	529	5	221
Upper Lake Roosevelt 61	18	548	5	305

Climate Change

The existing forest plan does not address the potential effect of climate change. Integrated management direction that provides flexibility and increased resiliency to respond to a changing environment is one the primary needs for change driving this forest plan revision process. Climate change is expected to affect physical hydrologic processes including the amount, timing, and type of precipitation. Changes in snowpack, (Hamlet et al. 2005) and timing of snowmelt are also expected, which can affect streamflow (Mantua et al, 2010) and temperature (Isaak et al. 2011, Luce et al 2014). Changes in climate would also affect forest vegetation which may have additional impacts on hydrologic processes and water available for consumptive uses and ecological and biological values (Adams et al 2012).

A climate change vulnerability assessment of hydrologic resources on the CNF is presented here. This analysis identifies key water resource values on the CNF that may be altered through climate change. This analysis focuses on vulnerable infrastructure and water resource values for consumptive uses and analyzes how potential change in hydrologic variables from climate change may impact these resources.

Water Uses

Water uses are key resource to focus climate change vulnerability assessment for the CNF because changes in timing and quantity of flows could affect multiple uses of water. Consumptive water uses on the CNF are a small proportion of consumptive uses at the subbasin scale. The primary climate change mechanisms with the potential to affect water uses both on and off the CNF are changes in the timing and amount of precipitation falling as snow, and the timing of snowmelt.

Snowpack

Loss of snowpack in the Pacific Northwest (PNW) is one of the most certain aspects of climate change (Kapnick and Hall 2012, Mote et al. 2005). Increasing temperatures across the PNW over the last 50 years have caused more precipitation to fall as rain, reduced spring snowpack and earlier snowmelt. The sensitivity of snowpack across the CNF was assessed using data from Kramer and Snook (2014) that analyzed snowpack data from the Snow Data Assimilation System (SNODAS) (NOHRSC 2004). SNODAS integrates ground, airborne, and satellite snow observations with weather prediction models to produce 1-km resolution daily snow data. Snow water equivalent (SWE) on April 1 (when snowpack is at its peak) SNODAS data from 2003-2012 was used to spatially classify and characterize snowpack sensitivity (USDA Forest Service, 2014(a)). April 1 SWE was classified based in differences in snowpack between warmer, drier El Nino and cooler, wetter La Nina years to spatially project potential changes in snowpack under a warmer climate scenario.

Classification of snowpack vulnerability and acres of CNF administrative forest in each category are shown in Table 54 and Figure 20.

Table 55. SWE classification and acres of CNF administrative forest within each category (Kramer and Snook 2014).

SWE Category	Description	Acres of CNF Administrative Forest	% CNF Administrative Forest Acres
No Snow	No snow on April 1	141,917	10%
Ephemeral Snow	April 1 SWE was less than 1.5 inches during warm dry years, and greater than 1.5 inches in cold wet years.	819,575	60%
Persistent-Most Sensitive	The timing of peak snowmelt in the warmest, driest years occurred more than 30 days earlier that the coldest, wettest years.	249,422	19%
Persistent-Least Sensitive	Timing of peak snowmelt occurred less than 30 days earlier in warm, dry years than cold, wet years.	147,837	11%

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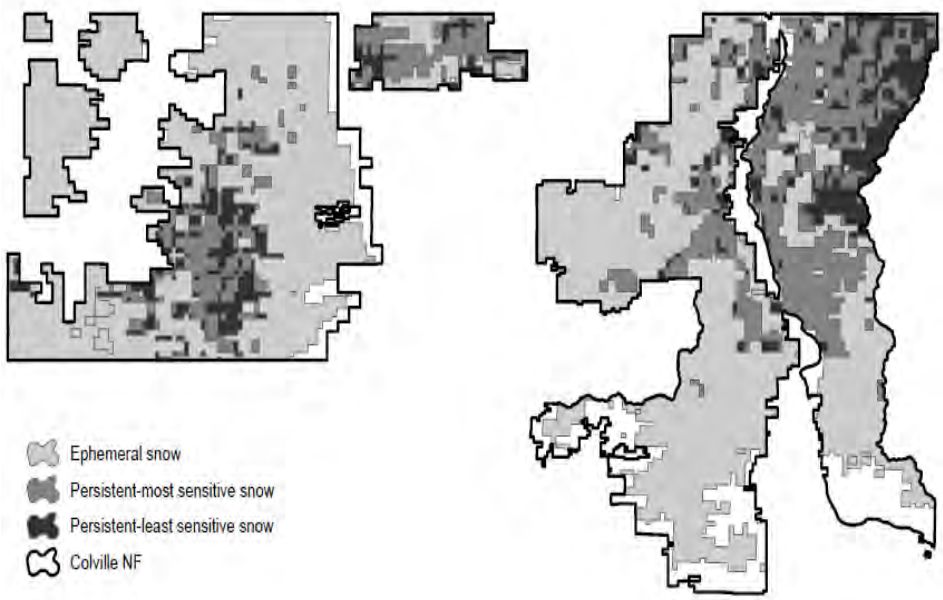

Figure 20. Snowpack sensitivity on the CNF (Kramer and Snook, 2014).

Snowpacks classified as persistent least-sensitive to warmer temperatures are located along the crests of the Kettle and Selkirk mountains. Mountain snowpacks are most sensitive to warmer temperatures in the mid-elevation bands in the Kettle and Selkirk Mountains. The majority of the CNF administrative forest is in the ephemeral snow zone where April 1 snowpack is generally not large enough to have high inter-annual variability. Snow in this zone is not as critical for sustained runoff during spring snowmelt, because snow generally melts before peak snowmelt. The ephemeral snow zone would likely see the greatest transition from snow to rain in warmer conditions.

Changes in snow accumulation and the timing of snowmelt have potential implications for decreases in summer low flows when flows are critical to satisfy consumptive water uses as well as in-stream flow and habitat requirements.

Low Flow Analysis

Summer low flows are influenced by the timing of snowmelt as well as physical landscape properties including geology, vegetation, and degree of watershed alteration from roads and other disturbances. These factors influence the process of converting precipitation into discharge (Safeeq et al. 2013).

The western US streamflow metric dataset was developed by Wenger et al. (2010) using daily simulations of the variable infiltration capacity (VIC) macro-scale hydrologic model Projections of future low flow using the VIC hydrologic model (Wenger et al. 2010) were used to assess potential change in summer low flow on perennial streams across the CNF using the NHD plus stream layer.

Percent change in mean summer flow (cfs) from historic data was calculated for the 2040 and 2080 warming scenarios. The magnitude of change in summer low flow is projected to be less than in other regions across the Pacific Northwest east of the Cascade Mountain Range. Miles of stream within each percent change category are shown graphically in Figure 21, and summarized in Table 55.

Table 56. Percent change in mean summer flow (cfs) from historic data and perennial stream mileage within each category under the 2040 and 2080 warming scenarios.

Percent change	Change Category	Vulnerability	2040 Miles	2080 Miles
>(-10)	1	Low	1,879	241
-10-(-20)	2	Moderate	2,220	2,815
>(-20)	3	High	26	1,069

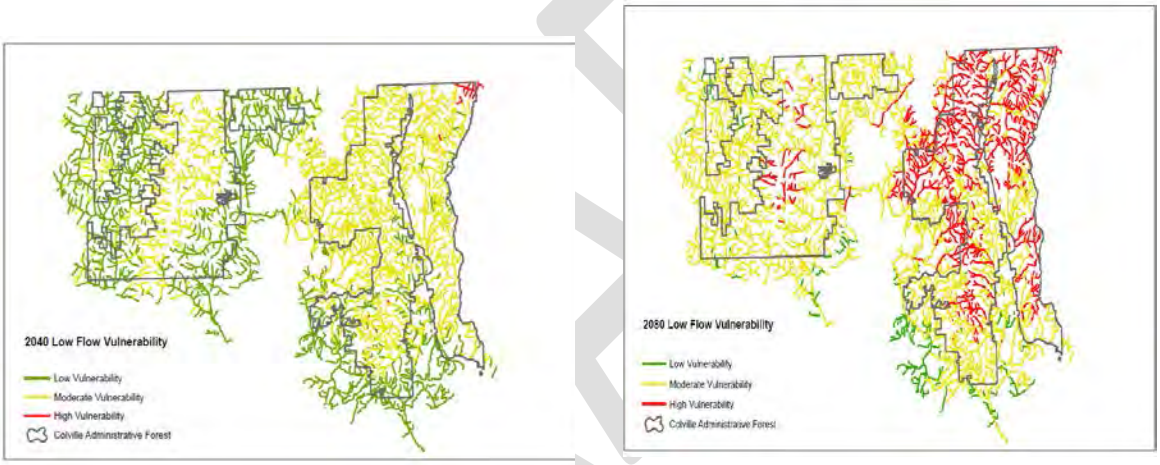

Figure 21. Stream low flow vulnerability for the 2040 and 2080 warming scenarios.

Potential decreases in summer low flows are relatively minor under 2040 projections with increases in low flow vulnerability in 2080. In 2040, the greatest vulnerability is in the Salmo-Priest Wilderness—where elevations are the highest, however only 26 miles of stream are within this category. Most streams are at moderate risk for reduction in low flows, with lower risk in the western portion of the CNF. In 2080, 1,069 miles of stream are projected to have a high risk decreased summer flow (>20% change in low flow) compared to 26 miles in 2040. Low flow vulnerability in 2080 is highest in the Selkirk Range, and on the Kettle Crest.

Infrastructure Risk

Hydrologic changes as a result of climate change may impact the infrastructure system on the CNF through reduced and earlier runoff of snowpack resulting in earlier use of roads, higher peak flows and flood risk, and reduced low-flows in summer.

Projected change in bankfull flow magnitude (cfs) was used in this analysis to assess potential risks to roads located near perennial streams. Stream reaches within 300ft of roads administered by the CNF were used to determine miles of road at risk under the 2040 and 2080 warming scenarios using VIC data (Table 56 and Figure 22). While there are several factors that affect the vulnerability of infrastructure to high flows, roads near perennial streams were selected for this analysis because roads in valley-bottoms adjacent to the stream network increases infrastructure sensitivity to flooding, channel migration, and bank erosion. Most existing stream crossings are aging culverts that are vulnerable to flood peaks and associated sediment and debris. Bankfull flows are projected to increase in 2040, with greater magnitude changes projected for 2080.

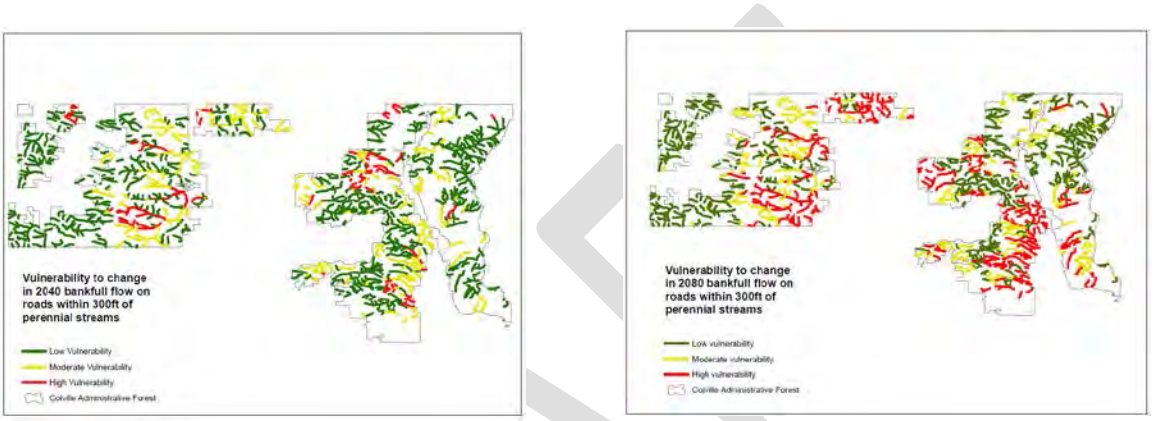

Figure 22. Infrastructure vulnerability to increases in bankfull flow for 2040 and 2080.

Table 57. Projected vulnerability of roads within 300ft of perennial streams for 2040 and 2080 categorized by percent increase in bankfull flows from VIC data.

Percent change	Change Category	Vulnerability	2040 Miles of Vulnerable Road	2080 Miles of Vulnerable Road
<0-10	1	Low	1,081	785
10-20	2	Moderate	372	346
>(-20)	3	High	142	464
Total			**1,595**	**1,597**

Adaptation to Climate Change

All alternatives in this analysis have components to adaptively manage hydrologic resources to respond to hydrologic changes in climate. The proposed action and alternatives R, P, and O address climate change through inclusion of desired conditions that address hydrologic and aquatic processes to improve resiliency to climate change. The no action and alternative B include riparian goals and RMOs included in INFISH that do not address the need for change based on climate change as effectively as the proposed action and alternatives R, P, and O.. While riparian goals in INFISH address the function and processes that improve climate change resiliency, the narrow RMOs do not provide the same flexibility for adaptive management as the aquatic and riparian plan components in the proposed action and alternatives R, P, and O. In addition, most aquatic and riparian objectives in alternatives R and P (ARCS-modified), and to a lesser extent in the proposed action and alternative O (ARCS) have prioritized potential

restoration treatments of roads, culverts, and recreation sites based on spatial analysis of vulnerability of these resources to changes in peak and low flows. Several other aquatic and riparian objectives respond to climate change vulnerability through increasing resiliency of the landscape through in-stream restoration, improvement of range infrastructure, and treatment of upland vegetation in RMAs. Standards and guidelines under alternatives R and P, and to a lesser extent, the proposed action and alternative O provide the framework to respond to changes in climate, including MA-STD-RMA-10, in which new or replaced culverts would accommodate a 100-year flow with associated bedload and debris. As the magnitude of 100-year flows change over time, calculation of this figure may also change, however this standard would still remain applicable.

No Action Alternative Cumulative Effects

The no action alternative would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in focus and priority watersheds (designated through the WCF process), and to a lesser degree in INFISH priority watersheds as funding and partnership opportunities are available. The no action alternative would help mitigate potential effects from off-forest activities with the potential to affect hydrologic function, water quality, and water uses. Focused restoration activities would improve resiliency of infrastructure to climate change. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, the No Action alternative would improve hydrologic function and be responsive to climate change, but may not be as effective as the proposed action, and alternatives R, P, and O.

Proposed Action Cumulative Effects

The proposed action would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 11 key watersheds designated as priorities for restoration. The proposed action expands the key watershed network from the INFISH priority network. The proposed action includes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Additional desired conditions, goals, objectives, standards, and guidelines in the proposed action would improve and preserve aquatic function and water quality. The proposed action also includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, the proposed action would improve hydrologic function and be responsive to climate change, but may not be as effective as alternatives R and P.

Alternative R Cumulative Effects

Alternative R would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative R expands the key watershed network from the INFISH priority network and the key watershed network in the proposed action. Alternative R proposes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Desired conditions, goals, objectives, standards, and guidelines in alternative R were updated to better preserve and improve aquatic function and water quality. Alternative R includes standards for development of hydroelectric and other

water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, alternative R is the most effective alternative for improvement of hydrologic function and responsiveness to climate change.

Alternative P Cumulative Effects

Similar to alternative R, alternative P would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative P expands the key watershed network from the INFISH priority network and the key watershed network in the proposed action. Alternative P proposes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Desired conditions, goals, objectives, standards, and guidelines in alternative P were updated to better preserve and improve aquatic function and water quality. Alternative P includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, alternative P would improve hydrologic function and be responsive to climate change, but may not be as effective as alternative R.

Alternative B Cumulative Effects

Alternative B would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in focus and priority watersheds (designated through the WCF process), and to a lesser degree in INFISH priority watersheds as funding and partnership opportunities are available. Alternative B would help mitigate potential effects from off-forest activities with the potential to affect hydrologic function, water quality, and water uses. Focused restoration activities would improve resiliency of infrastructure to climate change. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, alternative B would improve hydrologic function and be responsive to climate change, but may not be as effective as the proposed action, and alternatives R, P, and O.

Alternative O Cumulative Effects

Alternative O would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative O expands the key watershed network from the INFISH priority network. Alternative O includes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Additional desired conditions, goals, objectives, standards, and guidelines in the proposed action would improve and preserve aquatic function and water quality. Alternative O also includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the CNF, alternative O would improve hydrologic function and be responsive to climate change, but may not be as effective as alternatives R and P.

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Acronyms

AEC: Aquatic Ecological Condition
ARS: Aquatic Restoration Strategy
BA: Biological Assessment
BE: Biological Evaluation
BMPs: Best management practices
CD: Congressionally Designated
CNF: Colville National Forest
CWA: Clean Water Act
EMP: Effectiveness Monitoring Program
EPA: Environmental Protection Agency
ESA: Endangered Species Act
FERC: Federal Energy Regulatory Commission
FGDC: Federal Standards for Delineation of Hydrologic Unit Boundaries
GDE: Groundwater-dependent ecosystems
GRAIP: Geomorphic Roads Analysis and Inventory Package
ICBEMP: Interior Columbia Basin Ecosystem Management Project
INFISH: Inland Native Fish Strategy
NHD: National Hydrography Dataset
NFS: National Forest System
NWI: National Wetlands Inventory
ODW: Office of Drinking water
PACFISH: Interim Strategy for managing fish-producing watersheds in eastern Oregon and Washington, Idaho and portion of California
RW: Recommended Wilderness
PIBO: PACFISH INFISH Biological Opinion
POD: Point of diversion
POU: Purpose of use
RCW: Revised Code of Washington
RHCA: Riparian habitat conservation area
RMA: Riparian management area
SDRR: Storm Damage Risk Reduction
SNODAS: Snow data assimilation system
SWAP: Source Water Assessment Program
SWAT: Sanpoil watershed action team
SWPA: Source water protection area
SWS: Subwatershed
SWSL: Surface Water Source Limitations
TMDL: Total Maximum Daily Load
WAC: Washington Administrative Code
WADoE: Washington Department of Ecology “Ecology” throughout this document
WAP: Watershed action plan
WDFW: Washington Department of Fish and Wildlife
WQA: Water quality assessment
WQIP: Water quality implementation plan
WRIA: Water resource inventory area

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Appendices

Appendix A

Relevant Laws, Regulations, and Policy

Federal Statutes

The following is a partial listing of relevant laws which have been enacted by Congress. A Federal statute, or law, is an act or bill which has become part of the legal code through passage by Congress and approval by the President (or via congressional override). Although not specified below, many of these laws have been amended.

Bankhead-Jones Farm Tenant Act of July 22, 1937 - Directed the Secretary of Agriculture to develop a program of land conservation and utilization in order to correct maladjustments in land use and thus assist in such things as control of soil erosion, reforestation, preservation of natural resources, and protection of fish and wildlife.

Clean Water Act (see Federal Water Pollution Control Act)

Emergency Flood Prevention (Agricultural Credit Act) Act of August 4, 1978 - Authorizes the Secretary of Agriculture to undertake emergency measures for runoff retardation and soil-erosion prevention, in cooperation with land owners and users, as the Secretary deems necessary to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or other natural occurrence is causing or has caused a sudden impairment of that watershed.

Endangered Species Act of 1973, as amended - Authorizes the determination and listing of species as endangered and threatened; prohibits unauthorized taking, possession, sale, and transport of endangered species; authorizes the assessment of civil and criminal penalties for violating the Act or regulations; and, authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the Act or any regulation issued there under. Section 7 of the Act requires Federal agencies to use their authorities to carry out programs for the conservation of endangered and threatened species and to insure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Federal Land Policy and Management Act of October 21, 1976 - Requires that public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use. Also states that the United States shall receive fair market value of the use of the public lands and their resources unless otherwise provided for by law.

Federal-State Cooperation for Soil Conservation Act of December 22, 1944 - Authorized the adoption of eleven watershed improvement programs in various states for the improvement of water runoff, water flow retardation, and soil erosion prevention.

Federal Water Pollution Control Act and Amendments of 1972 (Clean Water Act) - Enacted to restore and maintain the chemical, physical, and ecological integrity of the Nation's waters.

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Provides for measures to prevent, reduce, and eliminate water pollution; recognizes, preserves, and protects the responsibilities and rights of States to prevent, reduce, and eliminate pollution, and to plan the development and use (including restoration, preservation, and enhancement) of land and water resources; and provides for Federal support and aid of research relating to the prevention, reduction, and elimination of pollution, and Federal technical services and financial aid to state and interstate agencies and municipalities for the prevention, reduction, and elimination of pollution.

Established goals for the elimination of water pollution; required all municipal and industrial wastewater to be treated before being discharged into waterways; increased Federal assistance for municipal treatment plant construction; strengthened and streamlined enforcement policies; and expanded the Federal role while retaining the responsibility of States for day-to-day implementation of the law.

Federal Water Project Recreation Act of July 9, 1965 - Requires that recreation and fish and wildlife enhancement opportunities be considered in the planning and development of Federal water development.

Forest and Rangeland Renewable Resources Planning Act of August 17, 1974 - Directs the Secretary of Agriculture to prepare a Renewable Resource Assessment every ten years; to transmit a recommended Renewable Resources Program to the President every five years; to develop, maintain, and, as appropriate, revise land and resource management plans for units of the National Forest System; and to ensure that the development and administration of the resources of the National Forest System are in full accord with the concepts of multiple use and sustained yield.

Healthy Forests Restoration Act of 2003 (H.R. 1904) - Purposes are to reduce wildfire risk to communities and municipal water supplies through collaborative hazardous fuels reduction projects; to assess and reduce the risk of catastrophic fire or insect or disease infestation; to enhance efforts to protect watersheds and address threats to forest and rangeland health (including wildfire) across the landscape; to protect, restore, and enhance forest ecosystem components such as biological diversity, threatened/endangered species habitats, enhanced productivity.

Joint Surveys of Watershed Areas Act of September 5, 1962 - Authorizes and directs the Secretaries of the Army and Agriculture to make joint investigations and surveys of watershed areas in the United States, Puerto Rico, and the Virgin Islands, and to prepare joint reports setting forth their recommendations for improvements needed for flood prevention, for the conservation, development, utilization, and disposal of water, and for flood control.

Knutson-Vandenberg Act of June 9, 1930 -Authorizes the Secretary of Agriculture to establish forest tree nurseries; to deposit monies from timber sale purchasers to cover the costs of planting young trees, sowing seed, removing undesirable trees or other growth, and protecting and improving the future productivity of the land; and to furnish seedlings and/or young trees for the replanting of burned-over areas in any National Park.

Land and Water Conservation Fund Act of September 3, 1964 - Authorizes the appropriation of funds for Federal assistance to States in planning, acquisition, and development of needed land and water areas and facilities and for the Federal acquisition and development of certain lands and other areas for the purposes of preserving, developing, and assuring accessibility to outdoor recreation resources.

National Forest Management Act of October 22, 1976 - The National Forest Management Act reorganized, expanded, and otherwise amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on National Forest System lands. The National Forest Management Act requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. It is the primary statute governing the administration of National Forests.

National Forest Roads and Trails Act of October 13, 1964 - Authorizes the Secretary of Agriculture to provide for the acquisition, construction, and maintenance of forest development roads within and near the National Forests through the use of appropriated funds, deposits from timber sale purchasers, cooperative financing with other public agencies, or a combination of these methods. The Act also authorizes the Secretary to grant rights-of-way and easements over National Forest System lands.

Organic Administration Act of June 4, 1897 - Authorizes the President to modify or revoke any instrument creating a national forest; states that no national forest may be established except to improve and protect the forest within its boundaries, for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States. It authorizes the Secretary of Agriculture to promulgate rules and regulations to regulate the use and occupancy of the national forests.

Multiple-Use Sustained-Yield Act of June 12, 1960 - States that it is the policy of Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes, and authorizes and directs the Secretary of Agriculture to develop and administer the renewable surface resources of the national forests for the multiple use and sustained yield of products and services.

Mining and Minerals Policy Act of December 31, 1970 - States that it is the policy of the Federal government to foster and encourage the development of economically sound and stable domestic mining, minerals, metal, and mineral reclamation industries; the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs; mining, mineral, and metallurgical research to promote the wise and efficient use of our natural and reclaimable mineral resources; and the study and development of methods for the disposal, control, and reclamation of mineral waste products and the reclamation of mined land.

National Environmental Policy Act of January 1, 1970 - Directs all Federal agencies to consider and report the potential environmental impacts of proposed Federal actions, and established the Council on Environmental Quality.

Safe Drinking Water Amendments of November 18, 1977 - Amended the Safe Drinking Water Act to authorize appropriations for research conducted by the Environmental Protection Agency relating to safe drinking water; Federal grants to states for public water system supervision programs and underground water source protection programs; and grants to assist special studies relating to the provision of a safe supply of drinking water.

Sikes Act of October 18, 1974, as amended - This Act authorizes the Forest Service to cooperate with state wildlife agencies in conservation and rehabilitation programs for fish, wildlife, and plants considered threatened or endangered.

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Soil and Water Resources Conservation Act of November 18, 1977 - Provides for a continuing appraisal of the United States' soil, water and related resources, including fish and wildlife habitats, and a soil and water conservation program to assist landowners and land users in furthering soil and water conservation.

Surface Mining Control and Reclamation Act of August 3, 1977 - Authorizes the Secretary of Agriculture to enter into agreements with landowners, providing for land stabilization, erosion, and sediment control, and reclamation through conservation treatment, including measures for the conservation and development of soil, water, woodland, wildlife, and recreation resources, and agricultural productivity of such lands.

U.S. Mining Laws (Public Domain Lands) Act of May 10, 1872 - Provides that all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are free and open to exploration and purchase, and the lands in which they are found to occupation and purchase by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners, so far as the same are applicable and not inconsistent with the laws of the United States. There are a number of Acts which modify the mining laws as applied to local areas by prohibiting entry altogether or by limiting or restricting the use which may be made of the surface and the right, title, or interest which may pass through patent.

Water Quality Improvement Act of April 3, 1970 - Amends the prohibitions of oil discharges, authorizes the President to determine quantities of oil which would be harmful to the public health or welfare of the United States; to publish a National Contingency Plan to provide for coordinated action to minimize damage from oil discharges. Requires performance standards for marine sanitation device and authorizes demonstration projects to control acid or other mine pollution, and to control water pollution within the watersheds of the Great Lakes. Requires that applicants for Federal permits for activities involving discharges into navigable waters provide state certification that they will not violate applicable water quality standards.

Water Resources Planning Act of July 22, 1965 - Encourages the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal government, states, localities, and private enterprises.

Watershed Protection and Flood Prevention Act of August 4, 1954 - Establishes policy that the Federal government should cooperate with states and their political subdivisions, soil or water conservation districts, flood prevention or control districts, and other local public agencies for the purposes of preventing erosion, floodwater, and sediment damages in the watersheds of the rivers and streams of the United States; furthering the conservation, development, utilization, and disposal of water, and the conservation and utilization of land; and thereby preserving, protecting, and improving the Nation's land and water resources and the quality of the environment.

Regulations

Below is a partial listing of relevant regulations. Federal executive departments and administrative agencies write regulations to implement laws. Regulations are secondary to law. However, both laws and regulations are enforceable.

33 CFR 323 Permits for Discharges of Dredged or Fill Material into Waters of the United States - This regulation prescribes those special policies, practices and procedures to be followed by the Corps of Engineers in connection with the review of applications for permits to authorize the discharge of dredged or fill material into waters of the United States.

36 CFR 212.5 (b) Roads - ...the responsible official must identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands. ... The minimum system is the road system determined to be needed to meet resource and other management objectives adopted in the relevant land and resource management plan (36 CFR 219), to meet applicable statutory and regulatory requirements, to reflect long-term funding expectations, to ensure that the identified system minimizes adverse environmental impacts associated with road construction, reconstruction, decommissioning, and maintenance.

Identification of unneeded roads. Responsible officials must review the road system on each National Forest and Grassland and identify the roads on lands under Forest Service jurisdiction that are no longer needed to meet forest resource management objectives and that, therefore, should be decommissioned or considered for other uses, such as for motorized routes.

Travel Management Rule (TMR) - On December 9, 2005, the Forest Service published the TMR. The agency rewrote direction for motor vehicle use on National Forest Service (NFS) lands under 36 CFR, Parts 212, 251, and 261, and eliminated 36 CFR 295. The rule was written to address at least in part the issue of unmanaged recreation. The rule provides guidance to the Forest Service on how to designate and manage motorized recreation on the Forests. The rule requires each National Forest and Grassland to designate those roads, motorized trails, and Areas that are open to motor vehicle use.

36 CFR 219 Planning - Sets forth a process for developing, adopting, and revising land and resource management plans for the National Forest System.

36 CFR 241 Fish and Wildlife - Sets forth the rules and procedures relating to the management, conservation, and protection of fish and wildlife resources on National Forest System lands.

40 CFR 121-135 Water Programs - Sets forth the provisions for the administration of water programs including: state certification of activities requiring a Federal license or permit; EPA administered permit programs; state program requirements; procedures for decision making; criteria and standards for the National Pollutant Discharge Elimination System; toxic pollutant effluent standards; water quality planning and management; water quality standards; water quality guidance for the Great Lakes System; secondary treatment regulation; and, prior notice of citizen suits. See Title 40 (Protection of Environment), Chapter 1 (Environmental Protection Agency), subchapter D (Water Programs).

40 CFR 1500 Council on Environmental Quality - Council on Environmental Quality regulations implementing the National Environmental Policy Act.

Executive Orders

Below is a partial listing of relevant executive orders. Executive orders are official documents by which the President provides instructions to executive departments and agencies. An executive order may be used to reassign functions among executive branch agencies. It may adopt guidelines, rules of conduct, or rules of procedure for government employees or units of government. It can also establish an advisory body or task force.

EO 11988 Floodplain Management, 1977 - Requires each Federal agency to provide leadership and to take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for acquiring, managing, and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and

improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

EO 11990 Protection of Wetlands, 1977 - Requires each Federal agency to provide leadership and to take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for acquiring, managing, and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

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Appendix B

Aquatic Direction Comparison Table for the Colville NF

6/22/2015

Plan components under ARCS-modified reflect the numbering system in the 6/10/2015 version of the Draft Forest Plan. To make comparison between aquatic and riparian resources across alternatives, the order of plan components presented in this table follows what was in the 2008 Proposed Action.

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
General Watershed Desired Conditions		
Riparian Goal (7) maintain or restore riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geoclimatic region.	National Forest System Lands contribute to: **Aquatic Ecosystems DC** The distribution, diversity, and complexity of watershed and landscape-scale features, including natural disturbance regimes, of the aquatic and riparian ecosystems to which species, populations, and communities are uniquely adapted. Subbasin scale for both Forest planning and project planning.	**FW-DC-WR-01**. Natural Disurbance Regime of Aquatic and Riparian Systems National Forest System lands contribute to the distribution, diversity, and resiliency of watershed and landscape-scale features, including natural disturbance regimes, of the aquatic, riparian, and wetland ecosystems to which plant and animal species, populations, and communities are adapted. Subbasin scale is used for Forest planning and 5th field watershed or subwatershed scale is used for project planning.
	National Forest System Lands contribute to: **Aquatic Ecosystems DC** Spatial connectivity within and between watersheds. 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	**FW-DC-WR-02**. **Hydrologic and Aquatic and Riparian Habitat Connectivity** National Forest System lands contribute to uninterrupted physical and biological processes within and between watersheds. Floodplains, wetlands, groundwater-dependent ecosystems, upslope areas, headwater tributaries, and intact habitat refugia provide lateral, longitudinal, and drainage network connections. These network connections provide chemically and physically

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
	routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many upland species of plants and animals. For Forest planning, spatial connectivity is between watersheds at the subbasin scale. For project planning, spatial connectivity is between subwatersheds at the watershed scale.	unobstructed routes to areas critical for fulfilling life history requirements of aquatic, riparian-dependent, and many terrestrial species of plants and animals. Subbasin scale is used for Forest planning and 5th field watershed or subwatershed scale is used for project planning.
Riparian Goal (8) maintain or restore habitat to support populations of well distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of aquatic-dependent communities.	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** Habitat and ecological conditions capable of supporting self-sustaining populations of native and desired non-native, riparian-dependent plant and animal species. Subbasin scale for Forest planning; watershed or subwatershed scale for project planning.	**FW-DC-WR-03. Self-Sustaining Native and Aquatic and Riparian-Dependent Species** National Forest System lands contribute to habitat and ecological conditions that are capable of supporting self-sustaining populations of native aquatic and riparian-dependent plant and animal species. Subbasin scale is used for Forest planning and watershed or subwatershed scale is used for project planning.
	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** The physical integrity of the aquatic system and riparian habitat, including shorelines, banks, and bottom configurations. Watershed scale for Forest planning; subwatershed scale for project planning.	**FW-DC-WR-04. Physical Integrity of Aquatic and Riparian Habitat** National Forest System lands contribute to the physical integrity of the aquatic system and riparian habitat, including, banks, and floodplains. 5th field watershed scale is used for Forest planning and 5th field watershed or subwatershed scale is used for project planning.
Riparian Goal (1) maintain or restore water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** Water quality necessary to support healthy riparian, aquatic, and wetland ecosystems.	**FW-DC-WR-05. Water Quality** National Forest System lands contribute to water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality is within the range that maintains

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
	Water quality is within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities. Watershed scale for both forest planning and project planning.	the biological, physical, and chemical integrity and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities. Subbasin scale is used for forest planning, and 5th field watershed or subwatershed scale is used for project planning.
Riparian Goal (2) maintain or restore stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** The sediment regime within the natural range of variability. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport. Watershed scale for both Forest planning and project planning.	**FW-DC-WR-06. Sediment Regimes** National Forest System lands contribute to the sediment regime within the natural range of variability. Elements of the sediment regime include; the timing, volume, rate, and character of sediment input, storage, and transport. Fifth field watershed scale is used for Forest planning, and 5th field watershed or subwatershed scale is used for project planning.
Riparian Goal (3) maintain or restore instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** In-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows are retained. Watershed scale for both Forest planning and project planning.	**FW-DC-WR-07. In-stream Flows** National Forest System lands contribute to in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows functions in concert with local geology, valley types, soils and geomorphology. Subbasin scale is used for Forest planning, and 5th field watershed or subwatershed scale is used for project planning.
	National Forest System Lands contribute to:	**FW-DC-WR-08. Floodplain Innundation** National Forest System lands contribute to the

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
	Aquatic Ecosystems-DC The timing, variability, and duration of floodplain inundation is within the natural range of variability. Subwatershed scale for both Forest planning and project planning.	timing, variability, and duration of floodplain inundation that are within the natural range of variation. Fifth field watershed or subwatershed scale is used for both Forest and project planning.
Riparian Goal (4) maintain or restore natural timing and variability of the water table elevation in meadows and wetlands;	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** The timing, variability, and water table elevation in wetlands, seeps and springs is within the natural range of variability. Subwatershed scale for both Forest planning and project planning.	**FW-DC-WR-09. Wetlands, Seeps, Springs, and Other Groundwater-Dependent Systems** National Forest System lands contribute to the timing, variability, and water table elevation in wetlands, seeps, springs, and other groundwater dependent systems. These features are within or moving toward proper functioning condition. Subwatershed scale is used for both Forest and project planning.
Riparian Goal (6) maintain or restore riparian vegetation, to: a) provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems; b) provide adequate summer and winter thermal regulation within the riparian and aquatic zones; c) and help achieve rates of surface erosion, bank erosion, and channel migration characteristic of those under which the communities developed.	National Forest System Lands contribute to: **Aquatic Ecosystems-DC** The species composition and structural diversity of native plant communities in riparian management areas including wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration, and to supply amounts and distributions of coarse woody debris and fine particulate organic matter sufficient to sustain physical complexity and stability. Watershed scale for Forest planning; subwatershed scale for project planning.	**FW-DC-WR-10. Native Plant Communities** National Forest System lands contribute to the species composition and structural diversity of native plant communities in riparian management areas (including wetlands). These contribute to 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 scale is used for Forest planning, and 5th field watershed or subwatershed scale is used for project planning.
Riparian Goal (5) maintain or restore diversity and productivity of native and desired non-native plant communities in riparian	National Forest System Lands contribute to:	**FW-DC-WR-11. Aquatic Invasive and Non-Native Species**

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
zones.	**Aquatic Ecosystems-DC** Native assemblages of riparian dependent plants and animals free of persistent non-native species. Watershed scale for both Forest and project planning.	Aquatic invasive species do not occur as a component of lake, stream and other riparian related ecosystems or compete with native species for critical resources. Subbasin scale is used for Forest planning. Fifth field watershed or subwatershed scale is used for project planning.
		FW-DC-WR-12. Aquatic Threatened, Endangered, and Sensitive Species National Forest System lands contribute to the recovery of federally threatened and endangered fish species and conservation of Regional Forester's sensitive fish species. Aquatic habitat supports spawning, rearing and other key life history requirements. Subbasin scale is used for Forest planning, and 5th field watershed or subwatershed scale is used for project planning.
		FW-DC-WR-13. Water Quality Standards in Source Water Protection Areas NFS lands in ground and surface source water protection areas provide water of sufficient quantity that meets or exceeds state water quality standards for drinking water with appropriate treatment.
		FW-DC-WR-17. Focus and Priority Watershed Network Focus and priority watersheds contribute to the sustainability of aquatic and riparian systems and species and provide resilient, productive habitat, high water quality, and instream flows sufficient to protect and preserve beneficial uses.

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
Key Watershed Desired Conditions		
No specific "DC" were incorporated into INFISH for Priority/Key WA	**Key Watersheds DC:** Networks of watersheds with good habitat and functionally intact ecosystems contribute to and enhance conservation and recovery of specific threatened or endangered fish species, fish species of concern, and fish species of interest, and high water quality and quantity. The networks contribute to short-term conservation and long-term recovery at the ESU/Recovery Unit or other appropriate population scale.	**FW-DC-WR-14. Key Watershed Network** Networks of watersheds with functional habitat and functionally intact ecosystems contribute to and enhance conservation and recovery of specific threatened, endangered and/or sensitive fish species and high water quality and natural flow regimes. The networks contribute to short-term conservation and long-term recovery at the Recovery Unit or other appropriate population scale.
	Key Watersheds DC: Roads in key watersheds do not present substantial risk to aquatic resources.	**FW-DC-WR-15. Roads in Key Watersheds** Roads in key watersheds are not a risk to the function of soil and water resources. Roads do not disrupt hydrologic or aquatic habitat function or threatened and endangered species biological and behavioral attributes.
	Key Watersheds DC: Key Watersheds have high watershed integrity and provide resilient aquatic and riparian ecosystems.	**FW-DC-WR-16. Key Watershed Integrity** Key watersheds have high watershed integrity and contribute to resilient aquatic and riparian ecosystems, provide water of high quality, and provide instream flows sufficient to protect and preserve beneficial uses.
Riparian Management Area Desired Conditions		
	Riparian Management Area DC Riparian management areas within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical, and biological conditions appropriate to natural disturbance regimes affecting the area.	**MA-DC-RMA-01. Composition** Riparian management areas include the desired composition of native flora and fauna and provide physical, chemical, and biological conditions appropriate to support proper function.

No Action and B Alternative	Proposed Action and O Alternative	R and P Alternatives
INFISH (1995)	**ARCS (2008)**	**ARCS-modified (2015)**
	Riparian Management Area DC 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, are operating consistently with local disturbance regimes.	**MA-DC-RMA-02. Key Riparian Processes** Key riparian processes and conditions (including slope stability and associated vegetative root strength, capture and partitioning of water within the soil profile, wood delivery to streams and within the riparian management areas, input of leaf and organic matter to aquatic and terrestrial systems, solar shading, microclimate, and water quality) are operating consistently with local disturbance regimes.
		MA-DC-RMA-03. Livestock Grazing Livestock grazing of riparian herbaceous vegetation retains sufficient plant cover, rooting depth and vegetative vigor to protect stream bank and floodplain integrity against accelerated erosional processes, altered stream heating and cooling processes and allows for appropriate deposition of overbank sediment.
		MA-DC-RMA-04. Roads Roads located in or draining to RMAs do not present a substantial risk to soil or hydrologic function. Roads do not disrupt riparian and aquatic function.
General Water Resources Objectives		
		FW-OBJ-WR-01. Aquatic Invasive Species Within the next 15 years, implement aquatic invasive species prevention measures at all developed recreation sites providing direct and/or indirect access to water bodies, such as boat ramps and other campgrounds, and day use areas that provide portal zones for hand carried watercraft. Implement aquatic invasive

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		species prevention measures as part of all aquatic survey and inventory procedures and other management activities which pose high potential for invasion vectors to occur. -For guidance on invasive riparian plants, see Vegetation Desired Condition section
		FW-OBJ-WR-02. Aquatic Invasive and Non-Native Species Within the next 15 years, implement aquatic invasive species control and eradication at 10 sites where such invasions have become established and prevent attainment of listed fish recovery plan goals and/or effects to social, economic, and ecological systems.
		FW-OBJ-WR-03. General Watershed Function and Restoration Within the next 15 years, decrease sediment delivery from management activities on 1,000 acres including but not limited to roads, trails, unauthorized off-highway vehicle use, vegetation management, dispersed and developed campsites, and livestock. Restore hydrologic, aquatic and riparian processes through activities that stabilize stream bank erosion, and other accelerated channel destabilizing processes (i.e., headcutting), improve lateral and vertical hydrologic connectivity, and improve stream channel and floodplain function on 10 miles of streams.
		FW-OBJ-WR-04. Fish Habitat Improvement Within 15 years restore or aquatic organism

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		passage for all life stages of native species at 45 road/stream crossings and man-made instream structures such as water diversions and dams outside of key watersheds. Culverts and other passage improvements are to be designed to restore and maintain hydrologic and aquatic habitat function and stream channel resiliency to a range of flows through natural channel design and other acceptable treatment measures.
		FW-OBJ-WR-10. Watershed Restoration in Focus and Priority Watersheds Over 15 years implement the watershed condition framework through completion of essential projects outlined in watershed action plans in existing focus and priority watersheds to improve watershed condition class. Focus watersheds designated at the 5th field watershed scale include, Upper Sanpoil, Chewelah Creek-Colville River, and LeClerc Creek-Pend Oreille River watersheds. Priority watersheds designated at the subwatershed scale include Ninemile Creek, East Branch LeClerc Creek, and West Branch LeClerc Creek subwatersheds.
Key Watershed Objectives		
	Water Resources, Key Watersheds Objective - 1 **Le Clerc Creek – Pend Oreille River, Upper San Poil, Chewelah Creek – Colville River watershed restoration (Colville)**	**FW-OBJ-WR-05. Key Watershed Restoration Prioritization** Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds

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	Reduce the road-generated sediment production and delivery over the next 15 years. Acceptable methods include culvert removal or replacement, livestock crossing armoring, stream crossing surfacing (placing crushed rock on road surface approaches), installing drainage crossings, road storm damage risk reduction measures, road maintenance level reduction, road decommission followed by riparian vegetation restoration, and riparian fencing. Methods to improve the stream channel and riparian habitat include, but are not limited to, culvert replacement or removal to provide upstream fish passage, road relocation and/or decommission, reducing the impacts of or closing and rehabilitating dispersed recreation sites, riparian fencing and planting, and instream structure placement.	that are a priority for restoration within 15 years of forest plan implementation. Key watersheds that are a priority for restoration include: *East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, Tonata Creek, Upper Sherman Creek, and South Fork Sherman Creek subwatersheds.* Additional key watersheds that are a priority for restoration would be identified, as appropriate, through the life of the plan.
	Water Resources, Key Watersheds Objective - 2 **All other key watersheds (Colville)** In the most important places for threatened, endangered and sensitive fish and water quality, prioritize restoration opportunities within Riparian Management Areas that improve riparian processes and water quality. Reduce road-generated sediment on 436 acres of road prism over the next 15 years. Acceptable methods can include culvert removal, stream crossing surfacing (placing crushed rock on road surface approaches), installing drainage crossings, road storm	**FW-OBJ-WR-06. Key Watershed Road Treatments** Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 78 miles of hydrologically connected road within 15 years of forest plan implementation. Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 50 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of Forest plan implementation through culvert replacement or

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	damage risk reduction measures, road maintenance level reduction, and road decommission followed by riparian vegetation restoration, and riparian fencing. Methods to improve channel and riparian habitat include, but are not limited to, culvert replacement or removal to provide upstream fish passage, road relocation and/or decommission, reducing the impacts of or closing and rehabilitating dispersed recreation sites, riparian fencing and planting, and instream structure placement.	crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
		FW-OBJ-WR-07. Key Watershed Range Infrastructure Improvements Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 250 acres within 15 years of plan implementation.
		FW-OBJ-WR-08. Upland Vegetation Structure in Riparian Management Areas in Key Watersheds Move upland vegetation within riparian management areas in key watersheds toward historic range of variability on 1,200 acres within 15 years of plan implementation.
		FW-OBJ-WR-09. Stream Restoration in Key Watersheds Restore hydrologic, geomorphic, and riparian process and function on 76 miles of stream within 15 years of forest plan implementation through activities including streambank

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		stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.
Riparian Management Area Objectives		
Pool Frequency (kf)- Varies by Channel Width (all systems) • Wetted with in feet: … • Number pools per mile: … **Water Temperature** (sf) No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period). Maximum water temperatures below 59°F within adult holding habitat and below 48°F within spawning and rearing habitats. **Large Woody Debris** (sf)(forested systems) East of Cascade Crest in Oregon, Washington, Idaho, Nevada and western Montana. >20 pieces per mile; >12 inch diameter; >35 foot length. **Bank Stability** (sf)(non-forested systems) - > 80 percent stable **Lower Bank Angle** (sf)(non-forested systems) - >75 percent of banks with <90 degree angle (i.e. undercut) **Width/Depth Ratio** (sf)(all systems) - <10, mean wetted width divided by mean depth	***Riparian Management Areas (Colville) Objective - 2*** Modify grazing practices in key watersheds with active grazing allotments in riparian management areas to move conditions toward the desired conditions for riparian management areas. ***Riparian Management Areas (Colville) Objective - 3*** Over the next 15 years, within the Riparian Management Areas, restore riparian processes at dispersed recreation sites with the priority being those sites where recreational use results in bank damage, a reduction in water quality, and/ or a reduction in shade over the stream. Consolidate access trails to the remaining dispersed campsites. ***Riparian Management Areas (Colville) Objective - 4*** Over the next 15 years, consolidate user-created access routes in Riparian Management Areas onto stable locations that minimize disturbance to riparian processes and water quality. Restore excess user-trails within Riparian Management Areas.	**MA-OBJ-RMA-01. Improve Riparian Function at Dispersed and Developed Recreation Sites** Over the next 15 years, restore riparian processes and balance need for occupancy and access to water at 50 dispersed and developed recreation sites, through education, enforcement, and engineering where recreational use results in bank damage, reduction in water quality, and/ or a reduction in stream shade. **MA-OBJ-RMA-02. Restoration of Riparian Habitat and Process on Roads** Restore hydrologic and riparian habitat function within RMAs in non-key watersheds by reducing road-related impacts on 30 miles of road within 15 years. **MA-OBJ-RMA-03. Restoration of Late Forest Structure** Move upland vegetation within riparian management areas outside of key watersheds toward historic range of variability on 500 acres within 15 years of plan implementation.

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	Riparian Management Areas (Colville) Objective - 5 Over the next 15 years, provide upstream fish passage at road crossings on the following fish bearing streams within the following key watersheds:	
General Water Resources Standards and Guidelines		
		FW-STD-WR-01. Aquatic Invasive Species—In-Water Work Implement prevention measures for in-water projects to decrease the potential for aquatic invasive species transference into non-infested water bodies.
		FW-STD-WR-02. Construction of New Roads, Trails and Developed Recreation Sites New roads and trails would be designed to minimize disruption of natural hydrologic processes at perennial and intermittent stream crossings, valley bottoms, valley approaches and other over land drainage features. New roads, trails and developed recreation sites would integrate features, such as, but not limited to, rocked stream crossings, drain dips, sediment filtration, cross drains and crossings that minimize unnatural stream constriction, bank erosion, channel incision, sedimentation, or disruption of surface and subsurface flow paths.
		FW-GDL-WR-01. Aquatic Invasive Species—Wildfire Suppression Equipment

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		During wildfire suppression, cross contamination between streams and lakes from pumps, suction, and dipping devices should be avoided. Dumping water directly from one stream or lake into another should be avoided. Water storage and conveyance components of water tenders, engines, and aircraft should be disinfected prior to use on a new on-forest incident.
		FW-GDL-WR-02. Aquatic Invasive Species—Aquatic Resource Sampling Aquatic sampling equipment should be disinfected prior to use in new stream or lake locations.
		FW-GDL-WR-03. Aquatic Invasive Species—Early Detection and Rapid Response Principles and processes of Early Detection and Rapid Response (EDRR) to find, identify and quantify new aquatic invasive species occurrences should be utilized. EDRR should be coupled with other integrated activities to rapidly assess and respond with quick and immediate actions to eradicate, control, or contain aquatic invasive species.
		FW-GDL-WR-04. Watershed Restoration Restoration methods that maximize the use of natural ecological processes for long-term sustainability and minimize the need for long-term maintenance should be used.

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		FW-GDL-WR-05. Hydrologic Function of Roads, Trails, and Developed Recreation Sites Roads and trails should be maintained to minimize disruption of natural hydrologic processes at perennial and intermittent stream crossings, valley bottoms, valley approaches and other over land drainage features. Roads and trails should integrate features, such as, but not limited to, rocked stream crossings, drain dips, sediment filtration, cross drains and crossings that minimize unnatural stream constriction, bank erosion, channel incision, sedimentation, or disruption of surface and subsurface flow paths.
Key Watershed Standards and Guidelines		
	Standard KW There shall be no net increase at any time in the mileage of Forest roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition. No net increase means that for each mile of new road constructed, at least one mile of road must be decommissioned to hydrologically stable, self-maintaining conditions. Priority should be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems.	**FW-STD-WR-03. Road Construction and Decommissioning in Key Watersheds** There shall be no net increase (i.e., for each mile of new road constructed, at least one mile of road must be decommissioned) at any time in the mileage of National Forest System roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition. The decommissioned road shall be in a hydrologically stable and self-maintaining condition. Priority for decommissioning would be given to roads that pose the greatest relative ecological risks to riparian and aquatic function.
	Standard KW Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that	**FW-STD-WR-04. Hydroelectric and Other Water Development Authorizations in Key Watersheds** Hydroelectric and other water development

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	maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.	authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.
	Standard KW New hydroelectric facilities and water developments shall not be located in a key watershed unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.	**FW-STD-WR-05. New Hydroelectric Facilities and Water Developments** New hydroelectric facilities and water developments shall not be located in a key watershed unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.
Riparian Management Area Standards and Guidelines		
		MA-SU-RMA-01. Suitable Uses Suitable uses see Table 1.
	Guideline RA When RMAs are properly functioning[1], project activities should maintain those conditions.	**MA-STD-RMA-01. Aquatic and Riparian Conditions** When riparian management areas are properly functioning[1], project activities shall maintain

[1] Proper functioning condition is a concept used to assess natural habitat forming processes of riparian and wetland areas (Pritchard et al. 1998). Systems in a proper functioning condition are dynamic and resilient to disturbance to structure, composition and processes of their biological and physical components. Primary elements typically include hydrologic characteristics, physical structure/form, vegetative characteristics, water quality and quantity, and aquatic/riparian biological community characteristics. The general methodology to assess properly functioning condition provides an integrated measure of condition and can be used at a variety of scales from individual reaches to watersheds. This basic approach is used to assess a wide range of process-based, riparian and aquatic conditions. The current R6 process to assess watershed condition, which uses the Ecosystem Management Decision Support (EMDS) model, and the R4 PFC Rapid Assessment Process are examples of this technique, used at the sub-watershed and watershed scales. This general methodology has also been used for salmonid systems by the NMFS (1996) and as a tool in salmon conservation and recovery planning (e.g., Ecosystem Diagnosis and Treatment Model (EDT) described by Lestelle et al. 2004).

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	When RMAs are not properly functioning, and to the degree that project activities would drive or contribute to improper function, project activities should improve those conditions. Project activities in RMAs should not result in long-term degradation to aquatic and riparian conditions at the watershed scale. Limited short term or site-scale effects from activities in RMAs may be acceptable when they support, or do not diminish, long-term benefits to aquatic and riparian resources.	those conditions. When riparian management areas are not properly functioning, and to the degree that management activities would drive or contribute to improper function, project activities shall be implemented to improve those conditions. Project activities in riparian management areas shall not result in long-term degradation to aquatic and riparian conditions at the 5th field watershed scale. Limited short term or site-scale effects from activities in riparian management areas may be acceptable when they support, or do not diminish, long-term benefits to aquatic and riparian resources.
	RMA Guideline RF: Fish passage barriers should be retained where they serve to restrict access by undesirable non-native species and are consistent with restoration of habitat for native species	**MA-GDL-RMA-08. Fish Passage Barriers** Consider retaining fish passage barriers where they serve to restrict access by undesirable non-native species and are consistent with restoration of habitat for native species.
	RMA Guideline RF: Protect fish habitat and water quality when withdrawing water for administrative purposes	**See MA-GDL-RMA-18**
RA-4. Prohibit storage of fuels and other toxicants within Riparian Habitat Conservation Areas. Prohibit refueling within Riparian Habitat Conservation Areas unless there are no other alternatives. Refueling sites within a Riparian Habitat Conservation Area must be approved by the Forest Service or Bureau of Land Management and have an approved spill containment plan.		**MA-GDL-RMA-01. Fuel Storage** Storage of fuel or other toxicants in RMAs should be avoided.
RA-3 Apply herbicides, pesticides, and other toxicants, and	**Standard RA**	**MA-STD-RMA-02. Chemical Application**

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other chemicals in a manner that does not retard or prevent attainment of Riparian Management Objectives and avoids adverse effects on inland native fish.	Apply herbicides, insecticides, piscicides and other toxicants, and other chemicals only to maintain, protect, or enhance aquatic and riparian resources or to restore native plan communities.	Apply herbicides, insecticides, piscicides, and other toxicants, other chemicals, and biological agents only to maintain, protect, or enhance aquatic and riparian resources and/or native plant communities.
RA-2 Trees may be felled in Riparian Habitat Conservation Areas when they pose a safety risk. Keep felled trees on site when needed to meet woody debris objectives.	**Guideline RA** Generally retain, on site, trees needed to maintain, protect, or enhance aquatic and riparian resources that are felled for safety.	**MA-GDL-RMA-02. Felling Trees** When trees are felled for safety, they should generally be retained onsite (channels and adjacent floodplains), to maintain, protect, or enhance aquatic and riparian resources unless otherwise determined that such trees pose a new risk to administrative or developed recreation sites.
TM-1 Prohibit timber harvest, including fuel wood cutting, in Riparian Habitat Conservation Areas, except as described below. a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuel wood cutting in Riparian Habitat. Conservation Areas only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects can be avoided to inland native fish. For priority watersheds, complete watershed analysis prior to salvage cutting in RHCAs. b. Apply silvicultural practices for Riparian Habitat Conservation Areas to acquire desired vegetation characteristics where needed to attain Riparian	**RMA Guideline TM** Timber harvest and thinning should occur in RMAs only as necessary to maintain, restore, or enhance conditions that are needed to support aquatic and riparian dependent resources.	**MA-STD-RMA-04. Timber harvest and Thinning** Timber harvest and thinning can occur in riparian management areas only as necessary to move vegetation in RMAs toward historic range of variability, which maintains, restores, or enhances conditions needed to support aquatic and riparian dependent resources.
	RMA Standard TM: Fuelwood cutting shall not be authorized in the active floodplain[2] or within primary source areas for large woody debris.	**MA-STD-RMA-03.** Personal Fuelwood Cutting Personal fuelwood cutting shall not be authorized within RMAs or source areas for large woody debris.

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

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Management Objectives. Apply silvicultural practices in a manner that does not retard attainment of Riparian Management Objectives and that avoids adverse effects on inland native fish.		
RF-1 Cooperate with federal, Tribal, state and county agencies and cost-share partners to achieve consistency in road design, operation and maintenance necessary to attain Riparian Management Objectives	**RMA Guideline TM:** New landings, designated skid trails, staging or decking should not occur in RMAs, unless there are no alternatives, in which case they should: • Be of minimum size, • Be located outside the active floodplain, and • Minimize effects to large wood, bank integrity, temperature and sediment levels.	**MA-GDL-RMA-03. Landings, Skid Trails, Decking, and Temporary Roads** Landings, designated skid trails, staging or decking should not occur in riparian management areas, unless there are no other reasonable alternatives, in which case they should: • Be of minimum size • Be located outside the active floodplain • Minimize effects to large wood, bank integrity, temperature, and sediment levels • Not result in unnatural modification of flow paths • Impacted site(s) to be reclaimed as soon as practicable. Existing infrastructure may be reused with intent of removal and restoration of riparian function as soon as practicable.
RF-2. For each existing or planned road, meet the Riparian Management Objectives and avoid adverse effects to inland native fish by: a) Completing watershed analyses prior to construction of new roads or landings in Riparian Habitat	**RMA Guideline TM:** • Yarding activities should achieve full suspension over the active channel[3].	**MA-STD-RMA-05. Yarding Activities** Yarding activities, if crossing streams, shall achieve full suspension over the active channel.
	RMA Guideline RF:	**MA-GDL-RMA-04. Road Construction**

[3] Active channel is the bankfull width of flowing perennial or intermittent streams.

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Conservation Areas within priority watersheds. b) Minimizing road and landing locations in RHCA's *c) included on page 161 of this table* d) avoiding sediment delivery to streams from the road surface. 1. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is infeasible or unsafe. 2. Route road drainage away from potentially unstable stream channels, fills and hillslopes e) Avoiding disruption of natural hydrologic flow paths f) f.) Avoiding sidecasting of soils or snow. Sidecasting of road material is prohibited on road segments within or abutting RHCA's in priority watersheds.	Generally avoid new road construction in RMAs except where necessary for stream crossings.	Construction of permanent or temporary roads in riparian management areas should be avoided except where necessary for: • stream crossings • stream, wetland or riparian restoration • mine reclamation • employee, contractor, or public safety
	RMA Standard RF: Avoid side-casting (placement of unconsolidated earthen waste materials resulting from road construction or maintenance) in RMAs.	**MA-STD-RMA-06. Road Construction and Maintenance** No sidecasting, placement of fill in riparian management areas. Snowplowing activities shall include measures to prevent runoff from roads in locations where it could deliver sediment to streams.
	RMA Standard RF: Avoid placing fill material on organic debris in RMAs.	**Consolidated into MA-STD-RMA-09**
	RMA Guideline RF: Wetlands and unstable areas should be avoided when reconstructing existing roads or constructing new roads and landings. Minimize impacts where avoidance is not practical	**MA-GDL-RMA-05. Road Construction—Wetlands and Unstable Areas** Wetlands and unstable areas should be avoided when reconstructing existing roads or constructing new roads and landings. Impacts should be mitigated where avoidance is not possible.
RF-3. Determine the influence of each road on the Riparian Management Objectives. Meet Riparian Management Objectives and avoid adverse effects on inland native fish by: a. Reconstructing road and drainage features that do not meet design criteria or operation and maintenance standards, or that have been shown to be less effective than designed for controlling sediment	**RMA Standard RF:** New or replaced permanent stream crossings would accommodate at least the 100-year flood, including associated bedload and debris	**MA-STD-RMA-07. Road Construction at Stream Crossings** New or replaced permanent stream crossings would accommodate at least the 100-year flood, including associated bedload and debris. Use natural channel design techniques.

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delivery, or that retard attainment of Riparian Management Objectives, or do not protect priority watersheds from increased sedimentation. b. Prioritizing reconstruction based on the current and potential damage to inland native fish and their priority watersheds, the ecological value of the riparian resources affected, and the feasibility of options such as helicopter logging and road relocation out of Riparian Habitat Conservation Areas. c. Closing and stabilizing or obliterating, and stabilizing roads not needed for future management activities. Prioritize these actions based on the current and potential damage to inland native fish in priority watersheds, and the ecological value of the riparian resources affected.		
RF-4 Construct new, and improve existing, culverts, bridges, and other stream crossings to accommodate a 100-year flood, including associated bedload and debris, where those improvements would/do pose a substantial risk to riparian conditions. Substantial risk improvements include those that do not meet design and operation maintenance criteria, or that have been shown to be less effective than designed for controlling erosion, or that retard attainment of Riparian Management Objectives, or that do not protect priority watersheds from increased sedimentation. Base priority for upgrading on risks in priority watersheds and the ecological value of the riparian resources affected. Construct and maintain crossings to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.	**RMA Standard RF:** In fish bearing streams, construction or reconstruction of stream crossings would provide and maintain passage for all fish species and all life stages of fish	**MA-STD-RMA-08. Road Construction-Fish Passage** In fish bearing streams, construction or reconstruction of stream crossings would provide and maintain passage for all native fish species at all life stages.
RF-5. Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams.	**RMA Guideline RF:** Construction or reconstruction of stream crossings should allow passage for other riparian dependent species where	**MA-GDL-RMA-07. Road Construction—Passage for Riparian—Dependent Species** Construction or reconstruction of stream crossings should allow passage for other

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	connectivity has been identified as an issue	riparian dependent species where connectivity has been identified as an issue.
	RMA Guideline RF: Generally minimize hydrologic connectivity and delivery from roads. This includes roads inside and outside of RMAs	
	RMA Guideline RF: Road drainage should be routed away from potentially unstable channels, fills, and hillslopes. This applies to both inside and outside of RMAs.	**MA-GDL-RMA-06. Road Management—Road Drainage** Road drainage should be routed away from potentially unstable channels, fills, and hillslopes.
RF-2. For each existing or planned road, meet the Riparian Management Objectives and avoid adverse effects to inland native fish by: c.) initiating development and implementation of a Road Management Plan or a Transportation Management Plan. At a minimum, address the following items in the plan: 1. Road design criteria, elements, and standards that govern construction and reconstruction. 2. Road management objectives for each road. 3. Criteria that govern road operation, maintenance, and management. 4. Requirements for pre-, during-, and post-storm inspections and maintenance. 5. Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives. 6. Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control. 7. Mitigation plans for road failures.	**RMA Standard GM** New livestock handling, management, or watering facilities shall be located outside of RMAs, except for those that inherently must be located in an RMA and those needed for resource protection	**MA-STD-RMA-09. Recreational and Permitted Grazing Management-Livestock Handling, Management, and Water Facilities** Locate new livestock handling, management, or watering facilities outside of riparian management areas, except for those that inherently must be located in a riparian management area and those that are needed for resource protection.

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GM-2. Locate new livestock handling and/or management facilities outside of Riparian Habitat Conservation Areas. For existing livestock handling facilities inside the Riparian Habitat Conservation Areas, assure that facilities do not prevent attainment of Riparian Management Objectives. Relocate or close facilities where these objectives cannot be met.	**RMA Guideline GM** Within green-line vegetation area adjacent to all watercourses[4]: Do not exceed 20 percent streambank alteration; Do not exceed 40% utilization of mean annual vegetative production on woody vegetation; Maintain at least 4-6 inches or do not exceed 40% utilization of mean annual vegetative production on herbaceous vegetation[5]	**MA-GDL-RMA-09. Permitted Grazing Management—Greenline Vegetation Areas[4]** Within greenline vegetation areas adjacent to all watercourses[6] measured in designated monitoring areas: • Streambank alteration should not exceed 25 percent • Utilization of available mean annual vegetative production on woody vegetation should not exceed 40 percent • Residual stubble height of at least 6 to 8 inches should be maintained and no more than 40 percent of mean annual vegetative production on deep-rooted herbaceous vegetation should be utilized as determined by plant community type

[4] National Forests can modify the numeric values in these guidelines to more effectively achieve desired conditions. Rationale for these changes should be documented.

[5] Sampling and assessment of these parameters is intended to portray the general condition of banks and riparian vegetation along an individual stream reach within each pasture. It is assumed that there would be some variability in conditions within the reach, including occasional, limited area of concentrated animal use, such as water gaps or crossings.

[6] Numeric values in this guideline may be modified to effectively achieve desired conditions. Rationale for these changes must be documented. This guideline can be applied solely or in combination as appropriate to site specific conditions. Sampling and assessment of these parameters is intended to portray the general condition of banks and riparian vegetation along an individual stream reach within each pasture after the grazing season. It is assumed that there would be some variability in geomorphic, hydrologic and vegetation conditions within designated monitoring areas, including occasional, limited areas of concentrated animal use, such as water gaps or crossings.

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	RMA Guideline GM During allotment management planning consider removal of existing livestock handling or management facilities from RMAs	**MA-STD-RMA-10. Permitted Grazing Management—Allotment Management Planning** During allotment management planning, negative impacts to water quality and aquatic and riparian function from existing livestock handling or management facilities located within riparian management areas shall be minimized to allow conditions to move towards the desired condition or eliminated.
GM-1. Modify grazing practices (e.g., accessibility of riparian areas to livestock, length of grazing season, stocking levels, timing of grazing, etc.) that retard or prevent attainment of Riparian Management Objectives or are likely to adversity affect inland native fish. Suspend grazing if adjusting practices is not effective in meeting Riparian Management Objectives.	**RMA Guideline GM** Livestock trailing, bedding, loading, and other handling activities should be avoided in RMAs	**MA-GDL-RMA-10. Recreational and Permitted Grazing Management—Livestock Handling Activities** Livestock trailing, bedding, loading, and other handling activities should be avoided in riparian management areas, except for those that inherently must occur in a riparian management area.
GM-3. Limit livestock trailing, bedding, watering, salting, loading, and other handling efforts to those areas and times that would not retard or prevent attainment of Riparian Management Objectives or adversely affect inland native fish.	**RMA Guideline GM** Generally avoid trampling of federally listed threatened or endangered fish redds by livestock	**MA-STD-RMA-11. Recreational and Permitted Grazing Management—Fish Redds** Prohibit livestock access to federally-listed threatened or endangered fish redds.
GM-4. Adjust wild horse and burro management to avoid impacts that prevent attainment of Riparian Management Objectives or adversely affect inland native fish.	**RMA Guideline RM** Generally avoid placing new facilities or infrastructure within expected long term channel migration zone. Where activities inherently must occur in RMAs (e.g. road stream crossings, boat ramps, docks, interpretive trails), locate them to minimize impacts on riparian dependent resource conditions (e.g., within geologically stable	**MA-GDL-RMA-11. Recreation Management—New Facilities and Infrastructure** New facilities or infrastructure should not be placed within expected long-term channel migration zones. Activities that inherently occur in riparian management areas (e.g., road stream crossings, boat ramps, docks, and interpretive trails) should be located to minimize impacts on riparian-dependent resource conditions (e.g., within geologically stable

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	areas, avoiding major spawning sites).	areas, avoiding major spawning sites).
RM-1. Design, construct, and operate recreation facilities, including trails and dispersed sites, in a manner that does not retard or prevent attainment of the Riparian Management Objectives and avoids adverse effects on inland native fish. Complete watershed analysis prior to construction of new recreation facilities in Riparian Habitat Conservation Areas within priority watersheds. For existing recreation facilities inside Riparian Habitat Conservation Areas, assure that the facilities or use of the facilities would not prevent attainment of Riparian Management Objectives or adversely affect inland native fish. Relocate or close recreation facilities where Riparian Management Objectives cannot be met or adverse effects on inland native fish cannot be avoided. **RM-2.** Adjust dispersed and developed recreation practices that retard or prevent attainment of Riparian Management Objectives or adversely affect inland native fish. Where adjustment measures such as education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures are not effective in meeting Riparian Management Objectives and avoiding adverse effects on inland native fish, eliminate the practice or occupancy.	**RMA Guideline RM** Consider removing or relocating existing recreation facilities that are causing unacceptable impacts in RMAs.	**MA-GDL-RMA-12. Recreation Management—Existing Facilities** Consider removing or relocating existing recreation facilities that are not meeting desired conditions in riparian management areas or are in active floodplains.
		MA-GDL-RMA-23. Administrative and Developed Recreation Facilities New administrative and developed recreation facilities should be located outside of RMAs unless they are needed for resource protection or must inherently be located within the RMA.
RM-3. Address attainment of Riparian management Objectives and potential effect on inland native fish in Wild and Scenic Rivers, Wilderness and other Recreation Management Plans.	**RMA Guideline MM** Adverse effects to aquatic and other riparian dependent resources from mineral operations should be minimized or avoided. For operations in a riparian management area ensure operators take all practicable measures to maintain, protect, and rehabilitate water quality, and habitat for fish and wildlife and other riparian dependent	**MA-GDL-RMA-13. Mineral Management—Operations in Riparian Management Areas** Operators should take all practicable measures to maintain, protect, and rehabilitate water quality and habitat for fish and wildlife, and other riparian-dependent resources that may be affected by operations occurring in the riparian management area.

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	resources which may be affected by the operations.	
MM-1. Minimize adverse effects to inland native fish species from mineral operations. If a Notice of Intent indicates that a mineral operation would be located in a Riparian Habitat Conservation Area, consider the effects of the activity on inland native fish in the determination of significant surface disturbance pursuant to 36 CFR 228.4. For operations in a Riparian Habitat Conservation Area ensure operators take all practicable measures to maintain, protect, and rehabilitate fish and wildlife habitat which may be affected by the operations. When bonding is required, consider (in the estimation of bond amount) the cost of stabilizing, rehabilitating, and reclaiming the area of operations.	**RMA Guideline MM** Structures and support facilities should be located outside RMAs. Where no alternative to siting facilities or roads in RMAs exists, locate them in a way to minimize adverse effects to aquatic and other riparian dependent resources. Existing roads should be maintained to minimize damage to aquatic and riparian dependent resources in the RMAs.	**MA-GDL-RMA-14. Minerals Management—Structures and Support Facilities** Structures and support facilities should be located outside riparian management areas. Where no alternative sites exist for facilities or roads outside of riparian management areas, work with Operators to locate them in a way to minimize adverse effects to aquatic and other riparian-dependent resources. Existing roads should be maintained to minimize damage to aquatic and riparian-dependent resources in the riparian management areas.
MM-2. Locate structures, support facilities, and roads outside Riparian Habitat Conservation Areas. Where no alternative to siting facilities in Riparian Habitat Conservation Areas exists, locate and construct the facilities in ways that avoid impacts to Riparian Habitat Conservation Areas and streams and adverse effects on inland native fish. Where no alternative to road construction exists, keep roads to the minimum necessary for the approved mineral activity. Close, obliterate and revegetate roads no longer required for mineral or land management activities.	**RMA Standard MM** Locate mine waste with the potential to generate hazardous material (per CERCLA) outside of RMAs. If no reasonable alternative to locating these facilities in RMAs exists, then locate and design the waste facilities using best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials.	**MA-GL-RMA-15. Minerals Management—Mine Waste** Forest mineral administrators would work with mine Operators, within the Plan of Operations review process, to store mine waste with the potential to generate hazardous material (per CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980) outside of riparian management areas. If no reasonable alternative to locating these facilities in riparian management areas exists, Forest mineral administrators would work with mine Operators, within the Plan of Operations review process, to design the waste facilities using best conventional techniques to ensure mass stability, neutralize waste materials to the extent practicable, and prevent the release of acid or toxic materials. Forest mineral administrators would work with

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		mine Operators, within the Plan of Operations review process, to reclaim and monitor waste facilities to assure chemical and physical stability and revegetation to avoid adverse effects to inland native fish.
MM-3 Prohibit solid and sanitary waste facilities in Riparian Habitat Conservation Areas. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in Riparian Habitat Conservation Areas exists, and releases can be prevented and stability can be ensured, then: a. Analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics. b. Locate and design the waste facilities using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, prohibit such facilities in Riparian Habitat Conservation Areas. c. Monitor waste and waste facilities to confirm predictions of chemical and physical stability, and make adjustments to operations as needed to avoid adverse effects to inland native fish and to attain Riparian Management Objectives. b. Reclaim and monitor waste facilities to assure chemical and physical stability and revegetation to avoid adverse effects to inland native fish, and to attain the Riparian Management Objectives. c. Require reclamation bonds adequate to ensure long-	**RMA Guideline MM** Where possible, adjust the operating plans for existing activities to minimize adverse effects to aquatic and riparian dependent resources in the RMAs.	**MA-GDL-RMA-16. Minerals Management—Operating Plans for Existing Activities** Forest mineral administrators would work with mine Operators, within the Plan of Operations review process, to locate or relocate mine operations and facilities outside riparian management areas to minimize adverse effects to aquatic and riparian dependent resources.

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term chemical and physical stability and successful revegetation of mine waste facilities.		
MM-4 For leasable minerals, prohibit surface occupancy within Riparian Habitat Conservation Areas for oil, gas, and geothermal exploration and development activities where contracts and leases do not already exist, unless there are no other options for location and Riparian Management Objectives can be attained and adverse effects to inland native fish can be avoided. Adjust the operating plans of existing contracts to (1) eliminate impacts that prevent attainment of Riparian Management Objectives and (2) avoid adverse effects to inland native fish		
MM-5. Permit sand and gravel mining and extraction within Riparian Habitat Conservation Areas would occur only if no alternatives exist, if the action(s) would not retard or prevent attainment of Riparian Management Objectives and adverse effects to inland native fish can be avoided.		
MM-6. Develop inspection, monitoring and reporting requirements for mineral activities. Evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of Riparian Management Objectives and avoid adverse effects on inland native fish.	**RMA Guideline FM** Temporary fire facilities (e.g., incident bases, camps, wheelbases, staging areas, helispots and other centers) for incident activities should be located outside RMAs. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian dependent resources should be used.	**MA-GDL-RMA-17. Fire and Fuels Management—Temporary Fire Facilities** Temporary fire facilities (e.g., incident bases, camps, staging areas, helispots, and other centers) for incident activities should be located outside riparian management areas. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian-dependent resources should be used.
FM-2. Locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of Riparian Habitat Conservation Areas. If the only suitable location for such activities is within the Riparian Habitat Conservation Area, an exemption may be granted following a review and recommendation by a resource advisor. The advisor	**RMA Guideline FM** Water drafting sites should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish	**MA-GL-RMA-18. Water Drafting Sites** Water drafting sites should be located and managed to minimize adverse effects on stream channel stability and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

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would prescribe the location, use conditions, and rehabilitation requirements, with avoidance of adverse effects to inland native fish a primary goal. Use an interdisciplinary team, including a fishery biologist, to predetermine incident base and helibase locations during pre-suppression planning.	habitat	
RA-5 Locate water drafting sites to avoid adverse effects to inland native fish and instream flows, and in a manner that does not retard or prevent attainment of Riparian Management Objectives.	**RMA Standard FM** Pumps shall be screened at drafting sites to prevent entrainment of native and desired non-native fish and shall have one-way valves to prevent backflow into streams.	**MA-GDL-RMA-20. Non-Emergency Pump and Dipping Equipment Cleaning** Suction devices and dipping apparatus should be cleaned and pumps should be de-contaminated between water sources to prevent the spread of aquatic invasive species. Pumping should be done in accordance with current Washington Department of Fish and Wildlife hydraulic project approval.
	RMA Standard FM Portable pump set-ups shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Vehicles should be parked in locations that avoid entry of spilled fuel into streams	***MA-STD-RMA-13. Fire and Fuels Management—Portable Pumps** Portable pump set-ups shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Park vehicles in locations that do not allow entry of spilled fuel into streams.
	RMA Guideline FM Generally locate and configure fire lines to minimize sediment delivery, creation of new stream channels and unauthorized roads and trails	**MA-GDL-RMA-19. Fire and Fuels Management—Fire Line Construction** Fire lines should be located and configured to minimize sediment delivery to streams and to minimize creation of new stream channels and unauthorized roads and trails.
	RMA Standard FM Use Minimum Impact Suppression tactics (MIST) during fire suppression activities in RMAs (NWCG 2006)	***MA-STD-RMA-12. Fire and Fuels Management—Minimum Impact Suppression Tactics** Use minimum impact suppression tactics (MIST) during fire suppression activities in riparian management areas.

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FM-1. Design fuel treatment and fire suppression strategies, practices, and actions so as not to prevent attainment of Riparian Management Objectives, and to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could perpetuate or be damaging to long term ecosystem function or inland native fish.	**RMA Guideline FM** Aerial application of chemical retardant, foam, or other fire chemicals and petroleum should be avoided within 300 feet of waterways.	Standards for fire retardant are now covered by national direction (FEIS Nationwide Aerial Application of Fire Retardant on National Forest System Land 10/2011).
FM-3. Avoid delivery of chemical retardant, foam, or additives to surface waters. An exception may be warranted in situations where overriding immediate safety imperatives exist, or, following a review and recommendation by a resource advisor and a fishery biologist, when the action agency determines an escape fire would cause more long-term damage to fish habitats than chemical delivery to surface waters.		
FM-4. Design prescribed burn projects and prescriptions to contribute to the attainment of the Riparian Management objectives.		
FM-5. Immediately establish an emergency team to develop a rehabilitation treatment plan to attain Riparian Management objectives and avoid adverse effects on inland native fish whenever Riparian Habitat Conservation Areas are significantly damaged by wildfire or a prescribed fire burning out of prescription.	**RMA Standard LH** Authorizations for all new and existing special uses including, but not limited to water diversion or transmission facilities (e.g., pipelines, ditches), energy transmission lines, roads, hydroelectric and other surface water development proposals, shall result in the re-establishment, restoration, or mitigation of habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, water and other riparian dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity, water quality, and integrity and	**MA-STD-RMA-14. Lands and Special Uses Authorizations** Authorizations for all new and existing special uses (including, but not limited to water diversion, storage or transmission facilities [e.g., pipelines, ditches], energy transmission lines, roads, hydroelectric and other surface water development proposals) shall result in the re-establishment, restoration, or mitigation of soil and habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, soil, water, and other riparian-dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity,

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	complexity of riparian and aquatic habitat.	water quality, and integrity and complexity of riparian and aquatic habitat.
LH-3. Issue leases, permits, rights-of way, and easements to avoid effects that would retard or prevent attainment of the Riparian Management Objectives and avoid adverse effects on inland native fish. Where the authority to do so was retained, adjust existing leases, permits, rights-of-way, and easements to eliminate effects that would retard or prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. If adjustments are not effective, eliminate the activity. Where the authority to adjust was not retained, negotiate to make changes in existing leases, permits, rights-of-way, and easements to eliminate effects that would prevent attainment of the Riparian Management Objectives or adversity affect inland native fish. Priority for modifying existing leases, permits, rights-of-way, and easements would be based on the current and potential adverse effects on inland native fish and the ecological value of the riparian resources affected.	**RMA Standard LH** Locate new support facilities outside of RMAs. Support facilities include any facilities or improvements (workshops, housing, switchyards, staging areas, transmission lines, etc.) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation or enhancement measures.	**MA-STD-RMA-15. Hydroelectric—New Support Facilities** Locate new support facilities outside of riparian management areas. Support facilities include any facilities or improvements (workshops, housing, switchyards, staging areas, transmission lines, etc.) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation, or enhancement measures.
LH-2 Locate new hydroelectric ancillary facilities outside Riparian Habitat Conservation Areas. For existing ancillary facilities inside the RHCA that are essential to proper management, provide recommendations to FERC to assure that the facilities would not prevent attainment of the Riparian Management Objectives and that adverse effects on inland native fish are avoided. Where these objectives cannot be met, provide recommendations to FERC that such ancillary facilities should be relocated. Locate, operate, and maintain hydroelectric facilities that must be located in Riparian Habitat Conservation Areas to avoid effects that would retard or prevent attainment of the Riparian Management Objectives and avoid adverse effects on inland native fish.	**RMA Guideline LH** If existing support facilities are located within the RMAs, they should be operated and maintained to restore or enhance aquatic and riparian dependent resources. At time of permit reissuance, consider removing support facilities, where practical.	**MA-GDL-RMA-22. Hydroelectric—Existing Support Facilities** Existing support facilities that are located within riparian management areas should be operated, maintained, or removed to restore or enhance aquatic and riparian-dependent resources.
LH-1 Require instream flows and habitat conditions for hydroelectric and other surface water development proposals that maintain or restore riparian resources, favorable channel		

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conditions, and fish passage, reproduction, and growth. Coordinate this process with the appropriate State agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that require fish passage and flows and habitat conditions that maintain/restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate State agencies.		
LH-4. Use land acquisition, exchange and conservation easements to meet Riparian Management Objectives and facilitate restoration of fish stocks and other species at risk of extinction.	**Watershed Restoration Guideline - 1** Watershed restoration projects should be designed to maximize the use of natural ecological processes as a tool in meeting and maintaining restoration objectives	**See FW-STD-WR-02. Watershed Restoration**
WR-1. Design and implement watershed restoration projects in a manner that promotes long-term ecological integrity of ecosystems, conserve the genetic integrity of native species, and contributes to attainment of Riparian Management Objectives.	**Watershed Restoration Guideline- 2** Watershed restoration projects should be designed to minimize the need for long-term maintenance.	**FW-STD-WR-02. Watershed Restoration**
WR-2. Cooperate with federal, state, local, and tribal agencies, and private landowners to develop watershed-based Coordinated Resource Management Plans (CRMPs) or other cooperative agreements to meet Riparian Management objectives.		
FW-1. Design and implement fish and wildlife habitat restoration and enhancement activities in a manner that contributes to attainment of the Riparian Management Objectives.		
FW-2. Design, construct and operate fish and wildlife interpretive and other user-enhancement facilities in a manner that does not retard or prevent attainment of the Riparian Management objectives or adversely affect inland native fish. For existing fish and wildlife interpretative and other user-enhancement facilities inside Riparian Habitat Conservation		

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Areas, assure that Riparian Management objectives are met and adverse effects on inland native fish avoided or relocate or close such facilities.		
FW-3. Cooperate with federal, tribal, and state wildlife management agencies to identify and eliminate wild ungulate impacts that prevent attainment of the Riparian Management objectives or adversely affect inland native fish.		
FW-4. Cooperate with federal, tribal, and state fish management agencies to identify and eliminate adverse effects on native fish associated with habitat manipulation, fish stocking, fish harvest and poaching.		

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Appendix C

Rationale for Calculation of Objectives

Objectives for water resources and RMAs are the primary element in the revised Colville Forest Plan that set the direction and methods for maintenance and improvement of hydrologic, aquatic, and riparian function toward desired condition through the life of the Plan (estimated at 15 years). Objectives complement programmatic objectives in the National Watershed Condition Framework and the R6 Aquatic Restoration Strategy, and Bull Trout Recovery Plans.

Table 1: Rationale for calculation of objectives.

Objective	Rationale for Calculation of Objective
FW-OBJ-WR-01	This objective acknowledges that it should be standard practice for the FS to post signage at all developed recreation sites providing direct and/or indirect access to water bodies to inform users of measures they should take to prevent the spread of aquatic invasive species.
FW-OBJ-WR-02	There is ongoing work to implement invasive species control and eradication in the Pend Oreille River and the Little Pend Oreille lakes. The ten sites are included in those treatment areas.
FW-OBJ-WR-03	This is a general objective for improvement of hydrologic, aquatic, and riparian function across non-key watersheds. The estimate of 1,000 acres of treatment and 10 miles of stream channel improvement over 15 years of plan implementation are an estimate of work outside of key watersheds that can be completed in conjunction with vegetation management projects and the forest damage response team. The forest damage response team is a crew that implements aquatic improvement projects as the need arises and completes between 75-100 acres of aquatic improvement and 1 mile of stream improvement per year.
FW-OBJ-WR-04	This objective is for treatment of crossings and man-made instream structures outside of key watersheds. Although the first priority for treatment of passage barriers is in key watersheds, this objective recognizes that additional passage barriers would be treated through the life of the plan in conjunction with vegetation management projects and in areas outside key watersheds as funding and opportunities are available.
FW-OBJ-WR-05	Key watersheds that are a priority for restoration were designated based on the ability to improve watershed condition through focused restoration activities (essential projects). Key watersheds that are a priority for restoration may be updated through the life of the plan based on completion of essential projects, or changes in aquatic species population and trends, life history characteristics and needs, distribution and use/non-use of habitats, or new listings of species.
FW-OBJ-WR-06	This objective includes estimates of miles of road treatment and treatment of road crossings to improve aquatic organism passage. Road miles estimated for treatment focus specifically on hydrologically connected roads in the key watershed network, with work focused primarily in key watersheds that are a priority for active restoration. Hydrologically connected road mileage across key watersheds that are a priority for active restoration was calculated and 78 miles was the

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	estimate of the work that could be completed based on miles of road in need of treatment. Estimates of road stream crossings to be treated to improve passage were calculated from spatial data on culverts where passage is impaired in key watersheds that are a priority for restoration.
FW-OBJ-WR-07	Calculation of this objective was based on acres of range improvements on acres already identified for treatment through range NEPA, and estimated work on allotments where NEPA would be completed in the next 15 years. For most projects (ie. improvement of water troughs), 1 project is estimated as 1 acre of treatment.
FW-OBJ-WR-08	This objective provides rationale for treatment of upland vegetation located within RMA boundaries in key watersheds. Riparian acres in key watersheds that are a priority for restoration were calculated to provide a rough estimate of total acres that could potentially be treated.
FW-OBJ-WR-09	Calculation of stream miles for treatment is based on miles of stream where restoration could improve channel and floodplain condition and function within key watersheds that are a focus for restoration. Existing watershed action plans, and planned FERC restoration projects were used to inform this estimate.
FW-OBJ-WR-10	This objective is based on the need to continue to complete essential projects outlined in watershed action plans in existing focus (designated through ARS) and priority watersheds (designated through WCF) that were in place before the designation of the key watershed network. Two focus watersheds; the Upper Sanpoil and Chewelah Creek-Colville River do not have any subwatersheds within the key watershed network because they lack the focal species presence and habitat condition required for inclusion in the key watershed network. The Ninemile subwatershed was designated as a priority watershed through WCF, but is not included in the key watershed network because it lacks the focal species presence and habitat condition required for inclusion in the key watershed network.
MA-OBJ-RMA-01	This objective is based on the need reduce and consolidate impacts from user-created access points to streams, rivers, and lakes. It was estimated that there is a need and ability to treat approximately 50 sites over the next 15 years.
MA-OBJ-RMA-02	This is an estimate of miles of road treated in RMAs outside of key watersheds over the next 15 years. Since road treatments for aquatic restoration purposes would be primarily focused in key watersheds, the 30 miles of treatment estimated outside of key watersheds is modest, and reflects work that would likely be completed in conjunction with vegetation management projects.
MA-OBJ-RMA-03	This objective provides rationale for treatment of upland vegetation located within RMA boundaries outside of key watersheds. Riparian acres outside of key watersheds were calculated for areas where treatment is expected in the next 15 years as part of scheduled vegetation management projects to provide a rough estimate of total acres where treatment is likely.

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