Recovery Plan for the Rock Creek Population of the Middle Columbia River Steelhead Distinct Population Segment

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National Marine Fisheries Service
Northwest Region

DISCLAIMER

Endangered Species Act (ESA) recovery plans delineate reasonable actions which the best available information indicates are necessary for the conservation and survival of listed species. Plans are published by the National Marine Fisheries Service (NMFS), usually with the assistance of recovery teams, state agencies, local governments, salmon recovery boards, non-governmental organizations, interested citizens of the affected area, contractors, and others. ESA recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in the plan formulation, other than NMFS. They represent the official position of NMFS only after they have been signed by the Northwest Regional Administrator. ESA recovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions.

With respect to the Middle Columbia Steelhead Recovery Plan, where areas of disagreement arose between a management unit plan and the species level, distinct population segment (DPS) plan, NMFS worked with the relevant parties to resolve the differences and in a few cases, identified in the DPS plan, decided not to incorporate the disputed material into the DPS plan.

ESA recovery plans provide important context for NMFS's determinations pursuant to section 7(a)(2) of the Endangered Species Act. However, recovery plans do not place any additional legal burden on NMFS or the action agency when determining whether an action would jeopardize the continued existence of a listed species or adversely modify critical habitat. The procedures for the section 7 consultation process are described in 50 CFR 402 and are applicable regardless of whether or not the actions are described in a recovery plan.

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Recovery Planning Glossary

abundance: In the context of salmon recovery, unless otherwise qualified, abundance refers to the number of adult fish returning to spawn.

adaptive management: Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of actions can become feedback on design and implementation of future actions.

anadromous fish: Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.

baseline monitoring: In the context of recovery planning, baseline monitoring is done before implementation, in order to establish historical and/or current conditions against which progress (or lack of progress) can be measured.

biogeographical region: an area defined in terms of physical and habitat features, including topography and ecological variations, where groups of organisms (in this case, salmonids) have evolved in common.

broad-sense recovery goals: Goals defined in the recovery planning process, generally by local recovery planning groups, that go beyond the requirements for delisting, to address, for example, other legislative mandates or social, economic, and ecological values.

compliance monitoring: Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.

delisting criteria: Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species. These criteria are a NMFS determination and may include both technical and policy considerations.

distinct population segment (DPS): A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NMFS policy. A population is considered distinct (and hence a “species” for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species’ range.

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

endangered species: A species in danger of extinction throughout all or a significant portion of its range.

effectiveness monitoring: Monitoring set up to test cause-and-effect hypotheses about recovery actions: Did the management actions achieve their direct effect or goal? For example, did fencing a riparian area to exclude livestock result in recovery of riparian vegetation?

ESA recovery plan: A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

evolutionarily significant unit (ESU): A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.

extinct: No longer in existence. No individuals of this species can be found.

extirpated: Locally extinct. Other populations of this species exist elsewhere. The ICTRT considers extirpated steelhead populations to be those that are entirely cut off from anadromy, such as the Crooked River population. Functionally extirpated populations are those of which there are so few remaining numbers that there are not enough fish or habitat in suitable condition to support a fully functional population.

factors for decline: Five general categories of causes for decline of a species, listed in the Endangered Species Act section 4(a)(1)(b): (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

functionally extirpated: Describes a species that has been extirpated from an area; although a few individuals may occasionally be found, there are not enough fish or habitat in suitable condition to support a fully functional population.

hyporheic zone: Area of saturated gravel and other sediment beneath and beside streams and rivers where groundwater and surface water mix.

implementation monitoring: Monitoring to determine whether an activity was performed and/or completed as planned.

independent population: Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations.

indicator: A variable used to forecast the value or change in the value of another variable.

interim regional recovery plan: A recovery plan that is intended to lead to an ESA recovery plan but that is not yet complete. These plans might address only a portion of an ESU or lack other key components of an ESA recovery plan.

intrinsic potential: The estimated relative suitability of a habitat for spawning and rearing of anadromous salmonid species under historical conditions inferred from stream characteristics including channel size, gradient, and valley width.

intrinsic productivity: The expected ratio of natural-origin offspring to parent spawners at levels of abundance below carrying capacity.

kelts: Steelhead that are returning to the ocean after spawning and have the potential to spawn again in subsequent years (unlike most salmon, steelhead do not necessarily die shortly after spawning).

large woody debris (LWD): A general term for wood naturally occurring or artificially placed in streams, including branches, stumps, logs, and logjams. Streams with adequate LWD tend to have greater habitat diversity, a natural meandering shape, and greater resistance to flooding.

legacy effects: Impacts from past activities that continue to affect a stream or watershed in the present day.

limiting factor: Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach a desired status.

locally developed recovery plan: A plan developed by state, tribal, regional, or local planning entities to address recovery of a species. These plans are being developed by a number of entities throughout the region to address ESA as well as state, tribal, and local mandates and recovery needs.

maintained status: Population status in which the population does not meet the criteria for a viable population but does support ecological functions and preserve options for ESU/DPS recovery.

major population group (MPG): A group of salmonid populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU or DPS.

management unit: A geographic area defined for recovery planning purposes on the basis of state, tribal or local jurisdictional boundaries that encompass all or a portion of the range of a listed species, ESU, or DPS.

metrics: A metric is something that quantifies a characteristic of a situation or process; for example, the number of natural-origin salmon returning to spawn to a specific location is a metric for population abundance.

morphology: The form and structure of an organism, with special emphasis on external features.

natural-origin fish: Fish that were spawned and reared in the wild, regardless of parental origin.

parr: The stage in anadromous salmonid development between absorption of the yolk sac and transformation to smolt before migration seaward.

phenotype: Any observable characteristic of an organism, such as its external appearance, development, biochemical or physiological properties, or behavior.

piscivorous: (Adj.) Describes fish that eat other fish.

productivity: The average number of surviving offspring per parent. Productivity is used as an indicator of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.

recovery domain: An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.

recovery goals: Goals incorporated into a locally developed recovery plan, which may include delisting (i.e. no longer considered endangered or threatened), reclassification (e.g., from endangered to threatened), and/or other goals. Broad-sense goals are a subset of recovery goals (see glossary entry above).

recovery plan supplement: A NMFS supplement to a locally developed recovery plan that describes how the plan addresses ESA requirements for recovery plans. The supplement also proposes ESA delisting criteria for the ESUs addressed by the plan, since a determination of these criteria is a NMFS decision.

recovery scenarios: Alternative combinations of target status for the populations in an ESU that would be generally consistent with TRT recommendations for ESU viability.

recovery strategy: Statements that identify the assumptions and logic – the rationale – for the species' recovery program.

redd: A nest constructed by female salmonids in streambed gravels where eggs are fertilized and deposited.

riparian area: Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland.

salmonid: Fish of the family *Salmonidae*, including salmon, trout, chars, grayling, and whitefish. In general usage, the term usually refers to salmon, trout, and chars.

smolt: A juvenile salmonid that is undergoing physiological and behavioral changes to adapt from freshwater to saltwater as it migrates toward the ocean.

spatial structure: Characteristics of a fish population's geographic distribution. Current spatial structure depends upon the presence of fish, not merely the potential for fish to occupy an area.

stakeholders: Agencies, groups, or private citizens with an interest in recovery planning, or who will be affected by recovery planning and actions.

Technical Recovery Team (TRT): Teams convened by NMFS to develop technical products related to recovery planning. TRTs are complemented by planning forums unique to specific states, tribes, or regions, which use TRT and other technical products to identify recovery actions.

threatened species: A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

threats: Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.

viability criteria: Criteria defined by NMFS-appointed Technical Recovery Teams to describe a viable salmonid population, based on the biological parameters of abundance, productivity, spatial structure, and diversity. These criteria are used as technical input into the recovery planning process and provide a technical foundation for development of biological delisting criteria.

viability curve: A curve describing combinations of abundance and productivity that yield a particular risk of extinction at a given level of variation over a specified time frame.

viable salmonid population (VSP): an independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame.

VSP parameters: Abundance, productivity, spatial structure, and diversity. These describe characteristics of salmonid populations that are useful in evaluating population viability. See NOAA Technical Memorandum NMFS-NWFSC-42, *Viable salmonid populations and the recovery of evolutionarily significant units* (McElhany et al. 2000).

Acronyms and Abbreviations

A/P	abundance/productivity
BACI	Before-After-Control-Impact
BLM	Bureau of Land Management
CAO	Critical Areas Ordinance
CCRP	Continuous Conservation Reserve Program
CEO	County Environmental Ordinance
cfs	cubic feet per second
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CRITFC	Columbia River Inter-tribal Fish Commission
CRP	Conservation Reserve Program
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSP	Conservation Security Program
CUPs	Conditional Use Permits
CZO	County Zoning Ordinance
DPS	Distinct Population Segment
Ecology	Department of Ecology
EDT	Ecosystem Diagnostic and Treatment
EIS	environmental impact statement
EKCD	Eastern Klickitat Conservation District
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FEIS	final environmental impact statement
FPO	Floodplain Management Ordinance
FREP	Forestry Riparian Easement Program
FY	fiscal year
GMA	Growth Management Act
GRP	Grassland Reserve Program
HFRP	Healthy Forest Reserve Program
ICTRT	Interior Columbia Technical Recovery Team
MaSA	Major Spawning Area
MOA	Memorandum of Agreement
MiSA	Minor Spawning Area
MPG	Major Population Group
NMFS	National Marine Fisheries Service
WDFW	Wahington State Department of Fish and Wildlife
WRIA	Water Resources Inventory Area
NOAA	National Oceanic and Atmospheric Administration-Fisheries
NPCC	Northwest Power and Conservation Council
NRCS	Natural Resources Conservation Service
PCSRF	Pacific Coastal Salmon Recovery Fund
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
RCW	Rock Creek Watershed
QAR	Quantitative Analytical Report
RM	River-mile
SDPs	Substantial Development Permits
SEPA	State Environmental Policy Act
SMP	Shorelines Master Plan
SRFB	Salmon Recovery Funding Board
SS/D	Spatial structure/diversity
SSB	Substitute Senate Bill
TNC	The Nature Conservancy
TRT	Technical Recovery Team
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VARs	Variances
VSP	Viable Salmonid Population
WAC	Washington Administrative Code
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WHIP	Wildlife Habitat Incentive Program
W/LC TRT	Willamette/Lower Columbia Technical Recovery Team
WRIA	Water Resources Inventory Area
WRP	Wetlands Reserve Program
WY	Water Years
YN	Yakama Nation

Executive Summary

The Endangered Species Act of 1973 (ESA) requires NOAA's National Marine Fisheries Service (NMFS) to develop recovery plans for species listed under the Act. The purpose of recovery plans is to identify actions needed to restore threatened and endangered species to the point that they are again self-sustaining elements of their ecosystems and no longer need the protections of the ESA.

This plan focuses on the conservation and survival of Middle Columbia River steelhead (*Oncorhynchus mykiss*) in the Rock Creek subbasin. Rock Creek drains an area of 223.2 sq. miles (578.1 sq. km) in southeastern Washington State. It joins the Columbia River at RM 230, approximately 12 miles upstream of John Day Dam (Figure ES-1). This is one of several recovery plans developed for independent populations of the Middle Columbia River steelhead distinct population segment (DPS), which was listed as threatened under the ESA on March 25, 1999 and reconfirmed on January 5, 2006 (71 FR 834). Similar plans have been prepared for Middle Columbia steelhead populations in the White Salmon River, Klickitat River, and Yakima River, as well as in areas of southeast Washington and the State of Oregon. These separate plans are part of a DPS-level plan that integrates recovery actions across the DPS.

Purpose of Plan

A recovery plan is a guidance document, not regulatory. This plan provides a roadmap for restoring the Rock Creek steelhead population and its habitats to a level that supports recovery of the Middle Columbia River steelhead DPS and allows the population to become a viable component of its ecosystem.

The plan describes the current status of the Rock Creek population and proposes a strategy for its conservation and recovery. The recovery strategy builds on past and current recovery efforts. A key component of the strategy is collaborative development of a research, monitoring, and evaluation plan to further characterize population and habitat characteristics. Finally, the plan provides guidelines for implementation and an adaptive management framework for making appropriate adjustments as new information becomes available.

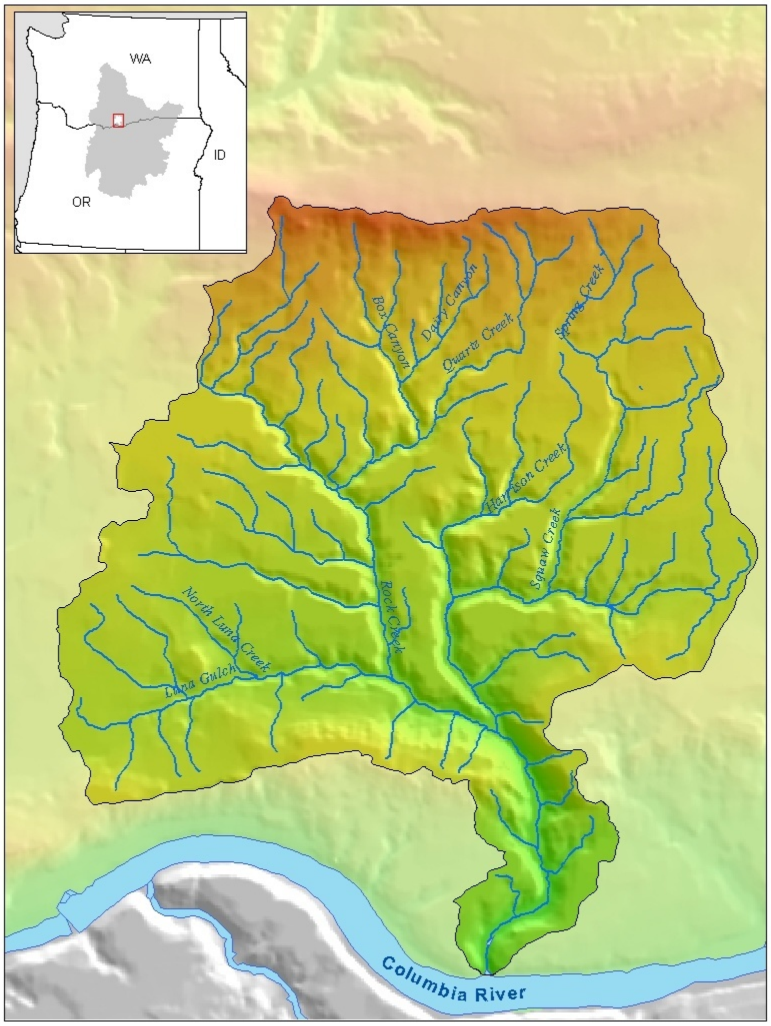

Figure ES-1. Rock Creek Subbasin.

Context of Plan Development

The plan is the product of a process initiated by NMFS; it incorporates information from the Yakama Nation (YN), Washington Department of Fish and Wildlife (WDFW), Klickitat County, the Washington State Governor's Salmon Recovery Office, other Federal agencies, state agencies, local governments, and the public.

Currently, there are 19 ESA-listed ESUs/DPSs of Pacific salmon and steelhead in the Pacific Northwest. For the purpose of recovery planning for these species, NMFS Northwest Region designated five geographically based "recovery domains" (Figure ES-2). The range of the Middle Columbia River steelhead DPS is located in the Middle Columbia sub-domain of the Interior Columbia domain.

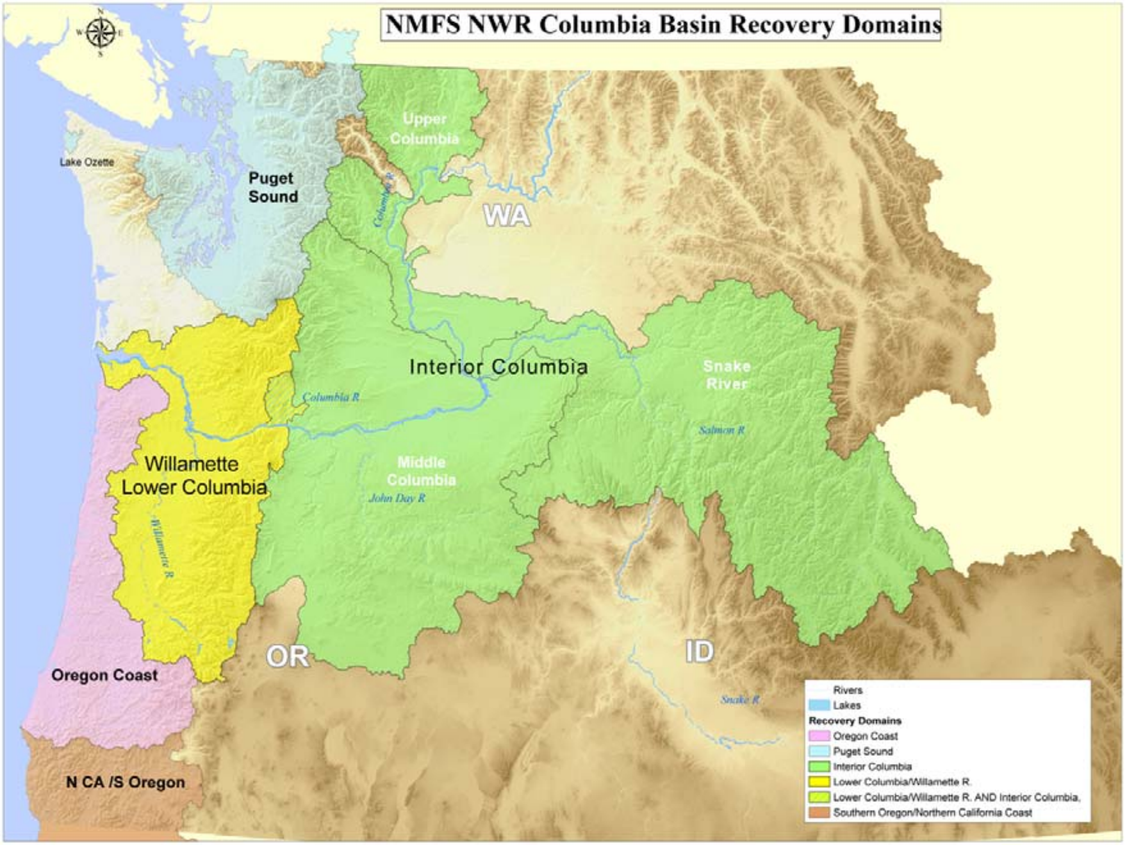

Figure ES-2. Columbia Basin Recovery Domains for NMFS Northwest Region.

For each domain, NMFS appointed a team of scientists, nominated for their geographic and species expertise, to provide a solid scientific foundation for recovery plans. The charge of each Technical Recovery Team (TRT) was to define ESU/DPS structures, develop recommendations on biological viability criteria for each ESU or DPS and its component populations, provide scientific support to local and regional recovery planning efforts, and provide scientific evaluations of proposed recovery plans. The Interior Columbia TRT (ICTRT) includes biologists from NMFS, states, tribes, and academic institutions.

All the TRTs used the same biological principles for developing their recommendations for ESU/DPS and population viability criteria – criteria that may be used, along with criteria based on mitigation of the factors for decline, in determining whether a species has recovered sufficiently to be downlisted or delisted. These principles are described in a NMFS technical memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000).

Viable salmonid populations (VSP) are defined in terms of four parameters: abundance, productivity (growth rate), spatial structure, and diversity. A viable ESU/DPS is naturally self-sustaining, with a high probability of persistence over a 100-year time period. Each TRT made recommendations using the VSP framework, based on data availability, the unique biological characteristics of the ESUs/DPSs and habitats in the domain, and the members' collective experience and expertise. Although NMFS has encouraged the TRTs to develop regionally specific approaches for evaluating viability and identifying factors limiting recovery, all the TRTs are working from a common scientific foundation. Viability criteria are an important part of recovery goals, as described later in this summary.

The Rock Creek Plan reflects direction for Rock Creek steelhead adopted into the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program subbasin plan (NPCC 2004). The subbasin plan was produced through a collaborative process involving the Yakama Nation, Washington Department of Fish and Wildlife, and NPCC. In addition, the plan reflects technical data drawn from the following sources:

- Watershed Resource Inventory Area (WRIA) 31 Watershed Assessment (Aspect and WPN 2004) and WRIA 31 Instream Habitat Assessment (Glass 2009)
- The Interior Columbia Technical Recovery Team (ICTRT) viability criteria and current status assessment for the Middle Columbia River steelhead DPS (ICTRT 2007a, 2007b, and 2009)

Biological Background

Salmonid species' homing propensity (their tendency to return to the locations where they originated) creates unique patterns of genetic variation and connectivity that mirror the distribution of their spawning areas across the landscape. Diverse genetic, life history, and morphological characteristics have evolved over generations, creating runs highly adapted to diverse environments. It is this variation that gives the species as a whole the resilience to persist over time.

Historically, a salmon ESU or steelhead DPS typically contained multiple populations connected by some small degree of genetic exchange that resulted from some spawners "straying" into neighboring streams. Thus, the overall biological structure of the ESU/DPS is hierarchical; spawners in the same area of the same stream will share more characteristics than those in the next stream over. Fish whose natal streams are separated by hundreds of miles will have less genetic similarity.

Definition of Evolutionarily Significant Units/Distinct Population Segments
An ESU is defined as a group of Pacific salmon that is "substantially reproductively isolated from other conspecific units and represents an important component of the evolutionary legacy of the species" (Waples 1991). A "population segment" is considered distinct (a DPS and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics; or if it occupies an unusual or unique ecological setting; or if its loss would represent a significant gap in the species' range (71 FR 834).

ESUs/DPSs may contain multiple populations that are connected by some degree of genetic exchange through straying, and hence may have a broad geographic range across watersheds and river basins.

Major Population Groups
Within an ESU/DPS, independent populations can be grouped into larger populations that share similar genetic, geographic, and/or habitat characteristics (McClure et al. 2003). These "major groupings" of populations (MPGs) are isolated from one another over a longer time scale than that defining the individual populations, but retain some degree of connectivity greater than that between ESUs/DPSs.

Independent Populations
McElhany et al. (2000) defined an independent population as follows:

"…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season."

The Rock Creek population is one of 17 extant independent populations that make up the Middle Columbia River steelhead DPS, and one of the five extant populations (Klickitat River, Fifteenmile Creek, Rock Creek, Deschutes River Eastside, and Deschutes River Westside) and two extirpated populations (White Salmon River and Deschutes Crooked River) that make up the major population group (MPG) of the Cascades Eastern Slope Tributaries (Figure ES-3). Steelhead in this MPG occupy diverse habitats, generally those draining the eastern slopes of the Cascades and the Columbia Plateau.

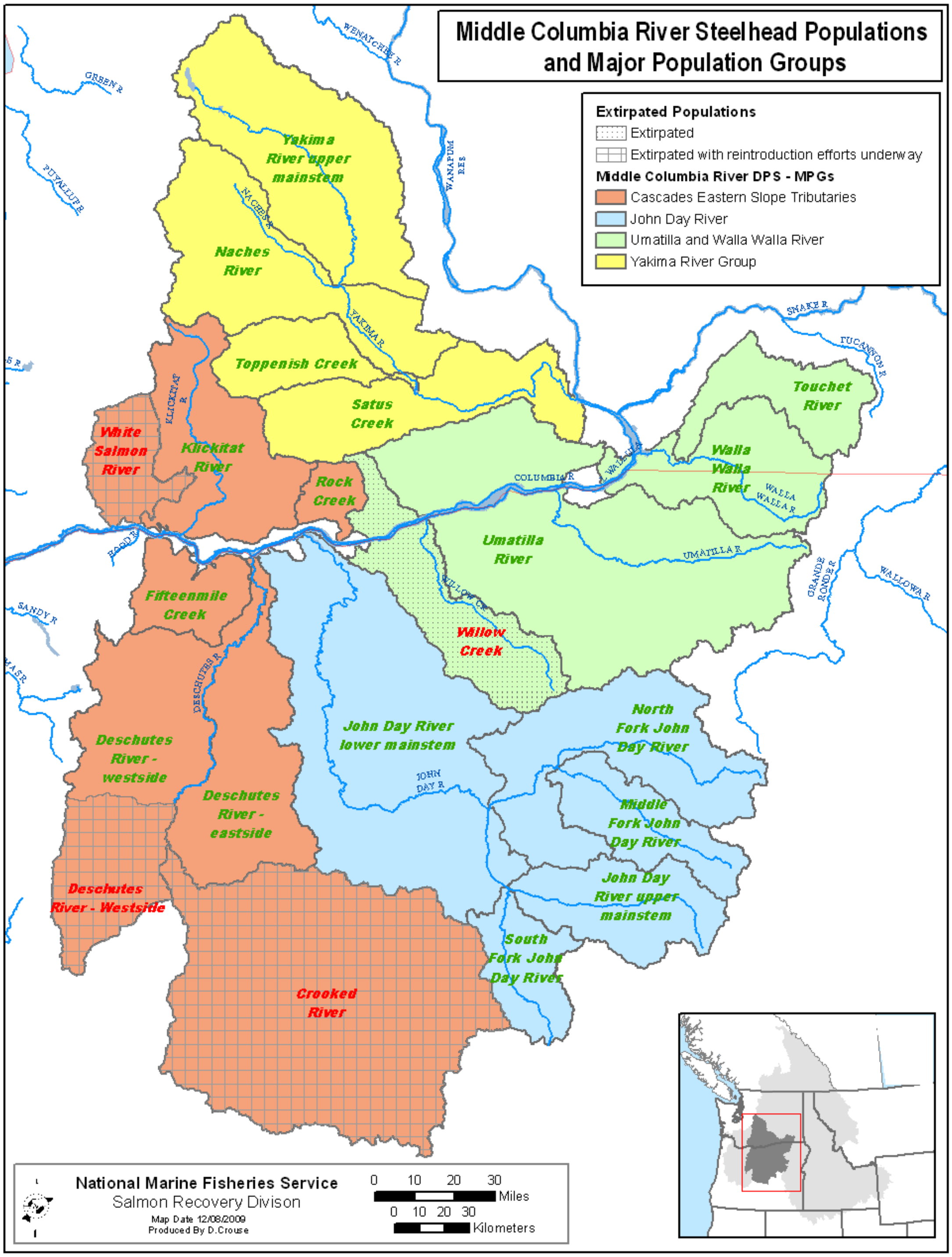

Figure ES-3 Middle Columbia River Steelhead Populations and Major Population Groups.

Physical Setting

Rock Creek begins in the Simcoe Mountains, which form the subbasin's northern border and the southern edge of the Yakama Indian Reservation. Major tributaries to Rock Creek include Badger Gulch, Harrison Creek, Luna Gulch, Quartz Creek and Squaw Creek. Lake Umatilla, the reservoir behind John Day Dam on the Columbia River, inundates the lower mile of Rock Creek.

The drainage has a high basalt plateau and deeply incised canyons that reflect its underlying basalt geology. Headwater streams cross a relatively flat basalt plateau that is primarily forested and above known anadromous use, and then drop into steep-walled canyons where gradients increase to 2 to 4 percent or more. Flows in the subbasin's canyon and alluvial reaches are considered flashy, rising and falling rapidly in response to precipitation and snowmelt. Snowmelt runoff from higher elevations appears to help sustain flows into early spring. Numerous springs also exist in the subbasin, most of which are located in the headwaters (Brown 1979). No flow regulation occurs in the drainage, although small amounts are diverted for stock watering.

Lands in the Rock Creek subbasin remain generally undeveloped, with nearly 47 percent rangeland, 26 percent forestland, and 4 percent dry land agriculture. Forests cover the upper elevations, and the middle and lower watershed supports range and agricultural uses. No irrigated land was estimated to exist as of 2001 (Aspect Consulting and WPN 2004). Developed land accounts for less than one percent of the subbasin area (Aspect Consulting and WPN 2004).

Rock Creek Steelhead Population

Steelhead in Rock Creek are considered indigenous. Rock Creek is a natural production area, with no hatcheries located in the subbasin, although it is possible that some strays from outside hatchery sources enter Rock Creek. The stock is considered distinct from other mid-Columbia stocks based on geographic isolation of the spawning population (ICTRT 2003).

Limited information exists on steelhead abundance in the Rock Creek drainage; however, some observations suggest that a significant number of steelhead may utilize the Rock Creek watershed in good water and ocean condition years. Surveys conducted by the Yakama Nation in lower Rock Creek in 2002, 2003 and 2004 show as many as 35 to 45 steelhead redds per mile in the lower five miles, and extensive distribution of redds throughout the watershed. Steelhead spawner surveys conducted in 2008 found 2 to 3 redds per mile (Glass 2009). More surveys are needed to determine steelhead abundance in the drainage. Efforts are underway to model the abundance and capacity within the watershed (J. Spencer, pers. comm. 2006).

Historically, steelhead likely utilized virtually all of the major streams and tributaries of Rock Creek for some part of their life history. Spawning distribution probably included all accessible portions of the Rock Creek watershed. As now, the highest spawning densities likely occurred in the more complex, braided reaches of the lower mainstem of

Rock Creek, and in third- and fourth-order tributaries with moderate (1-4 percent) gradients (NPCC 2004). The headwaters of the mainstem and Box Canyon are generally above known anadromous fish use (NPCC 2004); however, live steelhead, redds and *O. mykiss* fry have been observed up to the falls in Box Canyon.

All steelhead in the Columbia River Basin upstream of The Dalles Dam, including the Rock Creek population, are classified as summer-run fish (Chapman et al. 1994; ICTRT 2009); however, Yakama Nation biologists suspect that a portion of the steelhead population in Rock Creek consists of winter-run fish.

Recovery Goals and Criteria

The primary goal of ESA recovery plans is for the species to reach the point that it no longer needs the protection of the Act – i.e. to be delisted. Delisting criteria are applied at the DPS level, and are based on determinations of the viability of the independent populations that make up the DPS. Criteria for delisting the Middle Columbia steelhead DPS are described in the Middle Columbia River Steelhead ESA Recovery Plan, to which this plan is an appendix. The primary goal of this plan is for the Rock Creek steelhead population to be restored to moderate risk, also called "maintained," status and thus to support recovery of the Mid-Columbia steelhead DPS.

Two kinds of criteria enter into a delisting decision: population or demographic parameters (the biological viability criteria) and "threats" criteria related to the five listing factors detailed in the ESA (see Section 1.1). The threats criteria define the conditions under which the listing factors, or threats, can be considered to be addressed or mitigated. Together these make up the "objective, measurable criteria" required under section 4(f)(1)(B). Both kinds of criteria are discussed in Chapter 3.

Biological Criteria

The ICTRT developed biologically based viability criteria for ESA-listed salmon and steelhead in the Interior Columbia domain. The ICTRT based its approach to recovery on guidance from the NMFS Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). This memorandum provides general direction for setting viability objectives at the ESU/DPS and component population levels.

A viable salmonid population is defined as an independent population that has negligible (less than 5 percent) risk of extinction over a 100-year period (McElhany et al. 2000). The ICTRT criterion for a viable ESU/DPS is that all extant MPGs and any extirpated MPGs critical for proper functioning of the ESU/DPS should be at low risk. The ICTRT provided additional criteria for determining MPG viability (Section 3.2.1). The risk levels of the populations within the DPS collectively determine MPG viability and, in turn, the likely persistence of the DPS. However, it may not be necessary for all of the populations to attain the lowest risk level. There may be more than one way for a DPS to meet the viability criteria. The ICTRT called alternative combinations of population risk status that would meet the MPG and DPS-level criteria "recovery scenarios."

According to the ICTRT's recovery scenario for the Cascades Eastern Slope Tributaries MPG, the Rock Creek steelhead population should reach "moderate" risk status in order to support overall DPS viability. Moderate risk is defined as between 25 and 5 percent risk of extinction over a 100-year time period.

The ICTRT classified the Rock Creek steelhead population as a "Basic" sized population, based on historical habitat potential (ICTRT 2007b) and provided viability criteria for a Basic population, as follows (ICTRT 2007b):

Abundance
For a Basic population, viable status, i.e. a 5 percent or less risk of extinction over a 100-year timeframe, would require a mean minimum abundance threshold of 500 naturally produced spawners. Maintained status or moderate (6 to 25 percent) risk would also require a mean minimum abundance of 500 naturally produced spawners because populations with fewer than 500 individuals are at higher risk for inbreeding depression and a variety of other genetic concerns (ICTRT 2007b).

Productivity
Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater than 1.0 to allow the population to rapidly return to abundance target levels. For a maintained/moderate risk Basic population at 500 naturally produced spawners, productivity should be at about 1.3. For the population to reach viable status (the 5 percent risk level), productivity should be >1.56.

Spatial Structure and Diversity
In general, the ICTRT defined two goals, or biological or ecological objectives, that spatial structure and diversity criteria should achieve (ICTRT 2007b):

- Natural rates and levels of spatially mediated processes should be maintained.
- Natural patterns of variation should be maintained.

Threats Criteria and Approach

Section 3.2.2 of the Plan describes the listing factors and listing/threats criteria that must also be addressed to de-list the DPS. These listing factors are the features that were evaluated under section 4(a)(1) when the initial determination was made to list the species for protection under the ESA.

At the time of a delisting decision, NMFS will use the listing factors/threats criteria to review the status of the section 4(a)(1) listing factors and determine if the affected DPS is recovered to the point that it no longer requires protections of the ESA. NMFS expects that if the proposed actions described in this and other Middle Columbia River steelhead recovery plans are implemented, they will make substantial progress toward meeting the listing factor/threats criteria. These criteria are identified in Section 3.3 and address the five listing factors that were evaluated under section 4(a)(1): 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) over-utilization for commercial, recreational, scientific or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence.

Current Status Assessment

Chapter 4 summarizes the ICTRT's viability assessment results for Rock Creek's Middle Columbia River steelhead population. The ICTRT identified the Rock Creek steelhead population as a summer run within the Cascades Eastern Slope Tributaries MPG. It classified the population as a "basic" population based on historical habitat potential (ICTRT 2007b).

- *Abundance/Productivity:* The ICTRT determined that, at present, no direct estimates of abundance and productivity are available for Rock Creek steelhead. There have been no systematic redd surveys in this population area; however, the general presence of steelhead has been documented. Because of the lack of direct information on current or indirect assessments of abundance and productivity, the ICTRT assigned the Rock Creek steelhead population High risk.

- *Spatial Structure and Diversity:* The ICTRT gave the Rock Creek population a combined integrated Spatial Structure/Diversity rating of Moderate risk. Based on the ICTRT historical potential analysis, the team found that the Rock Creek population has a relatively simple population structure, containing a single major spawning area (MaSA). It determined that although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderate risk rating for complexity. It noted that there have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low for this parameter.

- *Overall Risk Rating*: The ICTRT concluded that the Rock Creek steelhead population does not currently meet viability criteria because the abundance/productivity parameter is assigned a High risk rating and the overall spatial structure/diversity parameter, Moderate risk. The lack of direct estimates of abundance and productivity for this population was a factor in assigning a high risk rating (ICTRT 2009).

Limiting Factors and Threats

The reasons for a species' decline are generally described in terms of limiting factors and threats. Analysis of limiting factors and threats across the entire species' life cycle forms the basis for designing recovery strategies and actions. NMFS defines limiting factors as the biological and physical conditions limiting DPS and population status (e.g. elevated water temperature), and defines threats as those human activities or naturally induced actions that cause the limiting factors (e.g. removal of riparian vegetation for agricultural or residential purposes, which causes loss of shade and, consequently, elevated water temperature).

While the term “threats” carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are typically legitimate human activities that may at times have unintended negative consequences on fish populations—and that can also be managed in a way that minimizes or eliminates the negative impacts.

For steelhead and other salmonids, survival to reproduce depends on a complex, interacting system of environmental conditions, with different conditions needed for each life stage. Optimal water temperature, for example, varies (within limits) for adult migration vs. egg incubation or juvenile rearing. In addition, the particular factors limiting production may vary across different sections of the tributary drainage used by a particular population. Data on a full range of potential limiting factors is rarely available at the reach level.

The list of potential limiting factors for the Rock Creek steelhead population, as for the other populations that make up the Middle Columbia steelhead DPS, is based on a substantial body of research on salmonids, local field data and field observations, and the considered opinions of regional experts. These are implicitly hypothetical statements to be tested, made with the expectation that by taking action in the face of some degree of scientific uncertainty, monitoring the results, continuing to conduct research to further characterize the factors limiting the population, and adapting our management actions in response, the state of our knowledge will improve and so will the survival of these fish, although not necessarily in a directly parallel process.

Freshwater Habitat

Habitat factors (e.g. temperature) may limit steelhead production in the Rock Creek watershed and, to some extent past and/or current land use practices may constitute threats that stress naturally occurring conditions. For example, anthropogenic changes in the subbasin may have reduced stream shade in some reaches and thereby increased the intensity of low summer flows and high summer water temperatures that likely occur naturally in some parts of the watershed because of aspect, low precipitation and high width-to-depth ratios.

The factors potentially limiting freshwater steelhead productivity within the Rock Creek watershed include degraded channel structure and complexity (lack of key habitat quantity and habitat diversity), riparian function and condition, and floodplain function and channel migration processes; low summer flows, high summer water temperatures, increased fine sediment, altered food web, predation, and competition with exotic species such as smallmouth bass. Section 5 provides more detail on limiting factors.

- *Hydrograph*: Seasonally low to intermittent and/or subsurface stream flows are potentially a primary factor that limits steelhead production in the Rock Creek. The hydrograph in the Rock Creek system is naturally flashy, with high intensity, short duration flow. Currently, low to nonexistent flows in the mainstem and many tributaries during late summer, fall and early winter might limit juvenile steelhead production and mobility. In 2008, sufficient pool volume was available to support an estimated population of 38,300 to 95,700 age-0 steelhead (Glass 2009).

- *Stream temperature:* Seasonally high water temperature is potentially a primary factor limiting steelhead production in the Rock Creek watershed (Glass 2009). Average daily summer water temperatures in the lower Rock Creek subbasin sometimes rise above 63.5°F (17.5°C), and in some reaches rise above 73.4°F (23.9°C) (Aspect Consulting 2005), a level considered potentially lethal for steelhead and other salmonids (Glass 2009). One headwater reach of Rock Creek is listed on the Washington State Department of Ecology's 2008 water quality assessment (303(d) list as impaired, Category 5 (Washington Department of Ecology 2008).

- *Riparian function and condition*: Rock Creek's rocky substrate and steep topography inhibit riparian forest stand development along many reaches. However, current riparian condition and function in some sections of Rock Creek have been disturbed due to wildfires, recent major flood events, past and current grazing, historical timber practices, road construction, and/or other land uses. Despite these influences, the amount of vegetation in the valley bottom has been increasing steadily since 1938, presumably due to fire suppression (Aspect Consulting 2005).

- *Channel structure and complexity:* Findings from a reconnaissance survey of portions of Rock Creek indicate that the creek's general channel characteristics may be similar to those noted in a 1860s survey (e.g., broad rocky reaches), with the exception that the lowermost reach may be somewhat wider today than historically (Aspect Consulting and WPN 2004). In-channel and riparian habitats in some stream reaches may be degraded because of disturbance from grazing, historic timber harvest, road construction, and other anthropogenic changes, and from major flood events. Inundation of the one-mile reach above Rock Creek's mouth by the pool behind John Day Dam (Columbia River) has altered key habitat quantity and complexity.

- *Floodplain function and channel migration processes*: The effects from several threats locally influence channel migration processes and morphology. Bridges on the Bickleton Highway (scheduled for replacement) and Old Highway 8 locally constrain flow and channel migration processes. The stream channel in lower Rock Creek is highly dynamic and moves across the valley bottom with regularity, often switching channels during flood flows (Aspect Consulting 2005). One of the more dynamic sections of the stream channel is upstream of the Old Highway 8 Bridge, where the channel changed courses many times over the period of photo record, and has distinctly different courses in 1938, 1969, 1996, and 2002 (Aspect Consulting 2005). This section of the creek also is one of the least densely vegetated along the mainstem of Rock Creek (Aspect Consulting 2005), reflecting the dynamic nature of the channel.

- *Sediment routing:* Sediment loads (the percentage of fines in spawning gravel, embeddedness and turbidity) in the Rock Creek subbasin may have increased over historical conditions; however, recent data indicates that the percent fines in spawning gravels is within a range that is unlikely to significantly affect survival of eggs and alevins in redds (Glass 2009).

- *Competition for food sources:* Changes in the hydrologic regime and riparian conditions could potentially affect the food web. No data are available regarding food sources in Rock Creek.

- *Predation and competition*: The building of the John Day Dam and subsequent inundation of the bottom mile of Rock Creek introduced exotic piscivorous fish such as smallmouth bass and channel catfish to the lower mile and reservoir and made it possible for these fish to travel up Rock Creek. Exotic piscivorous species have been observed in Rock Creek up to approximately one mile above the Old Hwy. 8 bridge (RM 3.5-4) (G. Morris, pers. comm. 2006). However, no exotic fish were observed upstream of the inundated area of the creek during snorkel surveys conducted in 2008 (Glass 2009).

Harvest

Without more data on Rock Creek steelhead abundance, and without targeted tagging of Rock Creek fish, the percentage of Rock Creek steelhead that are harvested in the Columbia River cannot be specifically calculated. However, it may be inferred that Rock Creek steelhead are subject to the same relatively low overall harvest rate estimated for other Middle Columbia steelhead. Washington Department of Fish and Wildlife (2008) estimates that in 2002, tributary fisheries in the Rock Creek area affected about 1 percent of the adult steelhead and less than 1 percent of the juvenile steelhead. Mainstem non-treaty commercial and recreational fisheries have an estimated impact of 1.6 percent of the A-run Middle Columbia steelhead (NMFS 2008a), and mainstem treaty fisheries have an estimate 6.64 percent impact (NMFS 2008a) for an overall estimated harvest impact of less than 10.24 percent.

Hatcheries

Steelhead are not stocked in Rock Creek, and very few fin-clipped steelhead have been seen in the subbasin. Hatchery strays of upriver origin may enter and spawn in Rock Creek, but the effects of out-of-subbasin hatchery programs on the Rock Creek steelhead population are unknown. Nevertheless straying, especially by non-indigenous hatchery steelhead, remains a concern.

Out-of-Subbasin Limiting Factors and Threats

Out-of-subbasin factors are discussed briefly in Section 5.3 and provide information on the influences from harvest, the Columbia River hydrosystem, and ocean conditions. The 2008 FCRPS Biological Opinion (NMFS 2008b) details the influences from the Columbia River hydrosystem on Middle Columbia steelhead populations. The Columbia River Estuary Module http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-

Recovery -Plans/upload/Estuary-Module.pdf discusses factors that limit viability of Rock Creek steelhead in the Columbia River Estuary.

Recovery Strategy and Actions

In Chapter 6, a recovery strategy is described to address the significant data gaps and uncertainties regarding the status of the Rock Creek steelhead population and to address the potential limiting factors based on the existing, best available science. In addition, Appendix II details the many efforts already underway to improve and protect watershed conditions in the Rock Creek subbasin—efforts that will benefit salmonids as well as other wildlife and human communities.

The overall aim of the recovery strategy is to gather needed data on the Rock Creek steelhead population and the watershed, while also addressing the potential limiting factors in a manner that is most likely to contribute to improved viability. The strategies and actions were defined through review and analysis of currently available information. They are consistent with actions identified in the Lower Mid-Columbia Mainstem Subbasin (including Rock Creek) Management Plan (NPCC 2004), and address risks identified in the ICTRT's viability assessment for the population. A collaboratively designed implementation program that includes a research, monitoring, and evaluation (RM&E) plan to support adaptive management will allow managers the flexibility to continue or change course in response to new information.

Gather Information on VSP Parameters

Information on population abundance, productivity, spatial structure, and diversity is needed to set priorities and determine the actions that will make the greatest contribution to steelhead recovery. Needed actions include initiating systematic surveys to calculate abundance and productivity, completing a gap analysis, characterizing spatial distribution and genetic variation, and evaluating hatchery contribution to naturally spawning steelhead in the Rock Creek subbasin.

Protect and Conserve Existing Good Quality Habitat

Protecting existing good quality habitat is a high priority. Many objectives are likely to be met through habitat protection and the associated natural recovery of upland and riparian areas. Protection and maintenance includes compliance with existing rules and regulations, such as the State Forest Practices Act, the State Shorelines Act, and other State, County, and local regulations designed to protect aquatic habitat. Protection may also incorporate a wide range of voluntary actions such as fencing riparian areas, participation in the various agricultural land reserve programs, and voluntarily implementing programs that help to avoid impacts to aquatic resources. Land acquisitions, easements, cooperative agreements, and protective land designations can also be used to facilitate high quality habitat protection.

Restore and Enhance Habitat and Gather Information

Restoration and enhancement of habitat conditions for salmon and steelhead populations should improve population production. The value of these actions to the viability of the population will depend on whether or not they address the factors currently limiting the population or threats associated with factors that are now, or are trending toward, becoming limiting, e.g. climate change. The success of these strategies is further enhanced when actions build from existing restoration efforts and incorporate a range of project types.

- Conduct research to further evaluate factors and threats limiting habitat diversity in the Rock Creek watershed. This information is needed to prioritize and focus restoration and enhancement activities.

- Improve instream flow during critical periods. The seasonally low to intermittent stream flow in the area of steelhead distribution upstream of the Columbia River backwater is a likely limiting factor on abundance, productivity, spatial structure, and diversity. Low flow can result in stranding and mortality to eggs or juvenile steelhead. Further study is required to determine causes of low flow, whether anthropogenic or natural, and options to enhance stream flow.

- Improve water quality, reduce summer high temperatures. Water temperature is directly related to riparian vegetative cover and other watershed characteristics such as channel complexity, floodplain function, and upland processes. Hence, many types of habitat actions are likely to function together to improve water quality, particularly water temperature. The more directly related actions to improve water quality include the following:
  - Restore riparian vegetative cover with appropriate native vegetation to increase shading.
  - Develop sediment control basins.
  - Manage livestock grazing in the riparian areas.
  - Increase deep pool habitat.

- Improve/restore riparian function and condition. Actions to address this potential limiting factor include the following:
  - Restore riparian vegetative cover with appropriate native vegetation.
  - Manage livestock grazing in riparian areas.
  - Eradicate invasive plant species from riparian areas.
  - Relocate beaver to suitable areas.

- Increase key habitat by improving or restoring channel structure and complexity. Key habitat, as described in Chapter 5, refers to characteristics such as riffles, pools, suitably aerated gravel, etc. that are essential to each steelhead life stage. The following actions would increase key habitat:
  - Introduce large woody debris (LWD) and other structures in stream as appropriate.
  - Improve riparian vegetation to provide future source of LWD.
  - Stabilize and protect stream banks.

- Fertilize streams with fish carcasses.

- Improve and/or restore floodplain function and channel migration processes. Reconnecting floodplain habitats and side channels would provide additional sheltered rearing areas. Increasing LWD and other actions such as relocating floodplain infrastructure where feasible, implementing road management BMPs or decommissioning roads as appropriate, could restore floodplain function, moderate the "flashiness" of the stream, and moderate peak flows.

- Improve or restore optimal sediment processes. Watershed processes of runoff and sediment production can be improved through restoring native upland plant communities, implementing appropriate upland management practices, managing off-road vehicle usage to reduce erosion and fine sediment, and managing roads to reduce fine sediment inputs to the stream.

- Conduct research to determine status of food web and presence or absence of competition from other species for food resources.

- Conduct research to determine presence and extent of predation on steelhead by non-native species such as piscivorous fish.

Review and Reduce Effects of Harvest

As described in Chapter 5, only adipose fin-clipped steelhead are allowed to be retained in sport or recreational fisheries in Rock Creek and throughout the Columbia River, but wild steelhead may be accidentally caught and/or retained. Poaching is also considered a problem. Actions to address harvest effects include better review of current practices, enforcement of regulations, and considering whether any modifications are needed. Outreach and education to reduce retention or handling mortality is also recommended.

Research Effects of Hatchery Fish (If Any)

As described in Chapter 5, hatchery strays of upriver origin may enter and spawn in Rock Creek, but no data are available on this issue. Monitoring for hatchery fish should be included in the RM & E program to be developed collaboratively after this plan is adopted.

Address Out-of-Subbasin Limiting Factors

Out-of-subbasin limiting factors for Rock Creek steelhead may include hydroelectric operations, harvest, interactions with hatchery fish, predation, food, disease, competition, and ocean conditions. Actions to address these factors for all Middle Columbia steelhead are presented in the Columbia River Estuary Module (NMFS 2007b) and the 2008 FCRPS Biological Opinion (NMFS 2008b), summarized in the Hydro Module (NMFS 2008c). Table ES-1 summarizes the recovery strategy designed to improve the viability of Rock Creek steelhead. The table links strategies and actions to the factors and threats potentially limiting steelhead viability in the subbasin, and the viability parameters and life stages that would be most affected. Priority locations are provided for some strategies, with stream reaches or areas where actions should be applied first to gain the greatest benefit.

Table ES-1. Recovery Strategy and Actions for the Rock Creek Population of Middle Columbia Steelhead.

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
Gather information on population size and productivity	• Gather information to calculate abundance and productivity estimates	Entire Watershed	Addresses a primary risk factor	N/A	N/A	abundance and productivity	N/A
Gather information on population spatial structure and diversity	• Conduct surveys to determine steelhead distribution. • Identify major life history strategies • Conduct studies to address genetic variation in the population • Assess the contribution of hatchery-origin steelhead to the natural spawning population	Entire Watershed	Addresses a primary risk factor	N/A	N/A	spatial structure and diversity	N/A
Gather information to further evaluate habitat limiting factors and threats in the basin	• Conduct surveys to evaluate factors affecting habitat quantity. • Conduct surveys to evaluate factors affecting habitat quality. • Conduct surveys to evaluate factors affecting habitat function.	Entire Watershed	Addresses a primary risk factor	N/A	All life stages	All VSP parameters	N/A
Protect and conserve natural ecological processes that support steelhead viability throughout the life cycle	• Apply BMPs to livestock grazing practices • Apply BMPs to road system management • Apply BMPs to agricultural practices to control erosion and runoff • Manage stream corridor through conservation easements and/or land acquisition from willing sellers • Adopt and manage cooperative agreements	Throughout watershed	Key habitat quality and diversity, sediment inputs, water quality, stream flow	Road and grazing management activities	All life stages	abundance, productivity, spatial structure and diversity	Immediate for sediment, other parameters 5-15 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
Improve instream flow during critical periods	• Most of the actions listed in other categories are likely to improve stream flow. • Protect springs	Rock Creek downstream of RM 19.2, lower Squaw Creek, upper watershed	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water tempera-ture, thermal refugia, altered food web	Road and grazing management, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve water quality, reduce summer water temperatures	• Restore riparian vegetative cover with suitable native vegetation to increase shading • Restore natural habitat functions and processes through actions previously identified • Develop sediment control basins • Management livestock grazing in the riparian areas • Increase deep pool habitat	Rock Creek downstream of RM 19.2, lower Squaw Creek, upper watershed	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water temperature, thermal refugia	Road and grazing management,, particularly in riparian areas, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve and/or restore riparian function and condition	• Restore riparian vegetation cover with appropriate native vegetation • Manage grazing in riparian areas • Eradicate invasive plant species from riparian areas • Relocate beaver to suitable areas	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	Hydrology, channel stability, fine sediment, water quality, key habitat quantity, habitat diversity, riparian vegetation	Road and grazing management activities	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve and/or restore channel structure and complexity	• Introduce LWD and other structure in stream as appropriate • Improve riparian vegetation to provide future source of LWD • Stabilize and protect stream banks • Fertilize streams with fish carcasses	Rock Creek downstream of RM 19.2, lower Squaw Creek, headwater streams	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water temperature, thermal refugia, altered food web	Road and grazing management, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve and/or restore floodplain function and	• Reconnect floodplain habitats • Reconnect side channels	Rock Cr. Below	Channel morphology,	Road and grazing	Juvenile rearing stage	abundance and productivity	0-10 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
channel migration processes	• Increase role and abundance of wood and large organic debris in streambeds • Relocate floodplain infrastructure, roads; improve maintenance, rehabilitate, decommission as appropriate • Remove dikes • Relocate beaver to suitable areas	unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	habitat diversity, key habitat quantity, riparian vegetation, fine sediments, flow, water temperature	management activities			
Address upland processes to minimize unnatural rates of erosion and runoff	• Restore native upland plant communities • Implement upland management practices to restore natural runoff and sediment production • Implement off-road vehicle management actions that reduce erosion and fine sediment • Implement road management actions that reduce fine sediment inputs	Upper watershed	Hydrology, channel stability, fine sediment, water quality, key habitat quantity, habitat diversity, riparian vegetation	Road and grazing management activities and off-road vehicles	Egg, fry	abundance and productivity	0-50 years
Review and reduce effects of harvest on the Rock Creek steelhead population	• Review the need for modifications to sport, tribal, and commercial harvest practices on direct catch and by-catch • Increase outreach efforts to reduce the number of steelhead caught in recreational fisheries near the mouth of Rock Creek	All fishing areas in the basin, the Columbia River, and off-shore	Direct mortality	Harvest	Adult migrants	abundance	0-10 years
Research and reduce hatchery effects on the Rock Creek steelhead population	• Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish • Monitor the potential for hatchery strays entering Rock Creek • Increase the proportion of Columbia River Basin hatchery steelhead marked with coded-wire	Columbia River and anadromous reaches of Rock Creek	Competition, genetic introgression	Hatchery releases	Juvenile and adult	abundance, spatial structure, diversity	2-10 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
	tags, especially in programs shown to stray at high rates in the past, and support the mass marking of all hatchery steelhead releases with, at a minimum, an adipose fin-clip						
Reduce competition with and predation by non-native piscivores	• Reduce the number of non-native predators	Columbia River and mouth of Rock Creek	Predation	Non-native species	fry and juvenile	abundance and productivity	2-20 years
Reduce mortality and/or improve passage at hydroelectric facilities	• Implement strategies and actions in the FCRPS Biological Opinion (NMFS 2008b)	Columbia River	Passage, predation, direct mortality	Hydroelectric plants	juvenile and adult	abundance	0-20 years

[1] Expected response of action implementation ─ including how long for action to achieve full effectiveness
[2]BLM=Bureau of Land Management, Ecology=Washington Department of Ecology, KC=Klickitat County, KCCD=Klickitat County Conservation Districts, NRCS=National Resources Conservation Service, Private=private landowners and businesses, TNC=The Natural Conservancy, WDFW=Washington Department of Fish and Wildlife, WRIA31 PU = WRIA 31 Planning Unit, YN=Yakama Nation, MNFS=National Marine Fisheries Service, ODFW=Oregon Department of Fish and Wildlife

Implementation

Implementation of this plan depends on the voluntary actions and cooperation of local entities and citizen groups. An important part of implementation will be working cooperatively to develop an implementation schedule that includes site-specific actions and a detailed research, monitoring, and evaluation (RM&E) plan addressing the information needs described in Chapter 8. A detailed RM&E plan should be developed collaboratively after the Rock Creek recovery plan is adopted.

NMFS has worked independently with the Yakama Nation, Washington Department of Fish and Wildlife, Klickitat County, and local entities to develop the recovery plan for the Rock Creek steelhead population. NMFS encourages the formation of a planning group for the Washington Gorge Management Unit, a forum or entity that would take responsibility for coordinating implementation of the plan. Implementing the proposed recovery actions for steelhead in the Washington Gorge Management Unit, including the Rock Creek subbasin, would be a primary task for a Washington Gorge Area Regional Board, subject to concurrence by state, tribal, and local governments and the opportunity for involvement and comment by the public.

In addition to their co-management responsibility and key role on a Gorge recovery board (if one is formed), the Yakama Nation will play an important role during implementation because of their funding agreement under the Columbia Basin Fish Accords, which are three Memorandums of Agreement (MOAs) entered into between the Federal Columbia River Power System (FCRPS) action agencies (Bonneville Power Administration, U.S. Army Corps of Engineers and the Bureau of Reclamation), four tribes, and one state. The most relevant MOA to the Middle Columbia River steelhead is with the Columbia River Inter-Tribal Fish Commission and the three treaty fishing tribes—Confederated Tribes of the Umatilla Indian Reservation; Confederated Tribes of the Warm Springs Reservation; and Confederated Tribes and Bands of the Yakama Nation. The MOAs are 10-year action agency commitments for projects to benefit fish affected by the FCRPS, with a focus on ESA-listed fish. The projects will be reviewed through the Northwest Power Act processes for implementing the Fish and Wildlife Program, administered by the Northwest Power and Conservation Council. The agreement secures approximately $200,000 per year for habitat actions, including project management, in the Rock Creek subbasin. Some of the projects listed in Table 7.1 will be implemented with these funds.

Cost Estimates

There are existing Federal, tribal, state, county, and other local programs that are being carried out in the Rock Creek subbasin. Many of those programs are described in Appendix II. This plan assumes that those existing programs are funded, and will continue to be. At this time, this plan provides only additional incremental costs that would be incurred with implementation of this recovery plan. Total time and cost of recovery is estimated for the DPS as a whole and is iincorporated into Chapter 8 of the Middle Columbia River Steelhead DPS Recovery Plan. As implementation proceeds and implementation schedules are developed, the costs of both existing programs and new incremental costs of this recovery plan will be included in those schedules. If existing programs are not funded, funding will be identified as a need in the implementation schedule and the cost estimates for the recovery plan adjusted accordingly.

In this chapter, cost estimates are provided for an extensive and reach-specific set of potential habitat actions that will be refined and prioritized in the implementation process. NMFS, in coordination with the Yakama Nation, developed these cost estimates for a range of habitat improvement/restoration actions that may be necessary to address limiting factors and improve viability of the Rock Creek steelhead population. These costs, presented in Table 7-1 (in Chapter 7), are general range summaries. Habitat action costs for recovery over a 10-year time period are estimated to be up to $1.8 million ($0.9 million for years 1-5). The actions listed in Table 7-1 do not include or account for RM&E (Section 6.1.1), because those costs will be developed as part of implementation planning, nor do they account for tributary fishery harvest management and enforcement activities (Section 6.1.4), which are considered existing programs, nor for costs of out-of-subbasin effects, which are addressed through other programs (Section 6.1.6).

RM&E and Adaptive Management Framework

Comprehensive, empirical monitoring data on fish populations and habitat are needed to identify appropriate projects and locations, populate habitat/production capacity modeling efforts (such as EDT, AHA, or other appropriate models), and inform adaptive management for the salmonid recovery plan. Information on fish distribution, abundance, productivity, habitat conditions, genetic diversity, pathogen levels, and other population parameters, as well as on population limiting factors, is necessary to help direct and evaluate these efforts. A coordinated monitoring program is needed to ensure that these various needs, including salmonid recovery planning, are met.

As part of implementing the Rock Creek steelhead recovery plan, a detailed monitoring and evaluation program will be collaboratively designed and incorporated into an adaptive management framework based on the principles and concepts laid out in the NMFS' guidance document, Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (NMFS 2007a) http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf. The Rock Creek subbasin monitoring and evaluation program will build on existing programs designed for monitoring tributary habitat in the Rock Creek subbasin and will emphasize regional coordination.

1. Introduction

The Endangered Species Act of 1973 (ESA) requires NOAA's National Marine Fisheries Service (NMFS) to develop recovery plans for species listed under the Act. The purpose of recovery plans is to identify actions needed to restore threatened and endangered species to the point that they are again self-sustaining elements of their ecosystems and no longer need the protections of the ESA.

This plan focuses on the conservation and survival of Middle Columbia River steelhead (*Oncorhynchus mykiss*) in the Rock Creek subbasin, which encompasses an area of 223.2 sq. miles (578.1 sq. km) in southeastern Washington and joins the Columbia River at RM 230, about 12 miles upstream of John Day Dam (Figure 1-1). Lake Umatilla, the reservoir behind the dam, inundates the lower mile of Rock Creek.

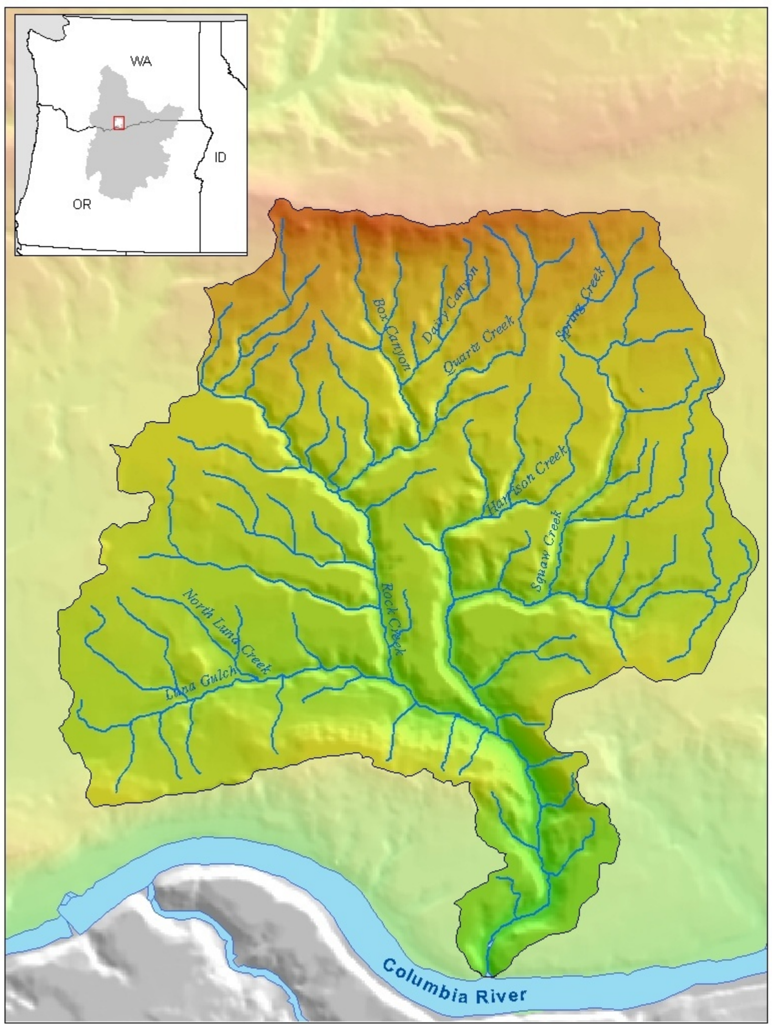

Figure 1-1 Rock Creek Subbasin.

"Steelhead" is the name commonly applied to the anadromous form of the biological species Oncorhynchus mykiss. The common name of the non-anadromous, or resident, form is rainbow trout. When NMFS originally listed the species as threatened on March 25, 1999 (64 FR 14517), it was classified as an "evolutionarily significant unit" (ESU) of salmonids that included both forms. Recently, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS) (Good et al. 2005). NMFS listed the Middle Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). Rainbow trout are under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). The DPS is made up of steelhead populations in Oregon and Washington tributaries of the Columbia River upstream of the Hood and Wind River systems, up to and including the Yakima River. Reasons for listing the Middle Columbia River steelhead DPS included low returns to the Yakima River, poor abundance estimates for Klickitat River and Fifteenmile Creek winter steelhead, and an overall decline of naturally producing "stocks" within the DPS.

NMFS developed this recovery plan with involvement and input from the Yakama Nation, Washington Department of Fish and Wildlife, Klickitat County, the Washington State Governor's Salmon Recovery Office, other Federal agencies, state agencies, local governments, and the public. While NMFS is directly responsible for ESA recovery planning for salmon and steelhead, NMFS believes that ESA recovery plans for salmon and steelhead should be based on the many state, regional, tribal, local, and private conservation efforts already underway throughout the region. Local support of recovery plans by those whose activities directly affect the listed species, and whose actions will be most affected by recovery efforts, is essential. NMFS therefore supports and participates in locally led collaborative efforts to develop recovery plans that involve local communities, state, tribal, and Federal entities, and other stakeholders.

1.1 Purpose of Plan

This Plan provides a roadmap for restoring the Rock Creek steelhead population and its habitats to a level that supports recovery of the Middle Columbia River steelhead DPS and allows the population to become a viable component of its ecosystem. The Plan is a guidance document. It describes the current status of the Rock Creek population and its habitat, and summarizes the results of a technical assessment of the population's viability. The Plan also identifies the factors and threats potentially affecting the population and proposes strategies and actions designed to aid in the population's recovery. Finally, the Plan provides an implementation and adaptive management framework for making needed future adjustments on the road to recovery.

1.1.1 ESA Requirements

Section 4(f) of the ESA requires that a recovery plan be developed and implemented for species listed as endangered or threatened under the statute.

ESA section 4(a)(1) lists factors for re-classification or delisting that are to be addressed in recovery plans:

A. The present or threatened destruction, modification, or curtailment of [the species'] habitat or range
B. Over-utilization for commercial, recreational, scientific or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting its continued existence

ESA section 4(f)(1)(B) directs that recovery plans, to the extent practicable, incorporate:

1. a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
2. objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this chapter, that the species be removed from the list; and;
3. estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

In addition, it is important for recovery plans to provide the public and decision makers with a clear understanding of the goals and strategies needed to recover a listed species and the science underlying those conclusions (NMFS Interim Recovery Planning Guidance, 2007).

Once a species is deemed recovered and therefore removed from a listed status, section 4(g) of the ESA requires the monitoring of the species for a period of not less than five years to ensure that it retains its recovered status.

1.1.2 Coordination with Others

The Plan aims to provide consistency among related recovery planning and management efforts, including NMFS' Federal treaty and trust responsibilities and the many state and local entities involved in salmon recovery.

Federal Treaty and Trust Responsibilities

Northwest Indian tribes have legally enforceable rights reserving to them a share of the harvestable salmon and steelhead. Achieving the basic purposes of the ESA such that the species no longer needs the protection of the Act may not by itself fully meet these rights and expectations, although it will lead to major improvements in the current situation. Ensuring a sufficient abundance of salmon to sustain harvest can be an important element in fulfilling trust and treaty rights as well as garnering public support for these plans.

It is NMFS policy that recovery of salmonid populations must achieve two goals: (1) the recovery and delisting of salmonids listed under the provisions of the ESA, and (2) the restoration of the meaningful exercise of tribal fishing rights. "It is the agency's view that there is no conflict between the statutory goals of the ESA and Federal trust responsibility to Indian tribes" (Letter from Terry Garcia, Assistant Secretary for Oceans and

Atmosphere, to Ted Strong, Executive Director, Columbia Inter-Tribal Fish Commission, July 21, 1998). Additionally, NMFS "will continue to join with states and tribes to develop a comprehensive approach to the restoration of fish and wildlife resources in a manner that fulfills all obligations under Federal law, including trust obligations to Indian tribes" (ibid.).

Thus, it is appropriate for recovery plans to take these considerations into account and plan for a recovery strategy that includes harvest. In some cases, the desired abundances for harvest may come about through increases in the naturally spawning population. In others, the recovery strategy may include appropriate use of hatcheries to support a portion of the harvest. So long as the overall plan is likely to achieve the biological recovery of the listed ESU, it will be acceptable as a recovery plan.

Treaty Indian fishing rights in the Columbia basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (filed in 1968). The parties to *U.S. v. Oregon* are the United States acting through the Department of Interior (USFWS and Bureau of Indian Affairs) and Department of Commerce (National Marine Fisheries Service), the Warm Springs, Umatilla, Nez Perce, Yakama, and Shoshone-Bannock Tribes, and the states of Oregon, Washington, and Idaho. In *U.S. v. Oregon*, the Court affirmed that the treaties reserved for the tribes 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas.

The Rock Creek subbasin is part of the Yakama Nation's ceded area, and home to the Rock Creek Band of the Confederated Bands and Tribes of the Yakama Nation. Yakama Nation staff developed much of the data on the Rock Creek population. The Yakama Nation is voluntarily participating in recovery planning and implementation in the Rock Creek subbasin and throughout its ceded area as a sovereign with treaty-reserved rights on and off the reservation, and as a fish and wildlife co-manager. In so doing, Yakama Nation does not waive or in any way alter its treaty-reserved rights.

Other Federal, State and Local Responsibilities

To ensure consistency in goals, strategies, and actions and to eliminate needless duplication of effort, the process aims to provide consistency between planning for ESA recovery, the Northwest Power and Conservation Council (NPCC) fish and wildlife program, the State of Washington watershed management and salmon recovery programs, and local planning and regulatory efforts.

The Plan follows ESA guidelines and builds upon direction for Rock Creek in the Lower Mid-Columbia Mainstem Subbasin Plan (NPCC 2004), which included information provided by Yakama Nation, Washington Department of Fish and Wildlife, and other Federal, state, and local entities. The NPCC adopted the subbasin plan into its Fish and Wildlife Program. Additional scientific data are drawn from other more recent sources, including technical products for WRIA 31 and those developed by the technical recovery team appointed by NMFS for the Interior Columbia recovery domain.

1.2 Context of Plan Development

Currently there are 19 ESA-listed ESUs /DPSs of Pacific salmon and steelhead in the Pacific Northwest. For the purpose of recovery planning for these species, NMFS Northwest Region designated five geographically based "recovery domains": Interior Columbia; Willamette-Lower Columbia; Puget Sound and Washington Coast; the Oregon Coast; and the Southern Oregon/Northern California Coast. The range of the Middle Columbia River steelhead DPS is located in the Middle Columbia sub-domain of the Interior Columbia domain (the other Interior Columbia sub-domains are the Snake River and Upper Columbia). Similar opportunities for technical and stakeholder involvement exist in each domain.

1.2.1 Technical Recovery Teams

For each domain, NMFS appointed a team of scientists, nominated for their geographic and species expertise, to provide a solid scientific foundation for recovery plans. The charge of each Technical Recovery Team (TRT) is to define ESU/DPS structures, develop recommendations on biological viability criteria for each ESU or DPS and its component populations, provide scientific support to local and regional recovery planning efforts, and provide scientific evaluations of proposed recovery plans. The Interior Columbia TRT (ICTRT) included biologists from NMFS, states, tribes, and academic institutions.

All the TRTs used the same biological principles for developing their recommendations for ESU/DPS and population viability criteria – criteria to be used, along with criteria based on mitigation of the factors for decline, to determine whether a species has recovered sufficiently to be downlisted or delisted. These principles are described in a NMFS technical memorandum, Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units (McElhany et al. 2000). Viable salmonid populations (VSP) are defined in terms of four parameters: abundance, population productivity or growth rate, population spatial structure, and diversity. A viable ESU/DPS is naturally self-sustaining, with a high probability of persistence over a 100-year time period. Each TRT made recommendations using the VSP framework, based on data availability, the unique biological characteristics of the ESUs/DPSs and habitats in the domain, and the members' collective experience and expertise. Although NMFS encouraged the TRTs to develop regionally specific approaches for evaluating viability and identifying factors limiting recovery, all the TRTs worked from a common scientific foundation.

1.2.2 Planning Forums

In each domain, NMFS has worked with state, tribal, local and other Federal entities to develop planning forums that build to the extent possible on ongoing, locally led recovery efforts. NMFS defined "management units" based on jurisdictional boundaries as well as areas where citizen planning efforts were underway. The Mid-Columbia management units are (1) Oregon; (2) Washington Gorge, which, in turn, is subdivided into three planning areas, White Salmon, Klickitat, and Rock Creek; (3) Yakima subbasin; and (4) Southeast Washington. These management units have active planning and implementation forums, with the exception of the Washington Gorge Management.

In the Washington Gorge Management Unit, NMFS has worked independently with the Yakama Nation, Washington Department of Fish and Wildlife (WDFW), Klickitat County, and local entities to develop the recovery plan for the Rock Creek steelhead population. NMFS encourages the formation of a planning forum for the Washington Gorge Management Unit.

Several small tributaries to the Columbia River drain areas in eastern Washington State upstream of Rock Creek. These tributaries are included in the Washington Gorge Management Unit. There is evidence of steelhead spawning in some of them, but very little data are available. Appendix I summarizes the available information about these tributaries as it relates to recovery of Middle Columbia steelhead. NMFS considers investigating these areas lower priority than restoring the core populations of the DPS, but includes a description of the areas because they are in the management unit and may be of interest to scientists and stakeholders at some future date.

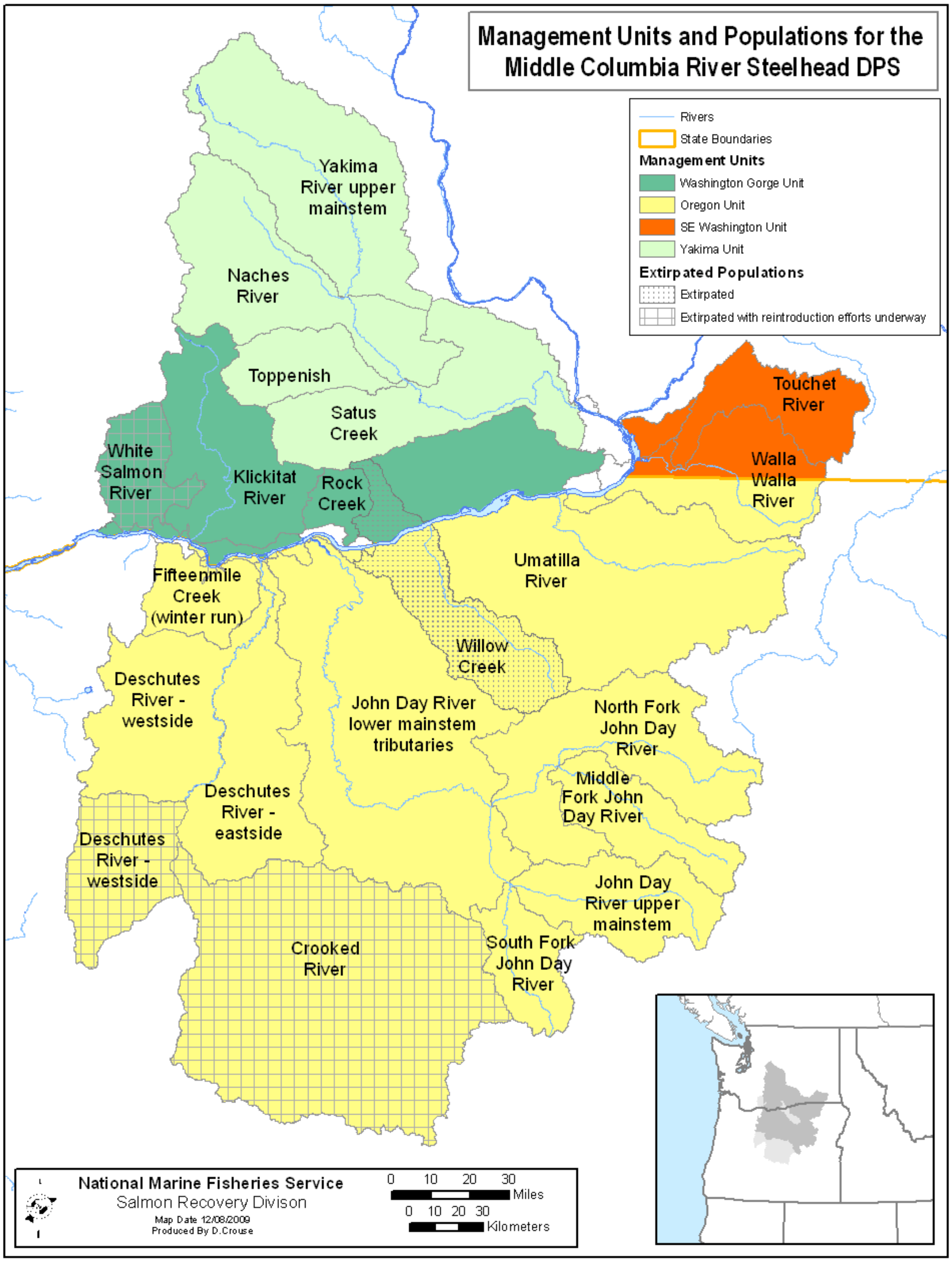

Figure 1-2 NMFS Management Units for the Middle Columbia Steelhead DPS.

1.3 How NMFS Intends to Use this Plan

Although recovery plans are not regulatory and their implementation is voluntary, they are important tools that help to do the following:

- Provide context for regulatory decisions.
- Guide decision making by Federal, state, Tribal, and local jurisdictions.
- Provide criteria for status reporting and delisting decisions.
- Organize, prioritize, and sequence recovery actions.
- Organize research, monitoring, and evaluation efforts.

NMFS will encourage Federal agencies and non-Federal jurisdictions to take recovery plans under serious consideration as they make the following sorts of decisions and allocate their resources:

- Actions carried out to meet section 7(a)(1) obligations to use their programs in furtherance of the purposes of the ESA and to carry out programs for the conservation of threatened and endangered species
- Actions that are subject to ESA sections 4d, 7(a)(2), or 10
- Hatchery and Genetic Management Plans and permit requests
- Harvest plans and permits
- Selection and prioritization of subbasin planning actions
- Development of research, monitoring, and evaluation programs
- Revision of land use and resource management plans
- Other natural resource decisions at the state, Tribal, and local levels

NMFS will emphasize recovery plan information in ESA section 7(a)(2) consultations, section 10 permit development, and application of the section 4(d) rule by considering:

- The importance of affected populations to listed species viability
- The importance of the action area to affected populations and species viability
- The relation of the action to recovery strategies and management actions
- The relation of the action to the research, monitoring, and evaluation plan for the affected species

In implementing these programs, recovery plans will be used as a reference and a source of context, expectations, and goals. NMFS staff will encourage the Federal "action agencies" to describe in their biological assessments how, within the action area, their proposed actions will affect individuals of specific populations and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.

2. Biological Background

This chapter describes habitat and population characteristics for Middle Columbia River steelhead in the Rock Creek subbasin, and also fills in some important background on salmonid biological structure.

2.1 Physical Setting

Rock Creek joins the Columbia River at RM 230, about 12 miles upstream of John Day Dam. The watershed encompasses an area of 223.2 sq. miles (578.1 sq. km). Lake Umatilla, the reservoir behind the dam, inundates the lower mile of Rock Creek. Headwater tributaries of Rock Creek flow out of the Simcoe Mountains, which form the subbasin's northern border and the southern edge of the Yakama Indian Reservation. Major tributaries to Rock Creek include Badger Gulch, Harrison Creek, Luna Gulch, Quartz Creek, White Creek and Squaw Creek (Figure 2-1).

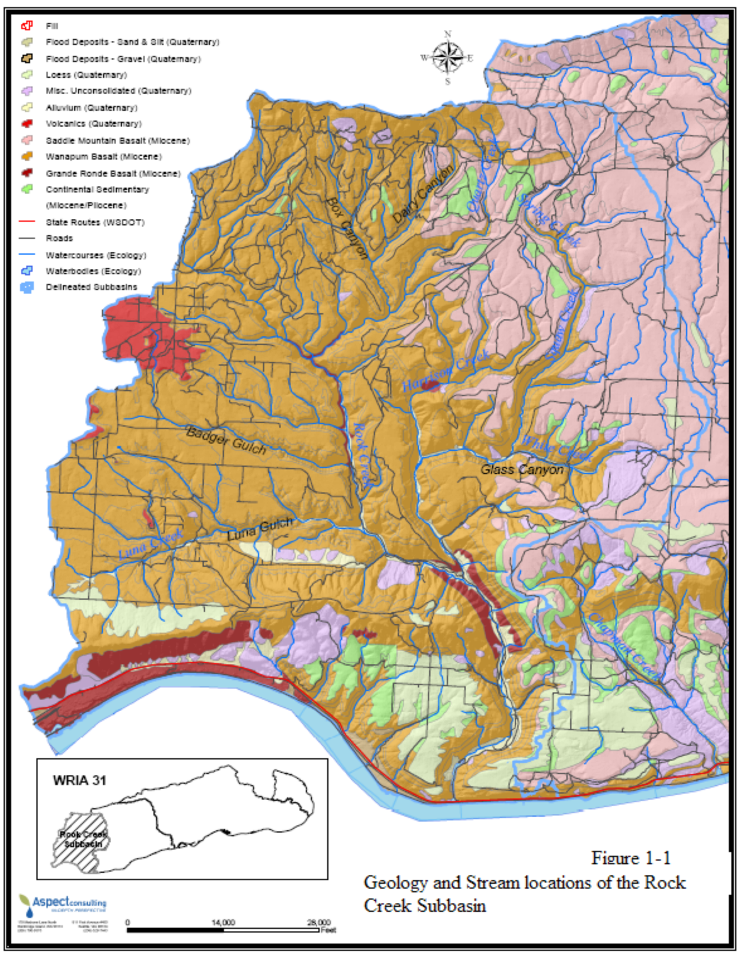

Figure 2-1. Geology and Stream Location of Rock Creek Subbasin (Aspect Consulting and WPN 2004).

The entirety of the Rock Creek subbasin is located within Klickitat County, and the subbasin's population, as of the 2000 census, was 503 persons. It is also part of the area the Yakama Nation ceded to the United States in the Treaty of 1855, while reserving fishing, hunting and gathering rights, among other rights and responsibilities. In the lower and eastern portions of the watershed, the Yakama Nation and its members own a significant amount of trust allotments.

Lands in the Rock Creek subbasin remain largely undeveloped, with nearly 47 percent rangeland, 26 percent forestland, and 4 percent dry land agriculture (Figure 2-2). Most forestland exists at upper elevations; range and agricultural lands generally cover the middle and lower watershed. No irrigated land was estimated to exist as of 2001 (Aspect Consulting and WPN 2004). Developed land accounts for less than one percent of the subbasin area (Aspect Consulting and WPN 2004), little of which is in the floodplain (http://klickitatcounty.org/Road/ContentROne.asp?fContentIdSelected=455695186&fCategoryIdSelected=948111261). Deeply incised canyons with narrow valley floors make up most of the upper portions of the fish-bearing tributaries.

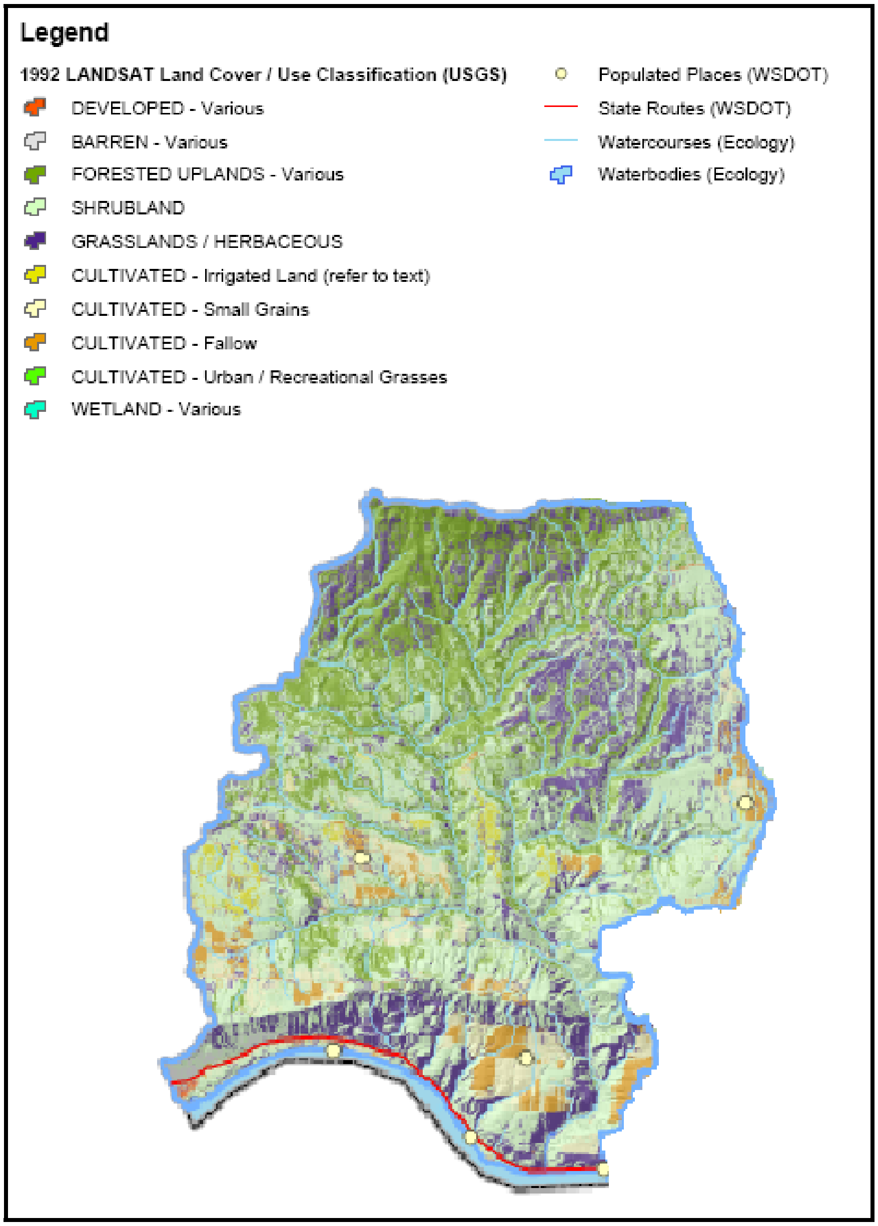

Figure 2-2. Land Use in the Rock Creek subbasin (Adapted from Aspect Consulting and WPN 2004).

2.1.1 Topography

The Rock Creek drainage has a steep topography; approximately 20 percent of the area has side slopes greater than 100 percent (Aspect Consulting and WPN 2004). This is reflected in the subbasin's great stream velocities and erosion potential. The underlying basalt geology also creates several potential barriers to upstream movement of adult anadromous fish, including partial barriers on Quartz Creek (RM 2.4) and upper mainstem Rock Creek (RM 19.4, RM 20.7, RM 22.7), as well as barriers on the upper Rock Creek mainstem (RM 23.1). A falls in Box Canyon (RM 0.3) is likely the only currently impassable barrier under most flow conditions (Greg Morris, pers. comm. 2006). No complete barriers (natural or manmade) to steelhead passage were identified during a habitat survey conducted in 2008 within the area delineated as steelhead distribution (Glass 2009); however, not all of the area was surveyed, and barriers could exist in the unsurveyed portions of the basin. The average Rock Creek basin elevation is 2,162 feet (maximum 4,728 feet, minimum 266 feet) (Aspect Consulting and WPN 2004).

Streams in the Rock Creek subbasin share many similar geomorphic characteristics. From the headwaters, the streams cross a relatively flat basalt plateau at gradients of generally less than 1 percent. Headwater and plateau areas are primarily forested and presumed to be above most anadromous use. Coming off the plateau, streams enter steep-walled canyons where gradients increase to 2-4 percent or more, and substrates consist of gravel, cobbles, and boulders. Although limited by narrow floodplains, riparian vegetation in the canyon reaches is often of relatively good quality (Glass 2009). Suitable spawning gravel and rearing areas (pools) are intermittent and limited by geomorphic conditions. Downstream of the canyon reaches, streams flow through alluvial valleys that support agriculture and range uses. Gradients in these reaches generally drop from between 1 percent and 2 percent near the upper end to less than 1 percent as streams approach the Columbia River (Lautz 2000).

In several reaches of the lower river, large quantities of rock have been deposited where the grade breaks (Glass 2009). Through these avulsed areas, the channel is not well defined and often changes course during major flood events. The riparian vegetation along the creek in the avulsed area is sparse, largely due to the naturally unstable condition of the channel in those reaches. In the rest of the lower Rock Creek basin, riparian vegetation is highly variable (Aspect Consulting 2005). Substrate in alluvial reaches is dominated by gravel and cobble (Glass 2009).

2.1.2 Hydrology

Average annual precipitation in Rock Creek is 16.2 inches (Aspect Consulting and WPN 2004). Flows in the subbasin's canyon and alluvial reaches are considered flashy, rising and falling rapidly in response to precipitation and snowmelt. Snowmelt runoff from higher elevations appears to help sustain flows into early spring. Aspect Consulting and WPN 2004 report that the streams have eroded into and dissected the underlying basalt unit, which has resulted in truncated basalt interflow zones, such that the aquifer units are discontinuous and disconnected from recharge sources. The water flowing in these discontinuous aquifer zones discharges along seepage faces in the canyons (Aspect Consulting and WPN 2004). Numerous springs in the subbasin also discharge groundwater through the incised underlying basalt. These springwater releases may provide important cool water refuges for juvenile salmonids during the summer and early fall when stream flows are at their lowest and stream temperatures are high (NPCC 2004). The releases, however, are generally insufficient to sustain continuous stream flows in the lower subbasin during the dry season (Aspect Consulting and WPN 2004). No flow regulation occurs in the drainage, although small amounts of water are diverted for stock watering.

Stream flow data are very limited for the subbasin and consist of historical information (presence or absence of flow) collected by the General Land Office in the 1860s (reported in Aspect Consulting and WPN 2004), USGS recorded flows from 1962 to 1968, incomplete staff gauge data being collected by the Yakama Nation since 2005, a continuous flow gauge operated by the Washington Department of Ecology since November 2007 (https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?wria=31), and spot measurements of flow taken by Eastern Klickitat Conservation District since 1995 (data for years 1995 to 2003 reported in Aspect Consulting and WPN 2004).

Flows in Rock Creek are typically seasonal, with no measured surface flow at the monitoring station in the summer months (Figure 2-3). The exception in the period of record is the summer of 1965, when flows were maintained as a result of an exceptionally wet winter and spring (Figure 2-4). Monthly median (50 percent exceedance) and low (90 percent exceedance) during August, September, and October are zero cfs (Figure 2-5; Aspect Consulting and WPN 2004). Pools are abundant in the basin even when stream flow is apparently zero. In late fall of 2008, no flow was apparent at the Department of Ecology flow gauge, yet at least 4,229 cubic meters of pool habitat were present. Pool volume in the reach inundated by Lake Umatilla and reaches on Tribal Trust lands were not included in the estimate (Glass 2009).

Historical information, coupled with observed intermittent conditions based on USGS stream gauge data in the 1960s, suggest that the streamflow in Rock Creek is naturally intermittent rather than a condition created by human development (Aspect Consulting and WPN 2004). Much of the runoff generally occurs in two or three discrete events (Figure 2-5). For example, in water year 2008-2009, much of the total runoff occurred during two major events in December, and the balance occurred at much lower levels in spring.

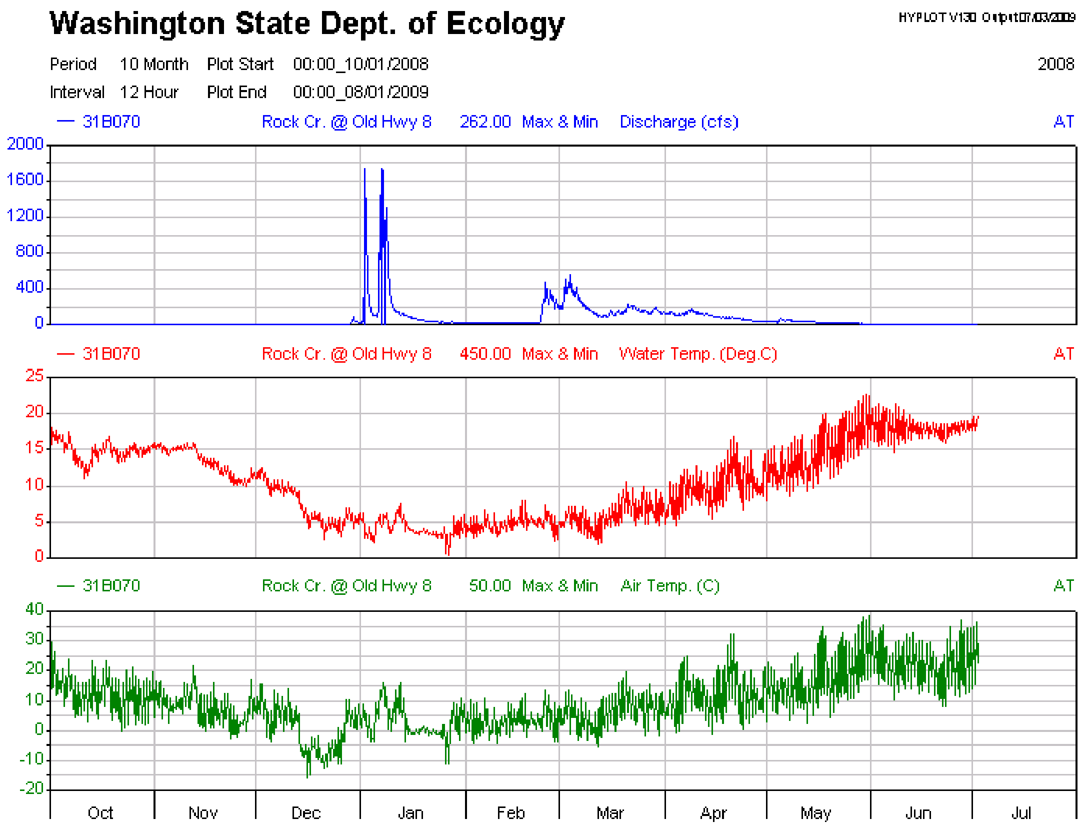

Figure 2-3. Stream flow, water temperature, and air temperature at the Washington Department of Ecology gage near the mouth of the Rock Creek. from October, 2008 to June 2009 (https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=31B070).

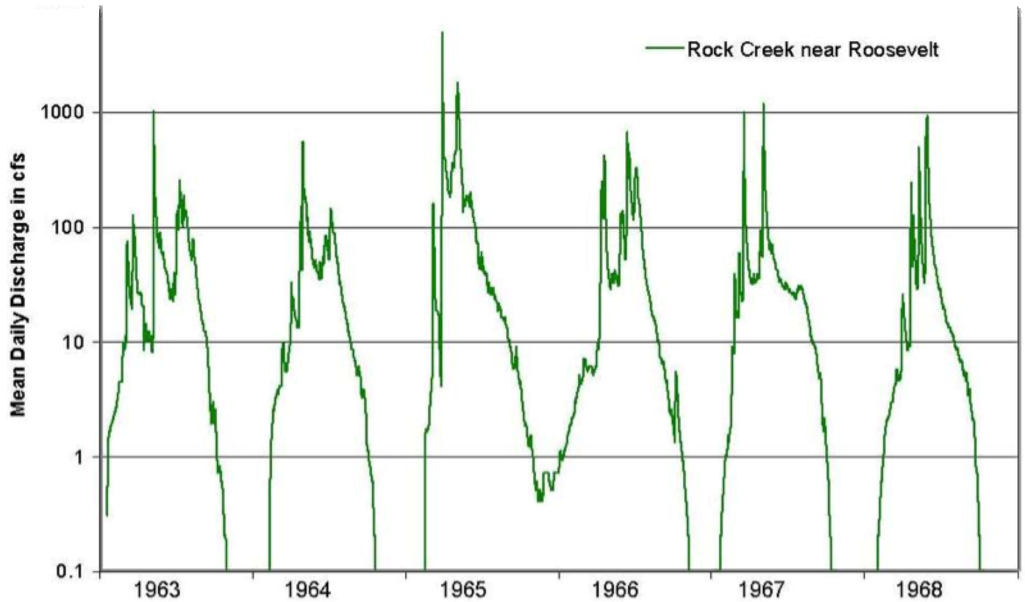

Figure 2-4. Discharge Hydrograph from Historical USGS flow Gauge near Mouth of Rock Creek. (Aspect Consulting and WPN 2004).

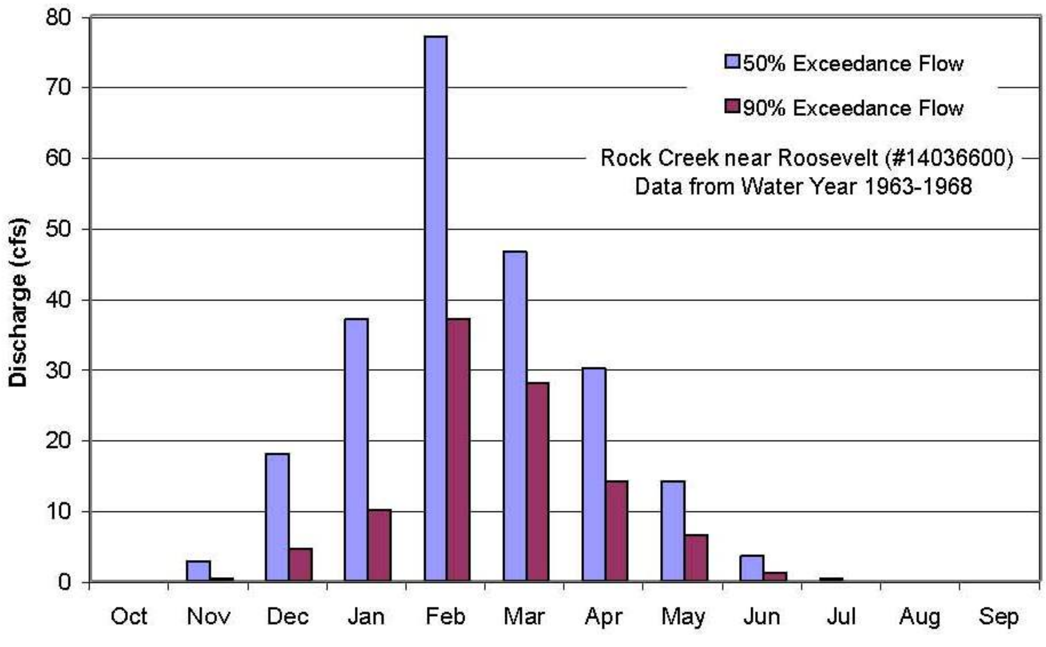

Figure 2-5. Monthly Exceedance Flows for Historical USGS Flow Gage near Mouth of Rock Creek. (Aspect Consulting and WPN 2004).

2.1.3 Water Quality

One headwater reach of Rock Creek is listed for temperature on the Washington Department of Ecology's (Ecology) 2008 water quality assessment list (often referred to as the "303(d) list") as Category 5, a water body that requires a TMDL (Ecology 2008). This headwater reach of Rock Creek was changed from Category 4B (designation for water bodies that have a pollution control program) to Category 5 on 3/24/05 because Ecology had not been able to confirm the results of implementation of items contained within the Memorandum of Agreement (MOA) between Ecology and the Eastern Klickitat Conservation District (EKCD) (http://apps.ecy.wa.gov/wats08/ViewListing.aspx?LISTING_ID=7967).

While only one reach in Rock Creek Basin is designated Category 5, published data suggest that many areas in Rock Creek and some of its tributaries (i.e., Quartz Creek, Squaw Creek, and Luna Gulch) frequently exceeded the applicable temperature criterion (7-DADMax of 17.5°C [63.5° F]) over the period of 1995 to 2004 (Aspect 2005) (Figure 2-6). A supplemental temperature standard (7-DADMax 13°C (55.4°F) for salmonid spawning and incubation is applicable to some areas of Rock Creek and several of its tributaries from February 1 to June 1 (http://www.ecy.wa.gov/pubs/0610038/start.pdf). Conformance with this supplemental standard has not been assessed, but available data suggest that it is exceeded in many areas of Rock Creek (Figure 2-6).

Approximately 73 percent of all O. mykiss observed in the basin during the single pass snorkel surveys conducted in late fall 2008 were found in the mainstem of Rock Creek between water temperature monitoring stations identified in Figure 2-6 as RC-09 and RC-06 (Glass 2009).

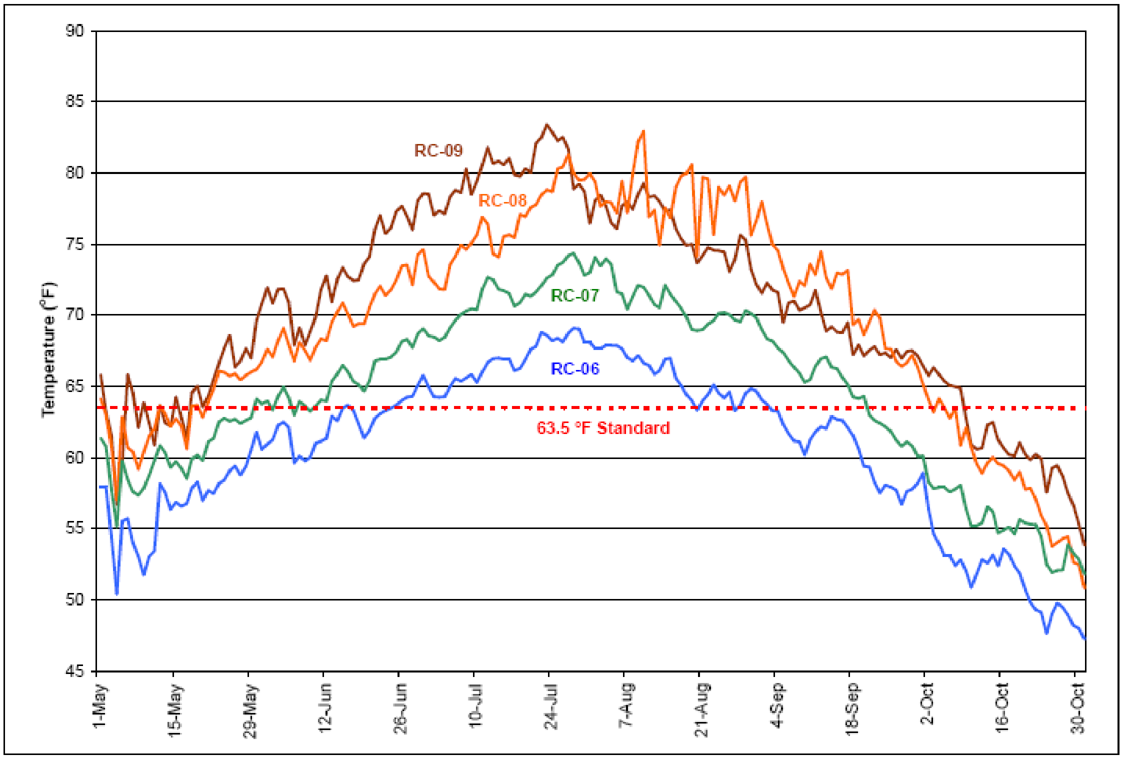

Figure 2-6. Daily maximum water temperature at four stations in Rock Creek based on 1999 to 2004 data (Aspect 2005). (RC-09 is located near the mouth of Rock Creek, RC-8 is located just downstream of the confluence with Squaw Creek, RC-7 is located in Squaw Creek near the confluence with the mainstem Rock Creek, and RC-6 is located upstream in the basin near the confluence with Badger Gulch.)

In 1995-1996, Ecology, in cooperation with the EKCD and the Natural Resources Conservation Service (NRCS), completed an evaluation of water temperature, including the influence of riparian canopy cover, on Rock Creek (Ehinger 1996). For the study, EKCD and the NRCS deployed continuous water temperature loggers at ten stations within Rock Creek during summer 1995. They also conducted a stream habitat evaluation at each station. During the study period, the loggers recorded daily maximum stream temperatures above the current default water temperature standard of 63.5°F (17.5°C) throughout the 1995 summer months at most stations monitored (Aspect Consulting and WPN 2004). In addition, stream habitat evaluation results showed that six of the ten stations had riparian canopy (vegetative) cover more than 10 percent below state target goals for eastern Washington Class A streams (Aspect Consulting and WPN 2004).

However, an analysis of historical aerial photographs revealed that the aerial extent of vegetation in the valley bottom of the mainstem of Rock Creek (lower 15 miles of the creek, excluding the area inundated by Lake Umatilla) increased 10 percent between 1996 and 2002, presumably due to fire exclusion (Aspect 2005). Ehinger (1996) inferred that the high water temperatures in upper Rock Creek "may be natural for a small creek in a hot, sunny summer climate." It was inferred that the lack of riparian shading and rocky substrate contribute to elevated water temperatures in the lower stream reaches (Aspect Consulting and WPN 2004).

Aspect Consulting (2005) arrived at much the same conclusion in an assessment of water temperature in Rock Creek conducted for the WRIA 31 Planning Unit. Namely, *"The Rock Creek subbasin is sparsely populated with minimal water use, and geological conditions limit the quantities of groundwater discharge (springs) to support summer stream flows. This lack of late-season baseflow, in conjunction with the braided and highly dynamic stream channel and limited riparian vegetation in the lower reaches, combine to create a situation in which the water that is present is subject to abundant solar heating, and thus elevated water temperatures, throughout the summer. In this case, ongoing water temperature monitoring by EKCD is serving to establish a baseline condition for the watershed. Although it is difficult to definitively attribute the observed high water temperatures to natural causes versus anthropogenic causes, we are not aware of any evidence indicating it is the result of anthropogenic causes*" (Aspect 2005).

2.2 Life History Characteristics

Based on their level of sexual maturity at the time they enter freshwater and the duration of the spawning migration, steelhead populations in the Mid-Columbia DPS can be classified into one of three major life history patterns: summer run, winter run or a summer/winter run arrangement (ICTRT 2009). All steelhead in the Columbia River Basin upstream of The Dalles Dam, including the Rock Creek population, are classified as summer-run fish (Chapman et al. 1994; ICTRT 2009); however, Yakama Nation biologists suspect that a portion of the steelhead population in Rock Creek consists of winter-run fish.

Generally, winter-run fish enter freshwater streams between November and April, while summer-run fish enter rivers between May and October. Summer steelhead are of the stream-maturing type and enter freshwater in a sexually immature condition, requiring several months in freshwater to mature and spawn. Winter steelhead mature in the ocean and enter freshwater with well-developed gonads and spawn relatively shortly after river entry (Bambrick et al. 2004).

A combination of environmental cues, including flow and temperature, triggers spawn timing throughout the Rock Creek watershed. Spawning begins in the middle of March and peaks in early April. Upper watershed steelhead appear to spawn about three weeks later. Steelhead generally spawn in clear, cool streams with suitable gravel size, depth and flow velocity (Bjornn and Reiser 1991).

The range of temperatures steelhead can tolerate varies with life stage and other characteristics. Temperatures above 13.3ºC (56ºF) can result in egg mortality (McEwan and Jackson 1996), and sufficient oxygen may not be available above 21.1ºC (70ºF) (ibid.). Steelhead are considered to do best at a range of 12.8-15.6º C (55.0-60.1º F) (Rich 1987). Temperatures above 22º C (72º F) are highly stressful for steelhead.

Data regarding the average age, sex ratio, etc. of steelhead spawners in Rock Creek are unavailable. Further research is needed. Spawners include an unknown number of kelts (repeat spawners). Some steelhead are *iteroparous* (do not die after spawning), and may return to the ocean for a short period and repeat the spawning migration, a life history adaptation that may be fundamental to ensuring population stability. Respawning rates may be affected by environmental conditions, location of the natal stream, sex, size at maturity, and differences in the energy investment of spawning among different stocks and species (Fleming 1998). Reduced genetic contributions from populations formerly supplemented by repeat spawners may contribute to the decline of steelhead stocks in the Columbia River basin (NMFS 2000).

Iteroparity for Mid-Columbia steelhead ranges from reported rates of 2-4 percent above McNary Dam (at RM 292 measured from the mouth of the Columbia) (Busby et al. 1996) to 17 percent in the unimpounded tributaries below Bonneville Dam (at RM 146.1) (Leider et al. 1986). Iteroparity rates for Rock Creek River steelhead are unknown.

Steelhead eggs incubate at the same time that temperatures are increasing. In the lower mainstem Rock Creek where densities are highest, fry emerge very rapidly. Densities from electro-shocking suggest that emergence occurs in approximately 60 days (NPCC 2004). Because the lower mainstem becomes intermittent from July to late October, juvenile steelhead in the reach must use a number of life history strategies. While juveniles likely continue to rear in upper watershed areas during these months, juveniles reared in the lower watershed may either move out of the system, take advantage of pools, risking encounter with smallmouth bass and other predators in the lower 3.5-4.0 miles, or move higher in the watershed (NPCC 2004). No predators were observed during snorkel surveys conducted in mid-October/early-November 2008 above the area inundated by Lake Umatilla excluding reaches on Tribal Trust lands (Glass 2009). Approximately 94 percent of the juveniles observed in the Rock Creek mainstem during these snorkel surveys were in the lower sections of the river, downstream of the Bickleton Bridge, suggesting that few, if any, move upstream to rear (Glass 2009). It is unknown if juveniles rearing anywhere in the watershed move into the Columbia River to rear.

While limited information exists on steelhead abundance in the Rock Creek drainage, some observations suggest that a significant number of steelhead may use the Rock Creek watershed in years of good water and ocean conditions. Surveys conducted by the Yakama Nation in lower Rock Creek in 2002, 2003, and 2004 found as many as 35 to 45 steelhead redds per mile in the lower 5 miles, and extensive distribution of redds throughout the watershed (NPCC 2004). These surveys, however, were intermittent and were not conducted across all potential habitat. Spawner surveys conducted in April of 2009 found 20 redds and 6 additional features that might have been redds between the Bickleton Bridge and River Mile 4 (Glass 2009), the equivalent of roughly 2 redds per mile. Survey crews estimated that 30 to 40 percent of that area could not be adequately surveyed due to limitation on visibility, so the actual number of redds may have been 30 to 40 percent higher than reported. More surveys are needed to determine steelhead abundance and distribution in the drainage. Further research is needed.

Steelhead are believed historically to have utilized virtually all of the accessible major streams and tributaries of Rock Creek for some aspect of their life history. Spawning distribution probably included all accessible portions of the Rock Creek watershed. Then as now, the highest spawning densities likely occurred in the more complex, braided reaches of the lower mainstem of Rock Creek, and in third- and fourth-order tributaries with moderate (1-4 percent) gradients (NPCC 2004). The headwaters of the mainstem are generally above known anadromous fish use (NPCC 2004), although spawning has been observed up to the falls in Box Canyon (RM 0.3).

The current steelhead range in the Rock Creek watershed likely resembles the historical condition. During single pass snorkel surveys conducted in early October to mid-November 2008, no O. Mykiss were observed in the Rock Creek mainstem between the upper extent of the Lake Umatilla backwater and approximately RM 2, where the survey stopped because of private land ownership. The snorkel survey resumed at approximately RM 5. Approximately 78 percent of the O. mykiss observed in the Rock Creek subbasin were between RM 5 and the confluence with Quartz Creek and a few more fish (5 fish total) were observed upstream of Quartz Creek. O. mykiss were also observed in Squaw Creek to a point roughly 5 miles upstream of the confluence with White Creek. The majority of O. mykiss in Squaw Creek were found downstream of the confluence with Harrison Creek. No O. mykiss were observed in the lower reaches of Quartz Creek. Since anadromous and resident forms cannot be visually distinguished, the proportion of the O. mykiss observed in 2008 that were of anadromous form is unknown (Glass 2009).

Yakama Nation biologists observed live steelhead adults, redds, and *O. mykiss* fry in Rock Creek above the confluence of Quartz Creek; in Quartz Creek above the Box Canyon confluence; and in lower Box Canyon up to the falls at RM 0.3 (from the Quartz Cr. confluence). Live steelhead and redds have also been confirmed 0.5 RM up an unnamed tributary located below the confluence of Rock and Quartz creeks (RM 19.2). Additionally, steelhead adults and *O. mykiss* fry have been observed in Badger Gulch. Landowners report having seen steelhead adults, redds, and *O. mykiss* fry up Luna Gulch, from the confluence with Rock Creek, and into Squaw Creek, as well as catching steelhead in White and lower Harrison creeks (up to RM 2.5). Yakama Nation staff also noted 'anecdotal' evidence of steelhead being observed in mainstem Squaw Creek 2.0 miles upstream of the confluence with White Creek. In the Rock Creek mainstem, BLM staff recorded seeing steelhead above the confluence with Quartz Creek as well as in lower Quartz Creek (BLM 1985; BLM 1986). Figure 2-7 shows the current distribution of Rock Creek steelhead as observed by Yakama Nation biologists.

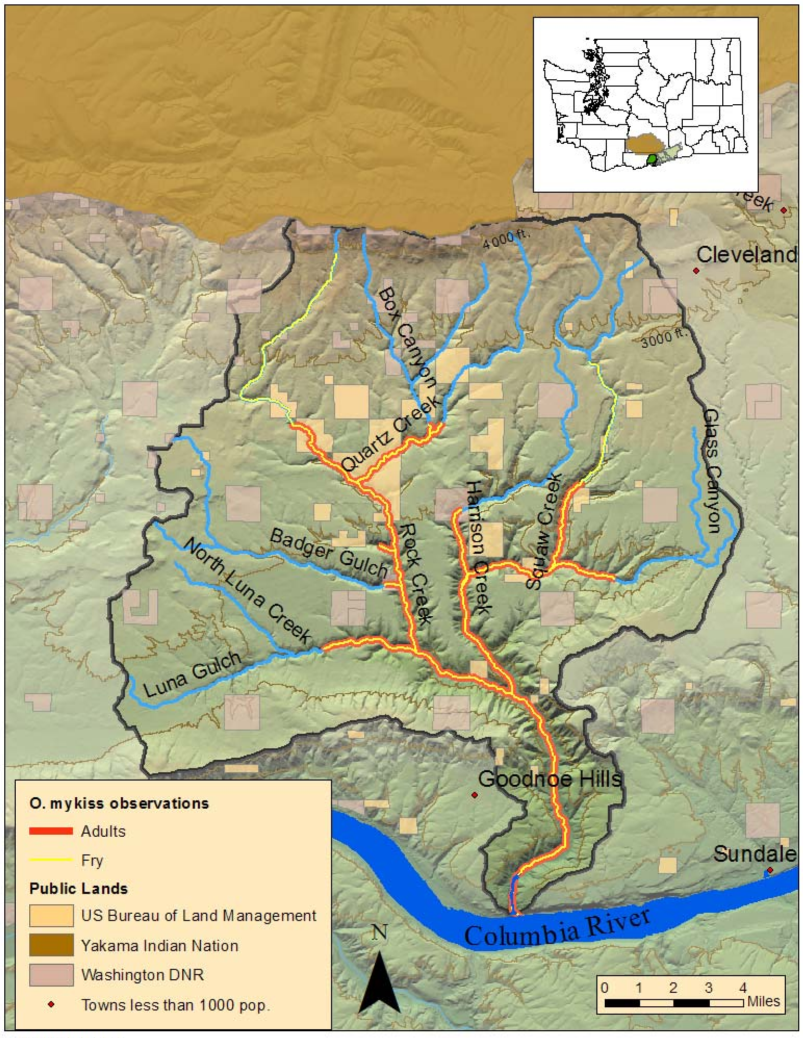

Figure 2-7. Rock Creek subbasin major streams and steelhead distribution as observed by Yakama Nation Fisheries Staff.

2.3 Major Spawning Area

The ICTRT identified potential intrinsic habitat in the Rock Creek subbasin as a major spawning aggregation (MaSA) for Middle Columbia River steelhead (Figure 2-8). The ICTRT delineated this MaSA using model results that estimated the historical amount of potentially accessible spawning and rearing habitat available to a specific population based on stream width, gradient, and valley width from GIS-based analysis of tributary habitat associated with each population (ICTRT 2005).

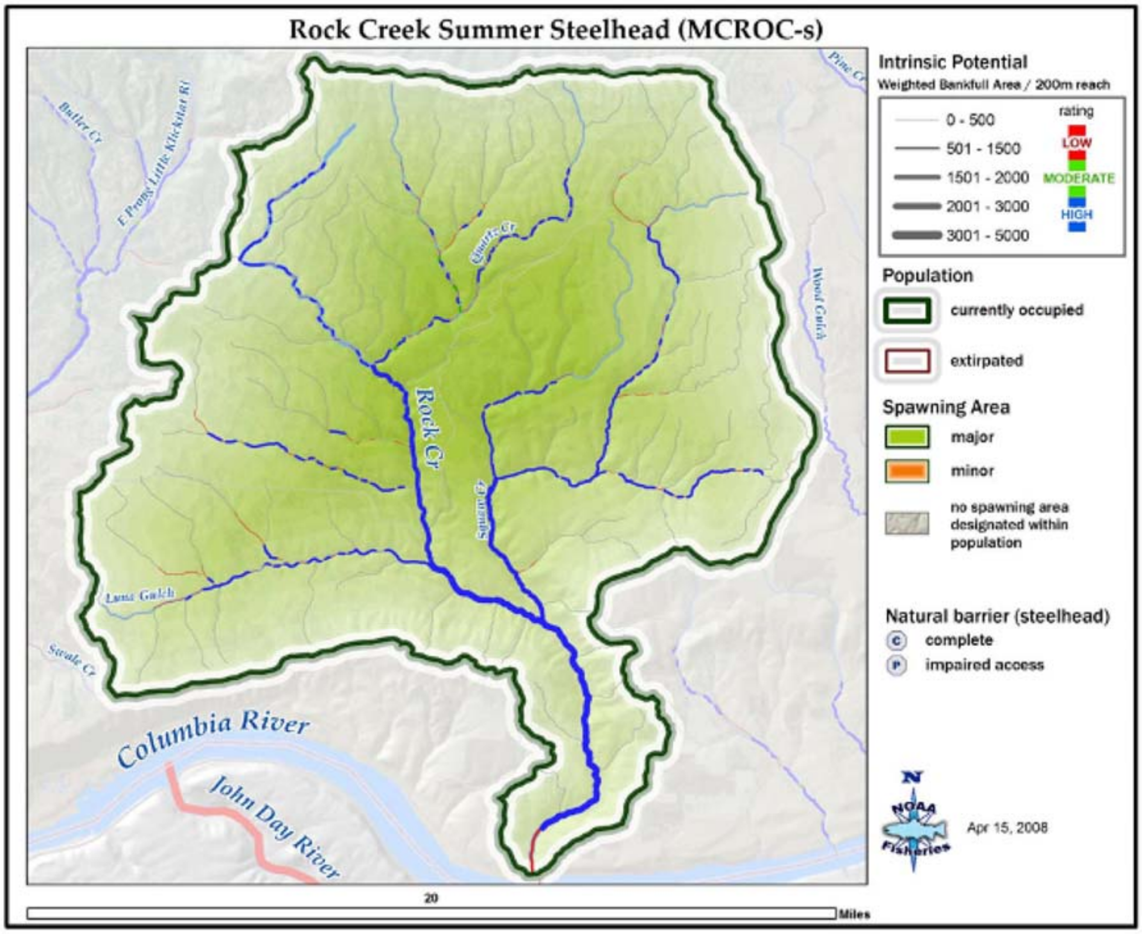

Figure 2-8. Rock Creek summer steelhead population boundary and major (MaSA) and minor (MiSA) spawning areas (ICTRT 2009).

2.4 Salmonid Biological Structure

Salmonid species' homing propensity (their tendency to return to the locations where they originated) creates unique patterns of genetic variation and connectivity that mirror the distribution of their spawning areas across the landscape. Diverse genetic, life history, and morphological characteristics have evolved over generations, creating runs highly adapted to diverse environments. It is this variation that gives the species as a whole the resilience to persist over time.

Historically, a salmon ESU or, as in this case, steelhead DPS typically contained multiple populations connected by some small degree of genetic exchange by straying spawners. Thus, the overall biological structure of the ESU/DPS is hierarchical; spawners in the same area of the same stream will share more characteristics than those in the next stream over. Fish whose natal streams are separated by hundreds of miles will have less genetic similarity. The ESU or DPS is a metapopulation defined by the common characteristics of populations within a geographic range. Recovery planning efforts focus on this biologically based hierarchy (Figure 2-9).

McElhany et al. (2000) formally identified two levels in this hierarchy for recovery planning purposes: the evolutionarily significant unit (ESU) or distinct population segment (DPS) and the independent population. The ICTRT identified an additional level between the population and ESU/DPS levels, which they call a major population group (MPG) (McClure et al. 2003).

2.4.1 Distinct Population Segments

An ESU or DPS is a distinctive group of Pacific salmon or steelhead that is uniquely adapted to a particular area or environment. Because of the hierarchical structure of salmonid populations, the concept of "distinctive group" has received considerable attention and refinement. An ESU is defined as a group of Pacific salmon that is "substantially reproductively isolated from other conspecific units and represents an important component of the evolutionary legacy of the species" (Waples 1991). A "population segment" is considered distinct (a DPS and hence, like ESUs, considered a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, or if it occupies an unusual or unique ecological setting, or if its loss would represent a significant gap in the species' range. ESUs/DPSs may contain multiple populations that are connected by some degree of migration, and hence may have a broad geographic range across watersheds and river basins.

2.4.2 Major Population Groups

Within an ESU/DPS, independent populations can be grouped into larger populations that share similar genetic, geographic, and/or habitat characteristics (McClure et al. 2003). These "major groupings" of populations (MPGs) are isolated from one another over a longer time scale than that defining the individual populations, but retain some degree of connectivity greater than that between ESUs/DPSs. The relationship between ESU/DPS, MPG, and independent populations is depicted in Figure 2-9.

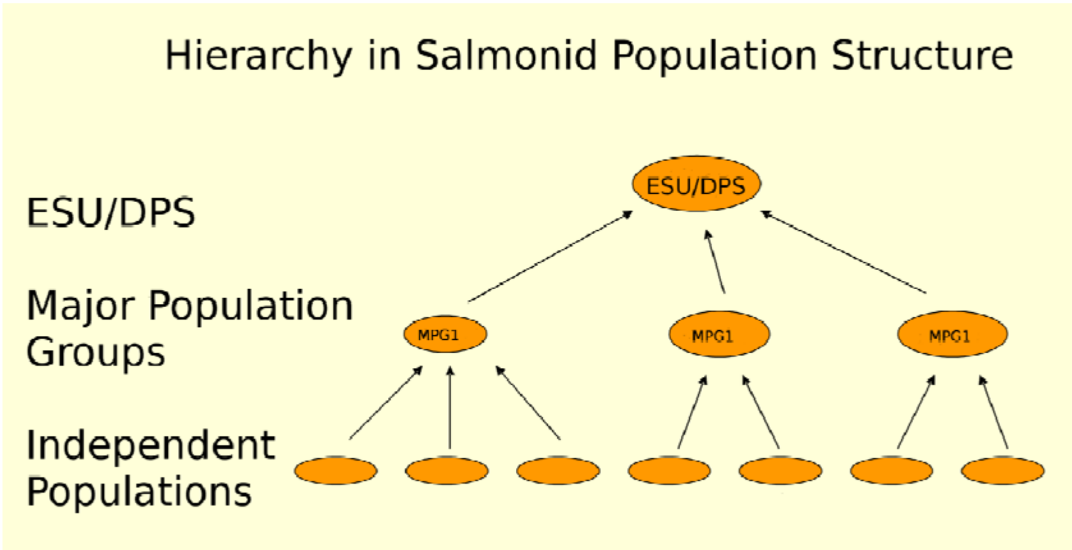

Figure 2-9 Hierarchical levels of salmonid species structure as defined by the TRTs for ESU/DPS recovery planning.

2.4.3 Independent Populations

McElhany et al. (2000) defined an independent population as follows:

"…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. For our purposes, not interbreeding to a 'substantial degree' means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame."

2.5 Middle Columbia Steelhead Populations and MPGs

The ICTRT identified 17 extant and 3 extirpated independent steelhead populations in the Middle Columbia River steelhead DPS (McClure et al. 2003). These populations are shown in Figure 2-10. The ICTRT delineated the populations based on genetic information, geography, life-history traits, morphological traits, and population dynamics.

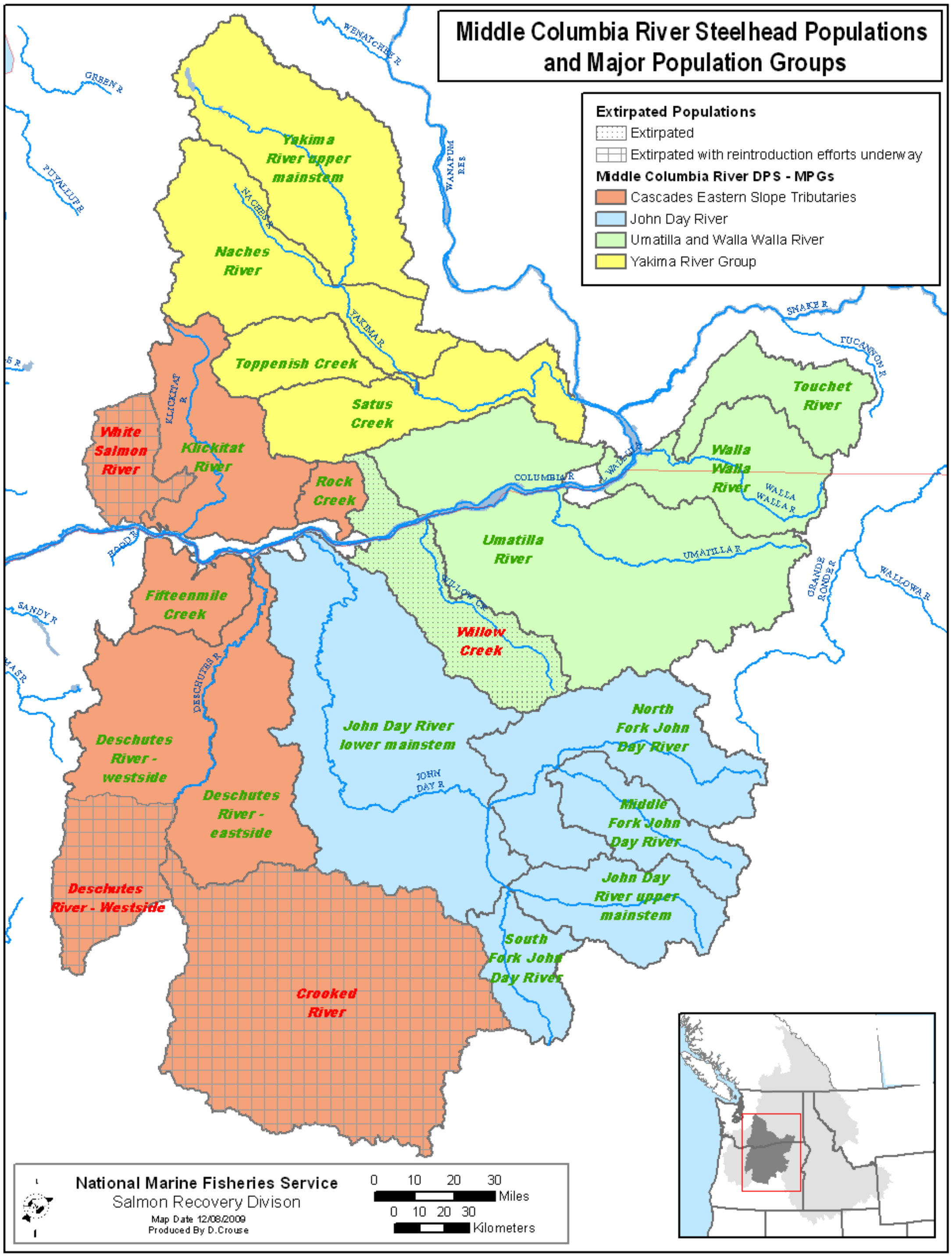

Figure 2-10 Middle Columbia River Steelhead Independent Populations and Major Population Groups.

The ICTRT grouped these independent populations into four major population groups (MPGs) within the DPS: the Cascades Eastern Slope Tributaries MPG, Yakima River

MPG, John Day River MPG, and Umatilla/Walla Walla MPG. The Rock Creek population is one of five extant populations (Klickitat River, Fifteenmile Creek, Rock Creek, Deschutes River Eastside, and Deschutes River Westside) and two extirpated populations (White Salmon River and Deschutes Crooked River) comprising the Cascades Eastern Slope Tributaries MPG (Figure 2-10). Populations in the group are united primarily by proximity and occupy diverse habitats, generally those draining the eastern slopes of the Cascades and the Columbia Plateau.

The ICTRT classified the Rock Creek population as Basic in size, based on intrinsic habitat potential (Table 2-1)

Table 2-1 Rock Creek Summer Steelhead Basin Statistics (ICTRT 2009).

Drainage area (km^2)	586
Stream lengths km (total) [a]	169
Stream lengths km (below natural barriers) [a]	166
Branched stream area weighted by intrinsic potential (km^2)	0.665
Branched stream area km^2 (weighted and temp. limited) [b]	0.411
Total stream area weighted by intrinsic potential (km^2)	0.683
Total stream area weighted by intrinsic potential (km^2) temp limited [b]	0.419
Size / Complexity category	Basic
Number of Major Spawning Areas (MaSAs)	1
Number of Minor Spawning Areas (MiSAs)	0

a. All stream segments greater than or equal to 3.8m bankfull width were included
b. Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22°C.

3. Recovery Goals and Delisting Criteria

The primary goal of ESA recovery plans is for the species to reach the point that it no longer needs the protection of the Act – i.e. to be delisted. Recovery plans may also contain "broad-sense goals," defined in the recovery planning process, that go beyond the requirements for delisting to address, for example, other legislative mandates or social, economic, and ecological values.

Delisting criteria are applied at the DPS level, and are based on determinations of the viability of the independent populations that make up the DPS. Criteria for delisting the Middle Columbia steelhead DPS are described in the Middle Columbia Steelhead ESA Recovery Plan, to which this plan is an appendix. This chapter provides recovery goals for the Rock Creek steelhead population, describes the criteria to be used to assess progress toward those goals, and describes the role of the Rock Creek steelhead population in overall DPS viability.

There are two kinds of criteria that enter into a delisting decision: population, or demographic parameters (the biological recovery criteria) and "threats" criteria related to the five listing factors detailed in the ESA. The threats criteria define the conditions under which the listing factors, or threats, can be considered to be addressed or mitigated. Together these make up the "objective, measurable criteria" required under section 4(f)(1)(B) of the ESA. Both kinds of criteria are discussed in this chapter.

3.1 Recovery Goals

The primary goal of this plan is for the Rock Creek steelhead population to be restored to a sufficiently robust condition to support recovery of the Mid-Columbia steelhead DPS. If a local, collaborative Washington Gorge Area Regional Board is formed, it may choose to define broad-sense goals for the Rock Creek subbasin and other areas within the Washington Gorge Management Unit. The Board's broad-sense goals for the area would likely build upon direction from, and respond to interests identified by various stakeholders in the area. These goals would then guide the Board as it defines and implements future recovery actions for the Rock Creek subbasin.

For DPS delisting, the Rock Creek population should attain at least "moderate" risk status, also called "maintained" status by the ICTRT (described in more detail in Section 3.2.2). Achieving moderate risk status would be consistent with putting the population on a trajectory toward achieving viability. The ICTRT cautioned against closing off the options for any population prematurely, because of the many uncertainties in predicting the biological response to recovery actions (ICTRT 2007a).

3.2 Biological Viability Criteria

The ICTRT developed biologically based viability criteria for ESA-listed salmon and steelhead in the Interior Columbia domain. The ICTRT based its approach to recovery on guidance from the NMFS Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). This memorandum provides general direction for setting viability objectives at the ESU/DPS and component population levels. A viable population is defined as an independent population that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (McElhany et al. 2000).

Viability criteria at the population level address four VSP parameters (McElhany et al. 2000):

- *Abundance* – the average number of spawners in a population over a generation or more,
- *Productivity* – the performance of a population over time in terms of recruits produced per spawner,
- *Spatial Structure* – a population's geographic distribution and the processes that affect that distribution, and
- *Diversity* – the distribution of genetic, life history and phenotypic variation within and among populations.

The ICTRT grouped specific population level criteria into two categories to assess viability at the independent population level: measures addressing abundance and productivity, and measures addressing spatial structure and diversity. The viability of an independent population is determined by integrating risks across the four parameters. Additionally, the VSP guidelines (McElhany et al. 2000) recommend that a viable DPS population should be large enough to:

1. have a high probability of surviving variation observed in the past and expected future;
2. be resilient to environmental and anthropogenic disturbances;
3. maintain genetic diversity; and
4. support/provide ecosystem functions.

They also recommend that viable populations demonstrate sufficient productivity to support a net replacement rate of 1:1 or higher at abundance levels established as long-term targets. Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater than 1.0 to allow the population to rapidly return to abundance target levels.

3.2.1 DPS and MPG Viability Criteria

The major objectives of the ICTRT's viability criteria are to ensure preservation of basic historical metapopulation processes including 1) genetic exchange across populations within an ESU/DPS over a long time frame; 2) the opportunity for neighboring populations to serve as source areas in the event of local population extirpations; 3) population distribution within an ESU/DPS so that they are not all susceptible to a specific localized catastrophic event (ICTRT 2007b).

Since MPGs are geographically and genetically cohesive groups of populations, they are critical components of ESU/DPS spatial structure and diversity. Having all MPGs within an ESU/DPS at low risk provides the greatest probability of persistence for the ESU/DPS. Thus, the ICTRT criterion for a viable ESU/DPS is that all extant MPGs and any extirpated MPGs critical for proper functioning of the ESU/DPS should be at low risk.

The population level assessments provide the basis for evaluation viability at the MPG level and, in turn, for the DPS as a whole. The combined effects of requiring each MPG to sustain a minimum number of viable populations, representation of larger size classes of populations, major life history patterns and the maintenance requirement provide for a network of populations that would sustain the DPS.

Further, the following five criteria should be met for an MPG to be regarded as low risk (viable) (ICTRT 2007b):

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) should meet viability standards. This equals to four for this MPG.

2. At least one population should be classified as "Highly Viable."

3. Viable populations within an MPG must include some populations classified (based on historical intrinsic potential) as "Very Large," "Large" or "Intermediate" generally reflecting the proportions historically present within the MPG. In particular, Very and Large populations should be at or above composite historical fraction within the MPG.

4. All major life history strategies (e.g. spring and summer run timing) that were present historically within the MPG should be represented in populations meeting viability requirements.

5. Remaining MPG populations should be maintained with sufficient abundance, productivity, spatial structure, and diversity to provide for ecological functions and to preserve options for DPS recovery.

The DPS criterion requiring viable populations in each of the extant MPGs would result in sustainable production across a substantial range of environmental conditions. The presence of viable populations across MPGs would preserve a high level of diversity within the DPS, thereby promoting long-term evolutionary potential for adaptation to changing conditions. The presence of multiple, relatively nearby, viable and maintained populations acts as protection against long-term impacts of localized catastrophic loss by serving as a source of re-colonization (ICTRT 2007a).

3.2.2 Application of Biological Viability Criteria to Rock Creek Population

Although the risk levels of the populations within the DPS collectively determine MPG viability and, in turn, the likely persistence of the DPS, it may not be necessary for all of the populations to attain the lowest risk level. There may be more than one way for a DPS to meet the viability criteria. The ICTRT called alternative combinations of population risk status that would meet the MPG and DPS-level criteria "recovery scenarios." In a January 8, 2007 technical memorandum (ICTRT 2007a), the ICTRT offered a detailed discussion of possible recovery scenarios for each MPG.

For the Eastern Cascades Slope Tributaries MPG to be viable, four populations representing historical types of diversity in terms of life history, size category, etc., should meet criteria for a low extinction risk, i.e. less than 5 percent risk of extinction (alternatively, more than 95 percent probability of persistence). The Klickitat River, Fifteenmile Creek, and Deschutes West and East populations need to meet low risk criteria because of their life history types and other characteristics. In this recovery scenario, the biological recovery goal for the Rock Creek steelhead population is to contribute to recovery for the Middle Columbia River Steelhead DPS by reaching a "maintained" or moderate risk status (ICTRT 2007a). A maintained or moderate risk is defined as having between 25 and 6 percent risk of extinction within 100 years. To achieve low risk the population would need to meet the 5 percent criterion, and for very low risk, 1 percent. Low and very low risk targets would be consistent with broad-sense goals that have been adopted for populations elsewhere.

The ICTRT classified the Rock Creek steelhead population as a "Basic" sized population, based on historical habitat potential (ICTRT 2007b) and provided viability criteria for a Basic population, as follows (ICTRT 2007b):

Abundance
For a Basic population, viable status, i.e. a 5 percent or less risk of extinction over a 100-year timeframe, would require a mean minimum abundance threshold of 500 naturally produced spawners. Maintained status or moderate (6 to 25 percent) risk would also require a mean minimum abundance of 500 naturally produced spawners because "populations with fewer than 500 individuals are at higher risk for inbreeding depression and a variety of other genetic concerns" (ICTRT 2007b).

Productivity
Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater than 1.0 to allow the population to rapidly return to abundance target levels. For a Basic population at 500 naturally produced spawners to meet the moderate risk criterion, productivity should be at about 1.3 (ICTRT 2007b, Figure 4a). To meet the 5 percent risk criterion (viable status), productivity should be >1.56.

Spatial Structure and Diversity
In general, the ICTRT defined two goals, or biological or ecological objectives, that spatial structure and diversity criteria should achieve (ICTRT 2007b):

- *Maintaining natural rates and levels of spatially mediated processes*. This goal serves to minimize the likelihood that populations will be lost due to local catastrophe, to maintain natural rates of recolonization within the population and between populations, and to maintain other population functions that depend on the spatial arrangement of the population.

- *Maintaining natural patterns of variation*. This goal serves to ensure that populations can withstand environmental variation in the short and long-terms.

Based on historical potential analysis, the ICTRT gave the Rock Creek population a combined integrated spatial structure/diversity rating of Moderate risk. The Rock Creek population has a relatively simple population structure, containing a single major spawning area (MaSA). Although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderate rating for complexity. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low for this parameter.

3.3 Threats Criteria

Listing factors are those features that were evaluated under section 4(a)(1) when the initial determination was made to list the species for protection under the ESA. These may or may not still be limiting recovery when in the future NMFS reevaluates the status of the species to determine whether the protections of the ESA are no longer warranted and the species could be delisted.

At the time of a delisting decision, NMFS will examine whether the section 4(a)(1) listing factors have been addressed. To assist in this examination, NMFS will use the listing factors (or threats) criteria described below in addition to evaluation of biological recovery criteria and other relevant data and policy considerations.

To determine that the affected DPS is recovered to the point that it no longer requires the protections of the ESA, NMFS will review the status of the listing factors according to the specific criteria identified for each of them (see below). The threats need to have been addressed to the point that delisting is not likely to result in their re-emergence. It is possible that current perceived threats will become insignificant in the future due to changes in the natural environment or changes in the way threats affect the entire life-cycle of salmon. Consequently, NMFS expects that the ranking of threats will change over time and that new threats may be identified. During the status reviews, NMFS will evaluate and review the listing factor criteria under conditions at the time.

The specific criteria listed below for each of the relevant listing/delisting factors helps to ensure that underlying causes of decline have been addressed and mitigated before considering a species for delisting. NMFS expects that if the proposed actions described in this plan are implemented, they will make substantial progress toward meeting the following listing factor (threats) criteria.

Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.

To determine that the DPS is recovered, threats to habitat should be addressed to a degree sufficient to support a viable Middle Columbia River steelhead DPS as outlined below:

1. Passage obstructions (e.g., dams and culverts) are removed or modified to improve survival and restore access to historically accessible habitat where necessary to support recovery goals.
2. Flow conditions that support adequate steelhead rearing, spawning, and migration of a viable DPS are achieved where possible through management of mainstem and tributary irrigation and hydropower operations, and through the improvement of other water user efficiencies and conservation, including for municipal supply and other consumptive purposes.
3. Forest management practices that protect watershed and stream functions are implemented on Federal, state, tribal, and private lands.
4. Agricultural practices, including grazing, are implemented to protect and restore riparian areas, floodplains, and stream channels, and to protect water quality from sediment, pesticide, herbicide, and fertilizer.
5. Urban and rural development, including land use conversion from agriculture and forestland to residential uses, avoids impairment of water quality or natural stream conditions.
6. The effects of toxic contaminants on salmonid fitness and survival in the mainstem and tributaries are sufficiently limited so as not to affect recovery.
7. Channel function, including vegetated riparian areas, canopy cover, stream-bank stability, off-channel and side-channel habitats, natural substrate and sediment processes, and channel complexity is restored to provide adequate rearing and spawning.
8. Floodplain function and the availability of floodplain habitats for salmon are restored to a degree sufficient to support a viable DPS. This restoration should include connectedness between river and floodplain and the restoration of impaired sediment delivery processes.

Factor B: Over-utilization for commercial, recreational, scientific or educational purposes

To determine that the DPS is recovered, any utilization for commercial, recreational, scientific, or educational purposes should be managed as outlined below:

1. Fishery management plans for steelhead are in place that (a) accurately account for total fishery mortality (i.e., both landed catch and non-landed mortalities) and constrain mortality rates to levels that are consistent with achieving population viability (i.e., provide for adequate spawning escapement given their productivity); and (b) are implemented in such a way as to avoid deleterious genetic effects on populations or negatively affect the distribution of populations.

2. Federal, state, and local fishing rules and regulations are effectively enforced.

3. Technical tools accurately assess the effects of the harvest regimes so that harvest objectives are met but not exceeded.

4. Handling of fish is minimized to reduce indirect mortalities associated with education or scientific programs, while recognizing that monitoring, research, and education are key actions for conservation of the species.

5. To the degree necessary to support a viable DPS, routine instream construction and maintenance practices are implemented in a manner to reduce or eliminate mortality of listed species.

Factor C: Disease or predation

To determine that the DPS is recovered, any disease or predation that threatens its continued existence should be addressed as outlined below:

1. Hatchery operations do not subject steelhead populations to deleterious diseases and parasites and do not result in increased predation rates of wild steelhead;

2. Predation by avian predators is managed in a way that promotes recovery of salmon and steelhead populations;

3. The northern pikeminnow and other exotic piscivorous species are managed to reduce predation on steelhead to a degree sufficient to meet recovery goals;

4. Populations of introduced smallmouth bass, walleye, channel catfish and other exotic piscivorous species are managed such that competition or predation does not impede steelhead recovery.

5. Predation of steelhead runs below Bonneville Dam by marine mammals is managed within the framework of applicable statutes and to the degree necessary to protect upstream migration of steelhead.

6. Physiological stress and physical injury that may cause disease or increase susceptibility to pathogens during rearing or migration should be reduced during critical low flow periods (e.g. low water years) or poor passage conditions (e.g. at diversion dams or bypasses).

Factor D: The inadequacy of existing regulatory mechanisms

To determine that the DPS is recovered, any inadequacy of existing regulatory mechanisms that threatens its continued existence should be addressed to the degree necessary to support a viable DPS, as outlined below:

1. Sufficient resources, priorities, regulatory frameworks, and coordination mechanisms are established and/or maintained for effective enforcement of land and water use regulations that protect and restore habitats and for the effective management of fisheries.

2. Habitat conditions and watershed functions are protected through land-use planning that guides human population growth and development.

3. Habitat conditions and watershed function are protected through regulations that govern resource extraction such as timber harvest and gravel mining.

4. Habitat conditions and watershed functions are protected through land protection agreements as appropriate, where existing policy or regulations do not provide adequate protection.

5. Regulatory, control, and education measures to prevent additional exotic plant and animal species invasions are in place.

Factor E: Other natural or manmade factors affecting its continued existence

To determine that the DPS is recovered, other natural and man-made threats to its continued existence should be addressed as outlined below:

1. Hatchery programs are being operated in a manner that is consistent with individual watershed and region-wide recovery approaches; appropriate criteria should be used for the integration of hatchery steelhead populations and extant natural populations inhabiting watersheds where the hatchery fish return.
2. Hatcheries operate using appropriate ecological, genetic, and demographic risk containment measures for (1) hatchery-origin adults returning to natural spawning areas, (2) release of hatchery juveniles, (3) handling of natural-origin adults at hatchery facilities, (4) withdrawal of water for hatchery use, (5) discharge of hatchery effluent, and (6) maintenance of fish health during their propagation in the hatchery.
3. Mechanisms are in place to reduce the incidence of, and impacts from, introduced, invasive, or exotic plant and animal species.

4. Nutrient enrichment programs should be evaluated to determine where additional nutrient inputs can provide significant benefits.

4. Current Status Assessment

This chapter summarizes the ICTRT's viability assessment results for Middle Columbia River steelhead in the Rock Creek watershed. The assessment reflects existing data, previous assessment findings and GIS analysis.

4.1 Abundance and Productivity

At present, no direct estimates of abundance and productivity are available for Rock Creek steelhead. There have been no systematic redd surveys in this population area. The general presence of steelhead has been documented (NPCC 2004). The ICTRT assigned the Rock Creek steelhead population High risk based on the lack of information on current abundance and productivity (ICTRT 2009).

4.2 Spatial Structure and Diversity

The Rock Creek population has a single major spawning area (MaSA) (a system of one or more branches capable of supporting 500 spawners). Steelhead are known to occur in Rock Creek up to a point ¼ mile above the confluence with Quartz Creek (BLM 1985, 1986), and possibly above it. Steelhead have also been located in lower Quartz Creek (BLM 1985, 1986). Steelhead are known to occur in Squaw Creek up to the confluence with Harrison Creek, and have occurred historically as far as the confluence with Spring Creek (C. Dugger, WDFW, pers. comm., 1999). Known utilization includes the lower and middle portions of Rock Creek, lower Quartz Creek and Squaw Creek.

The ICTRT rated the Rock Creek population at Moderate risk for spatial structure/diversity (Table 4-1). Based on the ICTRT historical potential analysis, the Rock Creek population had a relatively simple population structure, containing a single MaSA. Although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderate rating for complexity. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low for the diversity parameter.

Table 4-1 Rock Creek Summer Steelhead Population Spatial Structure and Diversity Risk Rating Summary (ICTRT 2009).

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	H (-1)	H (-1)	(Mean = 0.33) Moderate Risk	Moderate Risk	Moderate Risk
A.1.b	L (1)	L (1)			
A.1.c	L (1)	L (1)			
B.1.a	M (0)	M (0)	Moderate Risk (0)	(Mean=0.25) Moderate Risk	
B.1.b	M (0)	M (0)			
B.1.c	M (0)	M (0)			
B.2.a(1)	M (0)	M (0)	Moderate Risk (0)		
B.2.a(2)	L (1)				
B.2.a(3)	L (1)				
B.2.a(4)	VL (2)				
B.3.a	M (0)	M (0)	M (0)		
B.4.a	L (1)	L (1)	L (1)		

4.3 Overall Risk Rating

The Rock Creek steelhead population does not currently meet viability criteria because it is assigned High risk for abundance/productivity (Figure 4-1). The overall spatial structure/diversity rating is Moderate risk. The lack of direct estimates of abundance and productivity for this population was a factor in assigning it High risk.

Abundance/ Productivity Risk		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
	Very Low (<1%)	**HV**	**HV**	**V**	**M**
	Low (1-5%)	**V**	**V**	**V**	**M**
	Moderate (6 – 25%)	**M**	**M**	**M**	**HR**
	High (>25%)	**HR**	**HR**	**HR Rock Creek***	**HR**

Figure 4-1. Integrated Risk Rating for the Rock Creek Steelhead Population (ICTRT 2009). ***Viability Key: HV – Highly Viable; V – Viable; M – Moderate/Maintained; HR – High Risk; * = Candidate for Maintained; Shaded cells – does not meet viability criteria (darkest cells are at greatest risk).***

5. Limiting Factors and Threats

The reasons for a species' decline are generally described in terms of limiting factors and threats. Analysis of limiting factors and threats across the entire species' life cycle forms the basis for designing recovery strategies and actions. NMFS defines limiting factors as the biological and physical conditions limiting DPS and population status (e.g. elevated water temperature), and defines threats as those human activities or naturally induced actions that cause the limiting factors (e.g. removal of riparian vegetation for agricultural or residential purposes, which causes loss of shade and, consequently, elevated water temperature).

While the term "threats" carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are typically legitimate human activities that may at times have unintended negative consequences on fish populations—and that can also be managed in a manner that minimizes or eliminates the negative impacts.

For steelhead and other salmonids, survival to reproduce depends on a complex, interacting system of environmental conditions, with different conditions needed for each life stage. Optimal water temperature, for example, varies (within limits) for adult migration vs. egg incubation or juvenile rearing. In addition, the particular factors limiting production may vary across different sections of the tributary drainage used by a particular population. Data on a full range of potential limiting factors is rarely available at the reach level.

The list of potential limiting factors for the Rock Creek steelhead population, as for the other populations that make up the Middle Columbia steelhead DPS, is based on a substantial body of research on salmonids, local field data and field observations, and the considered opinions of regional experts. These are implicitly hypothetical statements to be tested, made with the expectation that by taking action in the face of some degree of scientific uncertainty, monitoring the results, continuing to conduct research to further characterize the factors limiting the population, and adapting our management actions in response, the state of our knowledge will improve and so will the survival of these fish, although not necessarily in a directly parallel process. This chapter describes factors that may be limiting Middle Columbia River steelhead production in the Rock Creek subbasin.

5.1 Freshwater Habitat

Low summer flows and high summer water temperatures occur naturally in some parts of the Rock Creek watershed because of bedrock terrain and steep slopes. The intensity of some of these factors may have increased because of anthropogenic changes in the subbasin. For example, historical forest practices, including logging and road construction, adversely impacted functional quality of riparian areas in some portions of the headwaters and canyon reaches (e.g., upper Rock Creek, Box Canyon and Quartz

Creek) (NPCC 2004). In addition, channel widening and incision, such as along lower Rock Creek, could cause a reduction or loss of summer base flows.

While the Rock Creek watershed is sparsely populated, anthropogenic influences occur throughout the subbasin. Much of the watershed has been grazed or logged, and primitive roads extend from near the Columbia River to the headwaters of most streams in the subbasin. Beaver were once likely abundant and are now less common. Still, while grazing, roads, and other uses may contribute to habitat problems in some parts of the watershed, considerable forest canopy remains and most stream reaches support at least shrub-dominated riparian areas.

The major factors and associated threats that potentially limit abundance, productivity, spatial structure and diversity of Middle Columbia River steelhead in the Rock Creek watershed are discussed briefly below. The factors were identified based on information in the Northwest Power and Conservation Council's subbasin plan for the Lower Mid-Columbia Mainstem, including Rock Creek (NPCC 2004) and the Watershed Assessment for Rock Creek, part of WRIA 31 (Aspect Consulting and WPN 2004). They also reflect the input data for an Ecosystem Diagnosis and Treatment (EDT) model for Rock Creek (available at: http://edt.jonesandstokes.com/).

The stakeholders in the Rock Creek–Glade Creek watershed completed and approved in April 2009 the WRIA 31 Watershed Management Plan (WRIA 31 Planning Unit et al. 2008), with the help of the State of Washington under the Watershed Management Act pursuant to chapter 90.82 Revised Code of Washington. The watershed plan includes identification of prioritized fish habitat issues and actions in the Rock Creek–Glade Creek watershed. In the fall of 2008 through spring of 2009, a quantitative instream habitat assessment and fish survey was conducted on non-Tribal lands in the Rock Creek watershed (Glass 2009). Fish habitat was assessed with a stratified random sample design incorporating the entire area indicated as potentially containing steelhead (Figure 2-7 of this document). The total stream length assessed was 11,700 meters, or 14.5 percent of a study area (Glass 2009). Potential limiting factors and threats identified in Glass 2009 and WRIA 31 Planning Unit et al. 2008 are incorporated in this summary.

- ***Hydrograph.*** Seasonally low to non-existent stream flows might be a primary factor limiting steelhead production in the Rock Creek watershed. Low to intermittent and/or subterranean flows in all streams during late summer, fall and early winter can limit juvenile mobility and cause mortality due to stranding. The historical information, coupled with documented intermittent conditions (USGS 1989; Ecology's gaging station, https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=31B070), which occur under minimal human water use (Aspect Consulting and WPN 2004), suggest that the streamflow in Rock Creek is naturally intermittent rather than a condition created by human development (Aspect Consulting and WPN 2004). However, the loss of riparian vegetation, instream habitat complexity and diversity, and floodplain connectivity in some reaches because of grazing, roads, and/or other land uses can increase the intensity of flows in some parts of the drainage. In the

Rock Creek subbasin, roads are at low density (Coe 2004, Harr et al. 1975, Aspect Consulting and WPN 2004). The amount of vegetation in the valley bottom has been increasing since 1938, presumably due to fire suppression (Aspect 2005). Most of the land in the basin is lightly grazed. Low summer stream flows occur in the lower part of the subbasin ─ lower Rock Creek mainstem, lower Squaw Creek, and lower Luna Gulch ─ but also occur in some headwater and canyon reaches (NPCC 2004, Ecology's stream gage https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=31B070). None of the stream length of the Rock Creek mainstem above the Bickleton Bridge to the upper extent of steelhead distribution (Figure 2-7) was dry in mid-October/early November 2008, although measured flow in the lower mainstem was zero (Glass 2009). Flow in some of lower Rock Creek is below the surface because of the high proportion of alluvial material in the substrate. Approximately 14 percent of the stream length was dry in the reaches of the Rock Creek subbasin surveyed in mid-October/early November 2008 when measured flow in the lower mainstem was zero. Spring outflows feed some reaches and pools, and may provide important refugia during periods of low flow.

- ***Water quality, high stream temperatures.*** Seasonally high water temperature is potentially a primary factor limiting steelhead production in the Rock Creek watershed (Glass 2009). As noted in Chapter 2, the range of temperatures steelhead can tolerate varies with life stage and other characteristics. Temperatures above 13.3ºC (56ºF) can result in egg mortality (McEwan and Jackson 1996), and sufficient oxygen may not be available above 21.1ºC (70ºF) (ibid.). Steelhead are considered to do best at a range of 12.8-15.6ºC (55.0-60.1ºF) (Rich 1987). Temperatures above 22ºC (72ºF) are highly stressful for steelhead. The Washington State water quality criteria for aquatic life list 63.5º F as the maximum for salmonid spawning, rearing, and migration; temperatures above 63.5º F can be lethal to developing fish embryos (WAC 173-201A-200).

  Summer water temperatures in the lower Rock Creek subbasin frequently rise above 63.5°F (Aspect 2005). With respect to steelhead incubation, some lower reaches of Rock Creek and Squaw Creek start exceeding 63.5°F in mid- to late-May and in some reaches rise above 73.4°F (23.9°C) (Aspect Consulting 2005), a level considered potentially lethal for salmon and steelhead (Glass 2009). One reach of Rock Creek is listed twice on the Washington State Department of Ecology's 2008 water quality assessment (known as the 303(d) list) as being impaired for water temperature (Category 5), and requiring a TMDL (http://apps.ecy.wa.gov/wats08/ViewListing.aspx?LISTING_ID=7967). Loss of habitat quantity and diversity, channel degradation due to flooding and other factors, low summer flows, and loss of riparian vegetation can contribute to this potential limiting factor. High stream temperatures during summer and early fall, especially in the lower watershed, limit juvenile mobility and may result in stranding or mortality because of thermal stress (NPCC 2004). Potential anthropogenic effects on stream temperature have not been quantitatively evaluated; however, the evidence suggests that high water temperatures in Rock

Creek are a natural condition (Ehinger 1996, Aspect Consulting and WPN 2004, Aspect Consulting 2005). The amount of vegetation in the valley bottom has been increasing steadily since 1938, presumably due to fire suppression (Aspect Consulting 2005). Fine sediment levels in the basin tend to be low (Glass 2009), which suggests that filling of pools or widening of the stream, which would contribute to warm temperature, is unlikely.

- ***Riparian function and condition.*** While the stream system's rocky substrate and steep topography naturally inhibit riparian forest stand development along many reaches, riparian function and condition have been affected by major flood events, grazing, historical timber practices, road construction, and other land uses. Since 2006, commercial forestry in the Rock Creek watershed is managed under a NMFS-approved Habitat Conservation Plan (HCP): the Forest Practices HCP, or FPHCP, which applies to private commercial timberlands regulated by State Forest Practice Rules. Tribal harvest is managed under the Yakama Nation Forest Management Plan. Glass (2009) concluded that the magnitude of the anthropogenic effects is likely minor, because roads are sparse, largely located upslope of streams, and likely input little sediment (Aspect Consulting and WPN 2004); harvest in riparian areas is highly regulated; and there is little development in the basin (Klickitat County Assessor's Office http://www.klickitatcounty.org/Road/ContentROne.asp?fContentIdSelected=455695186&fCategoryIdSelected=-342308583&fX=X). Grazing affects portions of the Rock Creek watershed; its impacts can be directly observed in the lower mainstem. A 1995 stream habitat evaluation along Rock Creek showed that six of ten sites examined during the evaluation had riparian vegetative cover more than 10 percent below the target for eastern Washington Class A streams (Aspect Consulting and WPN 2004; Ehinger 1996).

- ***Channel structure and complexity.*** Degraded channel structure and complexity in the subbasin may reduce key habitat quantity and habitat diversity for steelhead. Key habitat quantity refers to the amount of key habitat, such as riffles, that is present in the stream for each life stage. If key habitat is limited, fewer steelhead can be supported by the stream. Habitat diversity refers to the extent of habitat complexity, such as large wood, boulders, undercut banks and pools, and the processes that form pools and cover within a stream reach. Greater complexity increases survival and provides better habitat. Large wood in the stream plays a major role. Instream wood in the basin is low relative to streams of the Cascade Mountains (Glass 2009); however, riparian density has been increasing for at least 70 years (Aspect Consulting and WPN 2004), and increases in recruitment of instream wood are expected as the riparian stands mature.

  Glass 2009 estimated the area of spawning habitat in the Rock Creek subbasin at 59,506 square meters and the volume of pools at low flow at 4,229 cubic meters (Glass 2009). Findings from a reconnaissance survey of portions of Rock Creek indicate that the creek's general channel characteristics may be similar to those noted in an 1860s survey (e.g., broad rocky reaches), with the exception that the lowermost reach may be wider today than historically (Aspect and WPN 2004). Over the years, however, key habitat quantity and habitat diversity have declined in some reaches due to disturbance of channel and riparian habitats from grazing, historical timber harvest, road construction, other anthropogenic changes and from major flood events. These factors could potentially have contributed cumulatively to changes in the hydrograph, altering available perennial wet habitat as well as decreasing riparian quality and function and instream habitat and function. In addition, key habitat quantity and habitat diversity have been lost in the one-mile reach above Rock Creek's mouth as a result of inundation by Lake Umatilla behind John Day Dam on the Columbia River.

- ***Floodplain function and channel migration processes.*** The stream channel in lower Rock Creek is highly dynamic and moves across the valley bottom with regularity, likely switching channels during flood flows. One of the more dynamic sections of the stream channel is upstream of the Old Highway 8 Bridge, where the channel changed courses many times over the period of photo record, and has distinctly different courses in 1938, 1969, 1996, and 2002 (Aspect Consulting 2005). Bridges for the Bickleton Highway and Old Highway 8 have locally increased hydro confinement, constricting flow and channel migration processes. The Bickleton Bridge is scheduled for replacement with a longer spanned bridge. A series of dikes also exists in a middle mainstem Rock Creek reach that limit the stream's ability to meander. Extensive grazing, historically and currently, could potentially diminish riparian health and affect channel plain form in some reaches of the lower watershed, decreasing channel stability. However, most of the basin is lightly grazed, and grazing effects tend to be localized (Glass 2009). Although beavers have been observed near Luna Gulch (Glass 2009) and likely are present elsewhere in the basin, their abundance is likely lower than the historical population level.

- ***Sediment routing.*** Sediment loads (the percentage of fines in spawning gravel, embeddedness and turbidity) in the Rock Creek subbasin may have increased over historical conditions. Actions potentially contributing to increased sediment delivery include historical forest practices (skidding and road building, clearing of upland forests and stream banks), agricultural and grazing practices (rill irrigation, streamside grazing), and road building and maintenance activities.

  However, there is no commercial irrigation in Rock Creek, most of the basin lands are lightly grazed, and roads are sparse and largely located upslope from streams (Aspect Consulting and WPN 2004). These would tend to minimize the anthropogenic effects on sediment routing. A recent study that evaluated sediment loads in 278 riffles located throughout the basin found that only two of the riffles, both located in backwater areas, had fine sediment levels that exceeded 20 percent fines (Glass 2009). All other riffles had less than 20 percent fines and the majority of the riffles had less than 15 percent fines (Glass 2009). Previous studies have found these levels to have little effect on survival of eggs and alevins (Tappel and Bjornn, 1983, Chapman 1988).

- ***Competition for food sources.*** Changes in the hydrological regime and riparian conditions affect the food web and thus increase competition among species. Macroinvertebrates can be produced in reduced quantities where there are poorly functioning hyporheic zones, diminished pool and riparian presence, and a lack of stream structure. To date, there has been no assessment of food production or competition for food in the basin.

- ***Predation and competition.*** Inundation of the lower one mile of Rock Creek by the waters of Lake Umatilla behind John Day Dam may have increased access of piscivorous fish such as smallmouth bass, channel catfish, and northern pikeminnow to the lower mile of Rock Creek and the reservoir through which the steelhead must travel. However, no exotic piscivorous species were observed above the inundated area during snorkel surveys conducted in Rock Creek, Luna Gulch, and Squaw Creek during October and November of 2008 (Glass 2009). No evaluation has been done on the effects of predation and competition on the Rock Creek steelhead population.

  The ISAB (2007 and 2008) concluded that the Columbia River impoundments have created sloughs and backwater habitats where water exchange is very low and summer water temperatures are often several degrees warmer than the nearby main-channel habitats. As a consequence, introduced resident fish such as smallmouth bass and channel catfish are expanding into these habitats. The ISAB 2007 also commented that increases in water temperature would favor further expansion of warm-water piscivores. Hence, the potential for predation could increase over time.

5.2 Hatchery Effects

Anadromous fish production within the subbasin is almost exclusively natural. Steelhead are not stocked in Rock Creek, and very few fin-clipped steelhead have been observed in the subbasin. Hatchery strays of upriver origin may enter and spawn in Rock Creek, but the effects of out-of-subbasin hatchery programs on the Rock Creek steelhead population are unknown.

5.3 Tributary Harvest

Rock Creek and its tributaries are open to steelhead and trout fishing from June 1 to October 31 annually (trout over 20 inches are considered steelhead), and the area inundated by the John Day Pool (up to the Army Corps of Engineers Park at river mile 1) is open year around to allow for warm water fisheries and for trout over 12 inches (trout over 20 inches are considered steelhead) from June 16 to March 31. Only adipose fin-clipped steelhead may be retained (WDFW 2008a). Adult steelhead are not present in Rock Creek during the summer because of low or non-existent flows. They enter the creek after flows resume and temperatures drop, generally after the season is closed. Some minor tribal catches for ceremonial purposes are reported, but they are currently considered insignificant (Bill Sharp, Pers. comm. 2008). Poaching has been observed in the subbasin, however, and is considered a problem. While increased patrols are desired, funding levels are mostly inadequate to provide for such services.

The fishery targeting other species at the mouth of Rock Creek is quite active at times and it is expected that some steelhead are unintentionally caught by recreational anglers, of which only marked hatchery fish are permitted to be retained. Better educational opportunities at the Army Corps of Engineers Park may assist in preventing accidental catch and retention of wild steelhead.

The overall mortality rate for catch-and-release adult steelhead fisheries depends on the encounter rate of naturally produced fish (percentage of run actually caught and released) in the fisheries, and the mortality rate associated with being caught and released (hook-and-release mortality). In winter steelhead fisheries, WDFW (2008b) estimates that catch-and-release mortality is less than 5 percent, while mortality in summer steelhead fisheries is estimated to be higher, less than 10 percent of the wild fish handled, reflecting high temperatures. The catch and release mortality only affects that proportion of the wild run encountered in the fishery. WDFW (2008b) estimates that in the Rock Creek tributary fisheries less than 5 percent of the steelhead are handled, due to the closure of Rock Creek during the period adult steelhead would be present, and the limited effort during the time that steelhead may be present below the Army Corps of Engineers Park. Multiplying the catch and release mortality rate by the encounter rate provides the estimate of tributary fisheries impacts of less than one percent wild steelhead (WDFW 2008b). For further evaluation of the harvest rate, please see the Middle Columbia River Steelhead DPS Recovery Plan.

Steelhead occupy many waters that are also occupied by resident trout species. It is not possible to visually separate juvenile steelhead from similarly sized stream-resident rainbow trout. Because juvenile steelhead and resident rainbow trout are the same species, are similar in size, and have the same food habits and habitat preferences, it is reasonable to assume that catch-and-release mortality studies on stream-resident trout also apply to juvenile steelhead. WDFW has implemented a number of regulation changes to limit impacts on juvenile steelhead in Rock Creek. These include increasing the minimum size limit for rainbow trout fisheries from 6 inches to the current size limit of 8 inches in the tributary and 12 inches below the Army Corps of Engineers Park. The daily bag limit was also reduced from 6 fish to 2 fish. Trout angling is only open from June 1 to October 31 in the tributary, and June 16 to March 31 in the area below the Army Corps of Engineers Park. These changes have reduced impacts on naturally produced juvenile steelhead/trout to less than 1 percent of the population, a substantial reduction from historical impacts of tributary fisheries that were estimated to be over 50 percent in some Middle Columbia River steelhead basins (WDFW 2008b). Rainbow trout are not released into Rock Creek, and this also reduces harvest impacts. Fisheries that target non-resident warm water species can affect juvenile steelhead, but these fisheries are limited to the area below the Army Corps of Engineers Park (WDFW 2008a). WDFW has submitted to NMFS a Fisheries Management and Evaluation Plan (FMEP) for tributary fisheries in the Middle Columbia steelhead DPS to cover impacts from these fisheries under the 4(d) rule limit 4 of the ESA (WDFW 2008b). This FMEP, when finalized, will have all the site-specific actions for the tributary fisheries. NMFS expects the FMEP to be completed in 2010.

5.4 Out-of-Subbasin Limiting Factors and Threats

The Middle Columbia River Steelhead DPS Recovery Plan uses information from two "modules" developed by NMFS to address conditions in the Columbia River mainstem and estuary that affect all Middle Columbia steelhead: the Hydro Module, based on the NMFS 2008 Biological Opinion on the Federal Columbia River Power System (NMFS 2008b), and the Estuary Module (NMFS 2007b). In addition to proposed actions in the management unit plans, the DPS Plan relies upon Hatchery and Genetic Management Plans and Artificial Production for Pacific Salmon (Appendix C of the Supplemental Comprehensive Analysis, NMFS 2008 Biological Opinion) to address hatchery effects. For harvest effects, the Plan refers to fishery management planning through the 2008 U.S. v. Oregon agreement for mainstem fisheries, and Fisheries Management Evaluation Plans for tributary fisheries. The reader is referred to the DPS plan for this information. The following is a summary of the information most relevant to the Rock Creek plan.

5.4.1 Harvest

Without more data on Rock Creek steelhead abundance, and without targeted tagging of Rock Creek fish, the percentage of Rock Creek steelhead that are harvested in the Columbia River cannot be specifically calculated. However, it may be inferred that Rock Creek steelhead are subject to the same relatively low overall harvest rate estimated for other Middle Columbia steelhead. Washington Department of Fish and Wildlife (2008) estimates that in 2002, tributary fisheries in the Rock Creek area affected about 1 percent of the adult steelhead and less than 1 percent of the juvenile steelhead. Mainstem non-treaty commercial and recreational fisheries have an estimated impact of 1.6 percent of the A-run Middle Columbia steelhead (NMFS 2008a), and mainstem treaty fisheries have an estimate 6.64 percent impact (NMFS 2008a) for an overall estimated harvest impact of less than 10.24 percent.

The various fisheries that may harvest Rock Creek steelhead as they migrate through the Columbia River and Pacific Ocean are the following.

Ocean Fisheries

Since steelhead are rarely caught in ocean fisheries, these fisheries are not considered a significant source of mortality to Middle Columbia River steelhead (NMFS 2000). Ocean fishing mortality on Middle Columbia River steelhead is assumed to be zero.

Columbia River Mainstem Non-Tribal Fisheries

There has been no direct freshwater non-tribal harvest on wild steelhead from the Mid-Columbia DPS since 1992, when the last wild fish catch-and-release regulations on these populations became effective. Therefore, all current non-tribal harvest impacts on Mid-Columbia DPS steelhead are due to incidental bycatch in commercial or recreational fisheries that target hatchery steelhead or other species, and monitoring these impacts is complex. Released fish experience a mortality rate, possibly delayed and difficult to measure, that is highly variable and depends on what gear is used, how the fish is caught by the gear, how the fish are handled during capture and release, and environmental conditions. Release mortality is estimated to be very low (below 1 percent of encounters), with an unknown range of error. Recreational fisheries are monitored by creel surveys (fisheries technicians interview anglers about their catch, gear, and wild steelhead releases); the total recreational impact on winter and summer steelhead as they move through the mainstem to the tributaries is estimated to be less than 2.5 percent (Carmichael 2009).

There are three stocks of summer steelhead used for management of treaty and non-treaty mainstem fisheries, including the lower Columbia River Skamania stock, upriver A-run stock, and upriver B-run stock. All MCR steelhead populations are designated A-run, except the two winter-run populations. In NMFS' Biological Opinion for the 2008-2017 *U.S. v. Oregon* Fisheries Agreement (NMFS 2008a), the wild MCR steelhead DPS in the non-treaty winter, spring, and summer mainstem fisheries are subject to a 2 percent harvest rate limit. Non-treaty fall fisheries are also limited to a 2 percent harvest rate limit for A-run summer steelhead. The total annual harvest rate limit for A-run steelhead in non-treaty fisheries is 4 percent and 2 percent for the summer-run and winter-run of the MCR steelhead DPS, respectively. The expected harvest impacts from non-treaty fisheries are less than the limits proposed in the *U.S. v. Oregon* fisheries Agreement. The yearly incidental catch of A-run steelhead in non-treaty fisheries has averaged 1.6 percent since 1999, and are not expected to change over the course of the Agreement (NMFS 2008a).

Treaty Native American Fisheries

Tribal fishers in Zone 6 of the Columbia mainstem (between Bonneville Dam and McNary Dam) continue to retain wild steelhead for commercial sale or for personal use. Impacts on MCR steelhead from treaty-Native American fall fisheries that affect summer-run steelhead populations including Rock Creek are limited by harvest rate limits for B-run steelhead and Upper Columbia River bright fall Chinook (NMFS 2008a). The harvest rate on MCR summer-run steelhead in spring, summer, and fall Zone 6 treaty-Native American fisheries combined averaged 11.7 percent since 1985 and 6.64 percent since 1998 (NMFS 2008b, Table 8.8.5.5-1). The impacts resulting from the treaty-Native American fisheries are expected to be similar to the 1998-2006 average of 6.64 percent. The harvest rate is less for populations that pass fewer dams in Zone 6 and are therefore subject to fewer non-Native American and treaty-Native American fisheries.

5.4.2 Columbia River Hydropower Operations

Hydrosystem construction and operation (flow regulation) in the Columbia River Basin has been a major cause of changes to the Columbia River and estuary from historical conditions. The effects of Columbia River hydro operations on salmonids are reviewed briefly here and described in detail in two NMFS documents: the 2008 FCRPS Biological Opinion (NMFS 2008b) and the Hydro Module (NMFS 2008c).

Within the Rock Creek subbasin, steelhead and salmon were directly affected by the creation of the John Day Dam on the mainstem Columbia River, which effectively inundated the lowest reach of Rock Creek, reducing riparian habitat and increasing predation by native and non-native fish in the lower river. A lack of historical data inhibits quantitative evaluation of the impacts of John Day pool inundation on native fish, plant, and wildlife species.

In the mainstem Columbia River, changes in river flow, circulation, water quality, contaminants, channel alterations, and predation have negative impacts on adult and juvenile fish. Hydro operations have changed flow conditions in the Columbia River and through the estuary. Before the development of the hydrosystem, Columbia River flows were characterized by high spring-runoff from snowmelt and regular winter and spring floods. Dam construction and operation have altered Columbia River flow patterns substantially throughout its basin. Historical flow records at The Dalles and Bonneville Dam demonstrate that annual peak flows have been reduced by about 50 percent, as water is stored for power generation and irrigation, and winter flows have increased approximately 30 percent.

The Columbia River Estuary Module http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery -Plans/upload/Estuary-Module.pdf, provides more information on factors that limit viability of Rock Creek steelhead in the Columbia River estuary.

5.4.3 Ocean Conditions

The effects of ocean conditions on abundance of Pacific salmon and steelhead vary among species and populations within species. Migration patterns in the ocean may differ dramatically and expose different stocks to different conditions in different parts of the ocean. Some species have broad, offshore migration patterns that may extend as far as the Gulf of Alaska (steelhead, chum, some Chinook). Others have migration patterns along the Washington, British Columbia, Oregon and California coasts (Chinook, coho, cutthroat). Thus, ocean conditions do not have coincident effects on survival across species or populations.

Ocean survival of steelhead has been dramatically affected by widespread changes in ocean conditions. Cooper and Johnson (1992) showed that variation in steelhead run sizes and smolt-to-adult survival was highly correlated between runs up and down the West Coast. Smolt-to-adult survival rates generally varied 10-fold between good and bad years. Ocean survival rates for three West Coast steelhead populations where good annual index data were available showed high variability and a generally declining trend since the late 1970s.

5.4.4 Climate Change

Climate change represents a potentially significant threat to recovery of Rock Creek steelhead, as well as Mid-Columbia steelhead DPS. The Independent Scientific Advisory Board (ISAB) for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and NMFS reviewed the potential effects of climate change on salmonids in the Columbia River basin (ISAB 2007). The ISAB report shows that changes in climate may adversely affect steelhead in freshwater habitats across the DPS by exacerbating existing problems with water quantity (lower summer streamflows) and water quality (higher summer water temperatures). Consistently identified types of impacts on snow pack, stream flow, and water quality in the Columbia Basin are the following (ISAB 2007):

- Warmer temperatures will result in more precipitation falling as rain rather than snow.
- Snow pack will diminish, and the timing of stream flow will be altered.
- Peak river flows will likely increase.
- Water temperatures will continue to rise.

These changes may affect steelhead more than other salmonids because of their long rearing period in freshwater and sensitivity to water temperature.

Changing conditions could also affect salmonid health and survival in the ocean through a variety of mechanisms, including increased ocean temperatures, increased stratification of some waters, changes in the upwelling season, shifts in the distribution of salmonids, long term variability in winds and ocean temperatures, increased acidity, and increased atmospheric and oceanic variability. (NMFS 2007b, 2008a; ISAB 2007)

All other threats and conditions remaining equal, future deterioration of water quality, water quantity, and/or physical habitat can be expected to cause a reduction in the number of naturally produced adult steelhead returning to these populations across the DPS. This possibility further reinforces the importance of achieving survival improvements throughout the entire steelhead life cycle. Recent research also indicates that neighboring populations with differences in habitat may show different responses to climate changes (Crozier and Zabel 2006; Crozier et al. 2008). This research reinforces the importance of maintaining habitat diversity.

5.4.5 Other Large-Scale Threats

- Projected continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts on habitat and water conditions.
- Increase in exotic invasive species that potentially compete with native flora and fauna, and provide food and/or cover to species that potentially compete with, prey on or carry diseases which could affect native species.
- New disease and/or pathogen introductions (e.g. from marine aquaculture operations on steelhead ocean migration routes, illegal stocking of out-of-subbasin species).
- Natural catastrophic events (e.g. earthquake, volcanic eruption and related effects).

6. Recovery Strategy and Actions

The preceding chapters summarize recovery goals, biological criteria and threats criteria, current status assessment, and the limiting factors and threats identified for the Rock Creek steelhead population. How will we reach recovery? In this chapter, a recovery strategy is described to address the significant data gaps and uncertainties regarding the status of the Rock Creek steelhead population and to address the potential limiting factors based on the existing, best available science. In addition, Appendix II details the many efforts already underway to improve and protect watershed conditions in the Rock Creek subbasin—efforts that will benefit salmonids as well as other wildlife and human communities.

Lack of information about the Rock Creek steelhead population is a major problem for recovery planning for the Middle Columbia River steelhead DPS. Using the ICTRT criteria for DPS viability, this population needs to achieve "maintained" or moderate risk status for the DPS to be considered viable. The Rock Creek population's high risk rating was assigned primarily on the basis of uncertainty and lack of information on current abundance and productivity. Thus, research and monitoring to resolve the uncertainties and address data gaps is a top priority. Although some published and unpublished data are available, some disagreement also exists among regional experts concerning limiting factors and threats for the Rock Creek steelhead population. Further research will help to resolve these disagreements.

NMFS believes existing information and analyses are adequate to suggest a recovery trajectory and a scale of effort that can reasonably be expected to achieve the goal. A collaboratively designed implementation program that includes a research, monitoring, and evaluation (RM&E) plan to support adaptive management will allow managers the flexibility to continue or change course in response to new information.

The overall aim of the recovery strategy is to gather needed data on the Rock Creek steelhead population and the watershed, while also addressing the potential limiting factors in a manner that is most likely to contribute to improved viability. The strategies and actions were defined through review and analysis of currently available information. They are consistent with actions identified in the Lower Mid-Columbia Mainstem Subbasin (including Rock Creek) Management Plan (NPCC 2004), and address risks identified in the ICTRT's viability assessment for the population.

6.1 Strategies and Actions

The Plan proposes a number of strategies and actions to address data gaps and potentially limiting factors, assess anthropogenic effects, and implement actions to rebuild the Rock Creek steelhead population to the desired level of viability.

6.1.1 Gather Information on VSP Parameters

Information on population abundance, productivity, spatial structure, and diversity is needed to set priorities and determine the actions that will make the greatest contribution to steelhead recovery. Needed actions include initiating systematic surveys to calculate abundance and productivity, completing a gap analysis, characterizing spatial distribution and genetic variation, and evaluating hatchery contribution to naturally spawning steelhead in the Rock Creek subbasin.

6.1.2 Protect and Conserve Existing Good Quality Habitat

Protecting existing good quality habitat is a high priority. Many objectives are likely to be met through habitat protection and the associated natural recovery of upland and riparian areas. Protection and maintenance includes compliance with existing rules and regulations, such as the State Forest Practices Act, the State Shorelines Act, and other State, County, and local regulations designed to protect aquatic habitat. Protection may also incorporate a wide range of voluntary actions such as fencing riparian areas, participation in the various agricultural land reserve programs, and voluntarily implementing programs that help to avoid impacts to aquatic resources. Land acquisitions, easements, cooperative agreements, and protective land designations can also be used to facilitate high quality habitat protection.

6.1.3 Restore and Enhance Habitat and Gather Information

Restoration and enhancement of habitat conditions for salmon and steelhead populations should improve population production. The value of these actions to the viability of the population will depend on whether or not they address the factors currently limiting the population or threats associated with factors that are now, or are trending toward, becoming limiting, e.g. climate change. The success of these strategies is further enhanced when actions build from existing restoration efforts and incorporate a range of project types.

- Conduct research to further evaluate factors and threats limiting habitat diversity in the Rock Creek watershed.

- Improve instream flow during critical periods. The seasonally low to intermittent stream flow in the area of steelhead distribution upstream of the Columbia River backwater is a likely limiting factor on abundance, productivity, spatial structure, and diversity. Low flow can result in stranding and mortality to eggs or juvenile steelhead. Further study is required to determine causes of low flow, whether anthropogenic or natural, and options to enhance stream flow.

- Improve water quality, reduce summer high temperatures. Water temperature is directly related to riparian vegetative cover and other watershed characteristics such as channel complexity, floodplain function, and upland processes. Hence, many types of habitat actions are likely to function together to improve water quality, particularly water temperature. The more directly related actions to improve water quality include the following:
    - Restore riparian vegetative cover with appropriate native vegetation to increase shading.
    - Develop sediment control basins.
    - Manage livestock grazing in the riparian areas.

  - Increase deep pool habitat.

- Improve/restore riparian function and condition. Actions to address this potential limiting factor include the following:
  - Restore riparian vegetative cover with appropriate native vegetation.
  - Manage livestock grazing in riparian areas.
  - Eradicate invasive plant species from riparian areas.
  - Relocate beaver to suitable areas.

- Increase key habitat by improving or restoring channel structure and complexity. Key habitat, as described in Chapter 5, refers to characteristics such as riffles, pools, suitably aerated gravel, etc. that are essential to each steelhead life stage. The following actions would increase key habitat:
  - Introduce large woody debris (LWD) and other structures in stream as appropriate.
  - Improve riparian vegetation to provide future source of LWD.
  - Stabilize and protect stream banks.
  - Fertilize streams with fish carcasses.

- Improve and/or restore floodplain function and channel migration processes. Reconnecting floodplain habitats and side channels would provide additional sheltered rearing areas. Increasing LWD and other actions such as relocating floodplain infrastructure where feasible, implementing road management BMPs or decommissioning roads as appropriate, could restore floodplain function, moderate the "flashiness" of the stream, and moderate peak flows.

- Improve or restore optimal sediment processes. Watershed processes of runoff and sediment production can be improved through restoring native upland plant communities, implementing appropriate upland management practices, managing off-road vehicle usage to reduce erosion and fine sediment, and managing roads to reduce fine sediment inputs to the stream.

- Conduct research to determine status of food web and presence or absence of competition from other species for food resources.

- Conduct research to determine presence and extent of predation on steelhead by non-native species such as piscivorous fish.

6.1.4 Review and Reduce Effects of Harvest

As described in Chapter 5, only adipose fin-clipped steelhead are allowed to be retained in sport or recreational fisheries in Rock Creek and throughout the Columbia River, but wild steelhead may be accidentally caught and/or retained. Poaching is also considered a problem. Actions to address harvest effects include better review of current practices, enforcement of regulations, and considering whether any modifications are needed. Outreach and education to reduce retention or handling mortality is also recommended.

6.1.5 Research Effects of Hatchery Fish (If Any)

As described in Chapter 5, hatchery strays of upriver origin may enter and spawn in Rock Creek, but no data are available on this issue. Monitoring for hatchery fish should be included in the RM & E program to be developed collaboratively after this plan is adopted.

6.1.6 Address Out-of-subbasin Limiting Factors

Out-of-subbasin limiting factors for Rock Creek steelhead may include hydroelectric operations, harvest, interactions with hatchery fish, predation, food, disease, competition, and ocean conditions. Actions to address these factors for all Middle Columbia steelhead are presented in the Columbia River Estuary Module (NMFS 2007b) and the 2008 FCRPS Biological Opinion (NMFS 2008b), summarized in the Hydro Module (NMFS 2008c).

6.2 Summary of Recovery Strategy

Table 6-1 summarizes the recovery strategy designed to improve the viability of Rock Creek steelhead. The table links strategies and actions to the factors and threats potentially limiting steelhead viability in the subbasin, and the viability parameters and life stages that would be most affected. Priority locations are provided for some strategies, with stream reaches or areas where actions should be applied first to gain the greatest benefit.

Table 6-1. Recovery Strategy and Actions for the Rock Creek Population of Middle Columbia Steelhead.

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
Gather information on population size and productivity	• Gather information to calculate abundance and productivity estimates	Entire Watershed	Addresses a primary risk factor	N/A	N/A	abundance and productivity	N/A
Gather information on population spatial structure and diversity	• Conduct surveys to determine steelhead distribution. • Identify major life history strategies • Conduct studies to address genetic variation in the population • Assess the contribution of hatchery-origin steelhead to the natural spawning population	Entire Watershed	Addresses a primary risk factor	N/A	N/A	spatial structure and diversity	N/A
Gather information to further evaluate habitat limiting factors and threats in the basin	• Conduct surveys to evaluate factors affecting habitat quantity. • Conduct surveys to evaluate factors affecting habitat quality. • Conduct surveys to evaluate factors affecting habitat function.	Entire Watershed	Addresses a primary risk factor	N/A	All life stages	All VSP parameters	N/A
Protect and conserve natural ecological processes that support steelhead viability throughout the life cycle	• Apply BMPs to livestock grazing practices • Apply BMPs to road system management • Apply BMPs to agricultural practices to control erosion and runoff • Manage stream corridor through conservation easements and/or land acquisition from willing sellers • Adopt and manage cooperative agreements	Throughout watershed	Key habitat quality and diversity, sediment inputs, water quality, stream flow	Road and grazing management activities	All life stages	abundance, productivity, spatial structure and diversity	Immediate for sediment, other parameters 5-15 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
Improve instream flow during critical periods	• Most of the actions listed in other categories are likely to improve stream flow. • Protect springs	Rock Creek downstream of RM 19.2, lower Squaw Creek, upper watershed	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water tempera-ture, thermal refugia, altered food web	Road and grazing management, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve water quality, reduce summer water temperatures	• Restore riparian vegetative cover with suitable native vegetation to increase shading • Restore natural habitat functions and processes through actions previously identified • Develop sediment control basins • Management livestock grazing in the riparian areas • Increase deep pool habitat	Rock Creek downstream of RM 19.2, lower Squaw Creek, upper watershed	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water temperature, thermal refugia	Road and grazing management,, particularly in riparian areas, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve and/or restore riparian function and condition	• Restore riparian vegetation cover with appropriate native vegetation • Manage grazing in riparian areas • Eradicate invasive plant species from riparian areas • Relocate beaver to suitable areas	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	Hydrology, channel stability, fine sediment, water quality, key habitat quantity, habitat diversity, riparian vegetation	Road and grazing management activities	All life stages	abundance, productivity, spatial structure and diversity	0-50 years
Improve and/or restore channel structure and complexity	• Introduce LWD and other structure in stream as appropriate • Improve riparian vegetation to provide future source of LWD • Stabilize and protect stream banks • Fertilize streams with fish carcasses	Rock Creek downstream of RM 19.2, lower Squaw Creek, headwater streams	Channel morphology, habitat diversity, key habitat quantity, fine sediment, flow, water temperature, thermal refugia, altered food web	Road and grazing management, channelization	All life stages	abundance, productivity, spatial structure and diversity	0-50 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
Improve and/or restore floodplain function and channel migration processes	• Reconnect floodplain habitats • Reconnect side channels • Increase role and abundance of wood and large organic debris in streambeds • Relocate floodplain infrastructure, roads; improve maintenance, rehabilitate, decommission as appropriate • Remove dikes • Relocate beaver to suitable areas	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	Channel morphology, habitat diversity, key habitat quantity, riparian vegetation, fine sediments, flow, water temperature	Road and grazing management activities	Juvenile rearing stage	abundance and productivity	0-10 years
Address upland processes to minimize unnatural rates of erosion and runoff	• Restore native upland plant communities • Implement upland management practices to restore natural runoff and sediment production • Implement off-road vehicle management actions that reduce erosion and fine sediment • Implement road management actions that reduce fine sediment inputs	Upper watershed	Hydrology, channel stability, fine sediment, water quality, key habitat quantity, habitat diversity, riparian vegetation	Road and grazing management activities and off-road vehicles	Egg, fry	abundance and productivity	0-50 years
Review and reduce effects of harvest on the Rock Creek steelhead population	• Review the need for modifications to sport, tribal, and commercial harvest practices on direct catch and by-catch • Increase outreach efforts to reduce the number of steelhead caught in recreational fisheries near the mouth of Rock Creek	All fishing areas in the basin, the Columbia River, and off-shore	Direct mortality	Harvest	Adult migrants	abundance	0-10 years
Research and reduce hatchery effects on the Rock Creek steelhead population	• Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish • Monitor the potential for hatchery strays entering Rock Creek • Increase the proportion of	Columbia River and anadromous reaches of Rock Creek	Competition, genetic introgression	Hatchery releases	Juvenile and adult	abundance, spatial structure, diversity	2-10 years

Strategy	Actions	Action Area	Potential Limiting Factors Addressed	Threats Addressed	Life Stages Potentially Affected	VSP Parameters Addressed	Expected Biophysical Response[1]
	Columbia River Basin hatchery steelhead marked with coded-wire tags, especially in programs shown to stray at high rates in the past, and support the mass marking of all hatchery steelhead releases with, at a minimum, an adipose fin-clip						
Reduce competition with and predation by non-native piscivores	• Reduce the number of non-native predators	Columbia River and mouth of Rock Creek	Predation	Non-native species	fry and juvenile	abundance and productivity	2-20 years
Reduce mortality and/or improve passage at hydroelectric facilities	• Implement strategies and actions in the FCRPS Biological Opinion (NMFS 2008b)	Columbia River	Passage, predation, direct mortality	Hydroelectric plants	juvenile and adult	abundance	0-20 years

[1] Expected response of action implementation – including how long for action to achieve full effectiveness
[2]BLM=Bureau of Land Management, Ecology=Washington Department of Ecology, KC=Klickitat County, KCCD=Klickitat County Conservation Districts, NRCS=National Resources Conservation Service, Private=private landowners and businesses, TNC=The Natural Conservancy, WDFW=Washington Department of Fish and Wildlife, WRIA31 PU = WRIA 31 Planning Unit, YN=Yakama Nation, MNFS=National Marine Fisheries Service, ODFW=Oregon Department of Fish and Wildlife

7. Implementation and Cost Estimates

Implementation of this plan depends on the voluntary actions and cooperation of local entities and citizen groups. An important part of implementation will be working cooperatively to develop an implementation schedule that includes site-specific actions and a detailed research, monitoring, and evaluation plan addressing the information needs described in Chapter 8. As a regional collaborative structure begins to take shape, it has become clear that a detailed RM&E plan should be developed collaboratively after the Rock Creek recovery plan is adopted.

7.1 Implementation

NMFS has worked independently with the Yakama Nation, Washington Department of Fish and Wildlife, Klickitat County, and local entities to develop the recovery plan for the Rock Creek steelhead population. NMFS encourages the formation of a planning group for the Washington Gorge Management Unit, a forum or entity that would take responsibility for coordinating implementation of the plan. Implementing the proposed recovery actions for steelhead in the Washington Gorge Management Unit, including the Rock Creek subbasin, would be a primary task for a Washington Gorge Area Regional Board, subject to concurrence by state, tribal, and local governments and the opportunity for involvement and comment by the public.

The Board could consist of representatives from Klickitat, Yakima, and Benton counties, local landowners, and the Yakama Nation. The Washington Gorge Area Regional Board could also provide an opportunity for coordination with the Lower Columbia River Fish Recovery Board (LCFRB), since the Washington Gorge Management Unit encompasses both the Middle Columbia River Steelhead DPS, and the Willamette/Lower Columbia ESUs for Chinook, coho, and chum ESA-listed populations, which are covered by the LCFRB. The Board could prioritize recovery actions in the Rock Creek subbasin and other areas within the Washington Gorge Management Unit by developing one- and three-year implementation schedules that would build upon and respond to the interests of stakeholders in the area.

Setting priorities for projects for funding and developing an implementation schedule should be based on a balance between the biological benefit of the project, its cost, and feasibility of implementation. Projects that address primary limiting factors, have high biological benefit, are relatively inexpensive, and are feasible should receive highest funding priority. Projects that are costly, have low biological benefit to listed fish species, and have relatively low feasibility should receive lowest funding priority.

In addition to their co-management responsibility and key role on a Gorge recovery board (if one is formed), the Yakama Nation will play an important role during implementation because of their funding agreement under the Columbia Basin Fish Accords (Columbia Basin Accords 2008), which are three Memorandums of Agreement (MOAs) entered into between the Federal Columbia River Power System (FCRPS) action agencies (Bonneville Power Administration, U.S. Army Corps of Engineers and the Bureau of Reclamation), four tribes, and one state. The most relevant MOA to the Middle Columbia River steelhead is with the Columbia River Inter-Tribal Fish Commission and the three treaty fishing tribes—Confederated Tribes of the Umatilla Indian Reservation; Confederated Tribes of the Warm Springs Reservation; and Confederated Tribes and Bands of the Yakama Nation. The MOAs are 10-year action agency commitments for projects to benefit fish affected by the FCRPS, with a focus on ESA-listed fish. The projects will be reviewed through the Northwest Power Act processes for implementing the Fish and Wildlife Program, administered by the Northwest Power and Conservation Council. The agreement secures approximately $200,000 per year for habitat actions, including project management, in the Rock Creek subbasin. Some of the projects listed in Table 7-1 will be implemented with these funds.

7.2 Costs

There are existing Federal, tribal, state, county and other local programs that are being carried out in the Rock Creek subbasin. Many of those programs, for example the USDA NRCS Conservation Reserve Enhancement Program, the Washington State Forest Practices regulations and county plans and ordinances are described in Appendix II. This plan assumes that those existing programs are funded, and will continue to be. At this time, this plan provides only additional incremental costs that would be incurred with implementation of this recovery plan. Total time and cost of recovery is estimated for the DPS as a whole and is iincorporated into Chapter 8 of the Middle Columbia River Steelhead DPS Recovery Plan. As implementation proceeds and implementation schedules are developed, the costs of both existing programs and new incremental costs of this recovery plan will be included in those schedules. If existing programs are not funded, funding will be identified as a need in the implementation schedule and the cost estimates for the recovery plan adjusted accordingly.

In an earlier iteration of this recovery plan, rough, preliminary estimates were also made for the data gathering actions described in Chapter 8 as part of the recovery strategy. The preliminary estimate for RM&E was reported at that time as $3,350,000 over 10 years. As described above, NMFS is not going to incorporate this cost estimate at this time; rather, we expect those costs to be developed as part of a collaborative effort to design an RM&E plan.

In this chapter, cost estimates are provided for an extensive and reach-specific set of potential habitat actions that will be refined and prioritized in the implementation process. NMFS, in coordination with the Yakama Nation, developed these cost estimates for a range of habitat improvement/restoration actions that may be necessary to address limiting factors and improve viability of the Rock Creek steelhead population. These costs, presented in Table 7-1, are general range summaries. Habitat action costs for recovery over a 10-year time period are estimated to be up to $1.8 million ($0.9 million for years 1-5). The actions listed in Table 7-1 do not include or account for RM&E (Section 6.1.1), because those costs will be developed as part of implementation planning, nor do they account for tributary fishery harvest management and enforcement activities (Section 6.1.4), which are considered existing programs, nor for costs of out-of-subbasin effects, which are addressed through other programs (Section 6.1.6).

The list of actions in Table 7-1 was developed primarily to address habitat limitations in each major reach of Rock Creek. The actions are a primary component of the restoration and habitat enhancement strategy discussed in Section 6.1.3 of this plan. Costs were assigned to key actions such as riparian plantings with native vegetation, removal of exotic vegetation, fencing exclosures, and the installation of root wads and other instream structures. These labor-intensive actions will increase shading, resulting in an improvement to water quality and a restoration of riparian function and channel structure and complexity. Several water and sediment control basins will also be installed to assist in the removal of cattle from sections of the stream with an anticipated improvement of riparian condition. An additional major strategy is to protect and conserve existing good quality habitat (Section 6.1.2), through such actions as purchase of conservation easements or land acquisition from willing sellers. Table 7-1 includes costs for acquisition and easement estimates provided by personnel of The Nature Conservancy who have been involved with easements and acquisitions in the Rock Creek watershed. Although each easement and acquisition negotiation is unique, NMFS believes these values to be the best available estimate for such actions within the Rock Creek subbasin.

Table 7-1 Costs Associated with Proposed Reach-Specific Actions for Rock Creek Provided by Yakama Nation Fisheries.

	Rock Creek Actions and Costs				
	** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
Reach	**Action**	**Unit**	**Unit Cost**	**# Units**	**Cost**
RC1 – Rock Creek, mouth to boat ramp at RM 1.1	Due to reach's complete inundation by John Day Pool, only dam operation and reservoir actions can affect reach.				
RC2 – Rock Creek, boat ramp to Old Highway 8	Fencing #	per foot	1.4	2120	2968
	Riparian planting #	per tree	11	2890	31790
	Offsite water *	Each	1500	2	3000
	Instream structures (rock weir etc) *	Each	2000	8	16000
	Revetment #	per bank linear foot	10	350	3500
	Rootwad #	Each	600	15	9000
	Exotic vegetation removal	per acre	1000	10	10000
RC3 – Rock Creek, Old Hwy. 8 to Squaw Cr.	Bioengineered channel stabilization next to road	per foot of channel	47	400	18800
	Fencing #	per foot	1.4	46464	65049.6
	Riparian planting #	per tree	11	3468	38148
	Offsite water *	Each	1500	4	6000
	Instream structures (rock weir etc) *	Each	2000	7	1400
	Revetment #	per bank linear foot	10	400	4000
	Rootwad #	Each	600	15	9000
	Water and sediment control basin *	Each	3000	4	12000

	Rock Creek Actions and Costs				
	** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
	Exotic vegetation removal	per acre	1000	4	4000
SQ1 – Squaw Cr., mouth to Harrison Cr.	Fencing #	per foot	1.4	47520	66528
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	4	6000
	Instream structures (rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	8	4800
	Water and sediment control basin *	Each	3000	5	15000
	Exotic vegetation removal	per acre	1000	2	2000
SQ2 – Squaw Cr., Harrison Cr. to White Cr.	Fencing #	per foot	1.4	33792	47308.8
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	3	4500
	Instream structures (rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	4	2400
SQ3 – Squaw Cr., White Cr. to extent of distribution	Fencing #	per foot	1.4	31680	44352
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	3	4500
	Instream structures (rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	200	2000
	Water and sediment control basin *	Each	3000	5	15000
	Rootwad #	Each	600	4	2400
HA1 – Harrison Cr., to extent of distribution	Fencing #	per foot	1.4	22176	31046.4
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	2	3000
	Instream structures (rock weir etc) *	Each	2000	4	8000
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	4	2400
RC4 – Rock Cr., Squaw Creek to Imrie Property Bridge	Spring protection	per site	800	3	2400
	Dike removal	Cubic yard	8	10800	86400
	Fencing #	per foot	1.4	27456	38438.4
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	2	3000
	Instream structures (rock weir etc) *	Each	2000	8	16000

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
	Revetment #	per bank linear foot	10	300	3000
	Rootwad #	Each	600	8	3200
	Exotic vegetation removal	per acre	1000	6	6000
RC5 - Rock Creek, Imrie Property Bridge to Luna Gulch	Spring protection	per site	800	4	3200
	Dike removal	Cubic yard	8	4500	36000
	Fencing #	per foot	1.4	10560	14784
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	1	1500
	Instream structures (rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	200	2000
	Rootwad #	Each	600	8	3200
	Exotic vegetation removal	per acre	1000	8	8000
LG1 - Luna Gulch: Rock Creek to Extent of Distribution	Fencing #	per foot	1.4	73920	103488
	Riparian planting #	per tree	11	3468	38148
	Offsite water *	Each	1500	7	10500
	Instream structures (rock weir etc) *	Each	2000	11	22000
	Rootwad #	Each	600	16	9600
	Water and sediment control basin *	Each	3000	7	21000
	Exotic vegetation removal	per acre	1000	8	8000
RC6 – Rock Cr., Luna gulch to Badger Gulch	Fencing #	per foot	1.4	24288	34003.2
	Riparian planting #	per tree	11	1445	15895
	Dike removal	Cubic yard	8	1080	8640
	Offsite water *	Each	1500	2	3000
	Instream structures (rock weir etc) *	Each	2000	5	11000
	Rootwad #	Each	600	8	4800
	Exotic vegetation removal	per acre	1000	2	2000
BG1- Badger Gulch	Water and sediment control basin *	Each	3000	4	12000
	Riparian planting #	per tree	11	1445	15895
RC7- Rock Cr., Badger Gulch to Unnamed Trib1	Fencing #	per foot	1.4	5280	7392
	Riparian planting #	per tree	11	1445	15895
	Instream structures (rock weir etc) *	Each	2000	3	6000
UN1 – Unnamed trib at Rock Cr. RM 19.2	Water and sediment control basin *	Each	3000	3	9000
	Riparian planting #	per tree	11	1445	15895
RC8 – Rock Cr., Unnamed Trib 1 to Quartz Creek	Fencing #	per foot	1.4	32736	45830.4
	Instream structures (rock weir etc) *	Each	2000	3	6000

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
	Rootwad #	Each	600	6	3600
QZ1 – Quartz Cr., mouth to small slide	Water and sediment control basin *	Each	3000	12	3600
	Riparian planting #	per tree	11	2890	31790
QZ3- Quartz Cr., small slide to Box Canyon	Water and sediment control basin *	Each	3000	10	3000
	Riparian planting #	per tree	11	2890	31790
QZ4 – Quartz Cr., Box Canyon to Extent of Distribution	Water and sediment control basin *	Each	3000	14	42000
	Riparian planting #	per tree	11	2890	31790
	Instream structures (rock weir etc) *	Each	2000	6	12000
BX1 – Box Canyon, mouth to Box Canyon falls	Water and sediment control basin *	Each	3000	10	30000
	Riparian planting #	per tree	11	2890	31790
RC9 – Rock Cr., Quartz Creek to Small Fall	NO ACTIONS				
RC11 – Rock Cr., Falls to Super Slide	Water and sediment control basin *	Each	3000	6	18000
	Riparian planting #	per tree	11	2890	31790
	Instream structures (rock weir etc) *	Each	2000	4	8000
RC13- Rock Cr., super slide to small slide	Water and sediment control basin *	Each	3000	6	18000
	Riparian planting #	per tree	11	2890	31790
	Instream structures (rock weir etc) *	Each	2000	5	10000
RC15 – Rock Cr., slide to Triple Falls	Water and sediment control basin *	Each	3000	8	24000
	Riparian planting #	per tree	11	2890	31790
General	NRCS Conservation Reserve Program	Cost per acre	41.60	6000 annually	249600
General	Conservation Easements	Cost per acre	450	50 annually	22500
General	Land Acquisitions	Cost per acre	600	50 annually	30000

8. Monitoring, Research, and Adaptive Management

Comprehensive, empirical monitoring data on fish populations and habitat are needed to identify appropriate projects and locations, populate habitat/production capacity modeling efforts (such as EDT, AHA, or other appropriate models), and inform adaptive management for the salmonid recovery plan. Information on fish distribution, abundance, productivity, habitat conditions, genetic diversity, pathogen levels, and other population parameters, as well as on population limiting factors, is necessary to help direct and evaluate these efforts. A coordinated monitoring program is needed to ensure that these various needs, including salmonid recovery planning, are met.

As part of implementing the Rock Creek steelhead recovery plan, a detailed monitoring and evaluation program will be collaboratively designed and incorporated into an adaptive management framework based on the principles and concepts laid out in the NMFS' guidance document, Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (NMFS 2007a) http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf.

8.1 Adaptive Management

Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. It is a process of adjusting management actions and/or directions based on new information. It means taking an experimental approach to a complex task, making one's assumptions clear, and continuously evaluating them in light of new information. It works best when the collection of performance data and methods of evaluation are designed to get the information managers need to make sound decisions.

As outlined in the NMFS Adaptive Management guidance document, several types of monitoring are needed to support adaptive management: (1) implementation and compliance monitoring, which is used to evaluate whether the recovery plan is being implemented; (2) status and trend monitoring, which assesses changes in the status of an ESU and its component populations, as well as changes in status or significance of the threats to the ESU; and (3) effectiveness monitoring, which tests hypotheses and determines (via research) whether an action is effective and should be continued. (These three types of monitoring are discussed in more detail below.)

In addition, it is important to build in some research to illuminate the many unknowns in salmon recovery—the "critical uncertainties" that make management decisions all the harder. Critical uncertainty research may seem expensive or unnecessary in light of basic information needs; however, in the long run, it may reduce monitoring and implementation costs.

NMFS' guidance document presents a decision framework that can guide the design of a research, monitoring, and evaluation plan. The framework (Figure 8-1) contains two basic sorts of questions: (1) questions regarding ESU status (biological viability criteria) and (2) questions regarding statutory listing factors and factors limiting recovery (limiting factor and threats criteria). Evaluating a species for potential delisting requires an explicit analysis of both types of criteria.

The guidance document contains a more detailed discussion of the framework and identifies the specific questions that should be answered to evaluate ESU status. These specific questions take the form of a series of decision-question sets that address the status and change in status of a salmonid ESU and the risks posed by threats to the ESU. The decision-question sets are designed to elicit the information NMFS needs to make delisting decisions. For recovery planners, the framework can guide future decisions about strategies and actions aimed at achieving recovery goals.

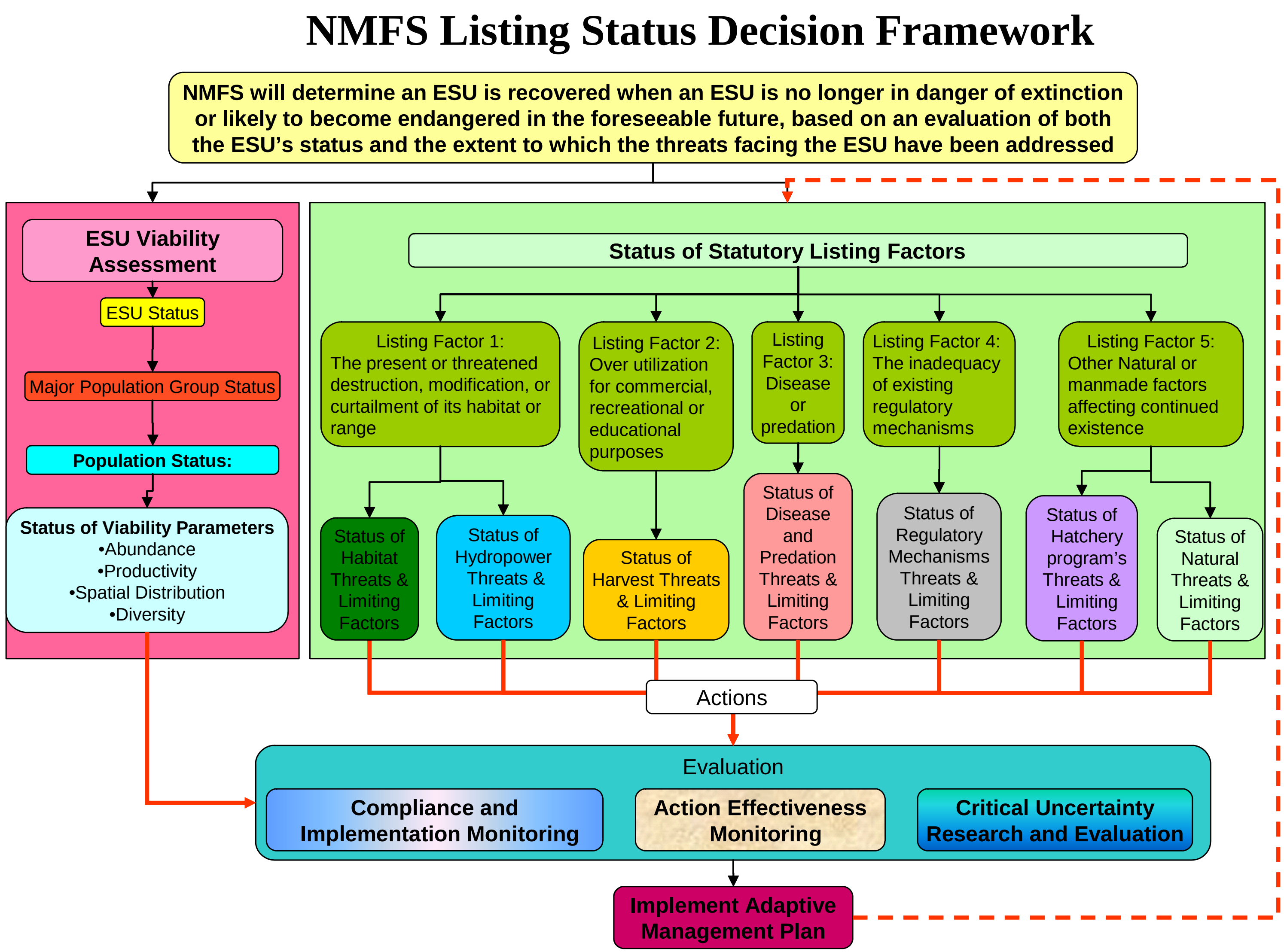

Figure 8-1 NMFS Listing Status Decision Framework.

8.2 Designing a Monitoring and Evaluation Program to Support Adaptive Management

Because of the length and complexity of the salmonid life cycle, there are many uncertainties involved in improving salmonid survival. Simply identifying cause-and-effect relationships between any given management action and characteristics of salmon populations can be a scientific challenge. It is essential to design a monitoring and evaluation program that will answer these basic questions: How will we know we are making progress? How will we get the information we need? And how will we use the information in decision making?

Designing an effective monitoring program for salmon recovery involves the following initial steps:

1. Clarify the questions that need to be answered for policy and management decision making. Include the full ESU and the full salmonid life cycle.
2. Identify entity or entities responsible for coordinating development of this program.
3. Identify:
    - Which populations and associated limiting factors to monitor
    - Metrics and indicators
    - Frequency, distribution, and intensity of monitoring
    - Tradeoffs and consequences of these choices
4. Assess the degree to which existing monitoring programs are consistent with NMFS guidance.
5. Identify needed adjustments in existing programs, additional monitoring needs, and strategy for filling those needs.
6. Develop a data management plan (See Appendix B of *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (May 1, 2007)* http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf
7. Prioritize research needs for critical uncertainties, testing assumptions, etc.
8. Identify entities responsible for implementation.

The Rock Creek subbasin monitoring and evaluation program will build on existing programs designed for monitoring tributary habitat in the Rock Creek subbasin, hydropower actions in the Mid-Columbia, Mid-Columbia hatchery programs, and other actions outside of the Mid-Columbia tributary subbasins (e.g., Columbia mainstem hydropower, estuary and ocean conditions and salmon use, mainstem and ocean harvest). The Rock Creek monitoring and evaluation program will provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be assessed, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be used to adjust strategies or actions aimed at achieving the Plan’s goals.

8.2.1 Implementation and Compliance Monitoring

Recovery actions implemented within the Rock Creek subbasin will be monitored to assess whether the actions were carried out as planned. This will be carried out as an administrative review and will not require environmental or biological measurements.

Implementation and compliance monitoring simply check on whether activities were carried out as planned, and whether specified criteria are being met as a direct result of an implemented action.

Implementation monitoring will address the types of actions implemented, how many were implemented, where they were implemented, and how much area or stream length was affected by the action. Indicators for implementation monitoring may include visual inspections, photographs, and field notes on numbers, location, quality, and area affected by the action. For example, if a fence is planned for 20 miles of stream corridor to keep livestock off the stream-banks so that riparian vegetation will rebound, implementation monitoring would verify the presence of the fence. Compliance monitoring would take note of the presence or absence of livestock in the fenced-off area.

Success will be determined by comparing field notes with what was specified in the plans or proposals (detailed descriptions of engineering and design criteria). Thus, design plans and/or proposals will serve as the benchmark for implementation monitoring. Any deviations from specified engineering and design criteria will be described in detail.

8.2.2 Status and Trend Monitoring

Status and trend monitoring is a simple compilation of data-based descriptions of existing conditions. To be useful in decision making, the raw data, or metrics, should be reduced to a more directly applicable form or indicator. For example, if the question is "What is the annual spawning population size of steelhead in Rock Creek?" the indicator would be total spawning numbers of steelhead over one season for the entire river basin; however, the metric, or directly measured thing, would be something quite different, perhaps steelhead redds sighted on weekly passes over known spawning grounds. Thus, the metric should be processed to translate it from the metric data type (e.g., redds) into the indicator data type (e.g., spawners), and then reduced to generate the indicator required (e.g., list of weekly counts on spawning grounds to annual total for watershed).

A future collaborative Washington Gorge Area Regional Board could direct implementation and develop a program to monitor the status and trend of steelhead population viability attributes, their habitats and their associated limiting factors throughout the Rock Creek subbasin. In the event that a collaborative Board cannot be established, co-managers along with participating local entities and individuals would establish such a program to utilize and comport with the guidelines developed in the NMFS, "Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance", the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and the Collaborative, and the Systemwide Monitoring and Evaluation Project (CSMEP).

8.2.3 Effectiveness Monitoring

Effectiveness monitoring specifically addresses cause-and-effect questions. Demonstrating the direct and indirect impact of management actions requires supporting all steps in the logical chain that connects the action to its expected impact. This chain is rarely short and usually contains several hypotheses. For this reason, it's better to build the effectiveness monitoring into the recovery action strategies, with, for example, pilot-scale tests or other methods carefully thought out beforehand.

Effectiveness monitoring, tests hypotheses and determines (via research) whether an action is effective and should be continued. Effectiveness monitoring should be coordinated with implementation monitoring. Not all recovery actions recommended in this plan need to be monitored for effectiveness. However, it is important that a sufficient number of replicates of each "type" of action be assessed for effectiveness. To the extent possible, effectiveness monitoring of recovery actions should be coordinated with the Washington's effectiveness monitoring program and should be monitored using the Before-After-Control-Impact (BACI) design with stratified random sampling, as described in the Comprehensive Statewide Monitoring Strategy (Monitoring Oversight Committee 2002). This strategy describes in detail the approach, indicators, and protocols needed to assess effectiveness of habitat restoration classes.

Monitoring and evaluation will only provide the answers to the questions they were designed to address; they do not provide the framework for revising these questions if they are ill-posed, evaluating the assumptions upon which the strategy was built, or incorporating learning into future decisions on actions and strategies—this is the role of adaptive management. Further guidance on effectiveness monitoring and validation monitoring/research can be found in NOAA's "Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance."

8.3 Research and Critical Uncertainties

Critical uncertainties, the unknown aspects of environmental conditions vital to salmonid survival, are a major focus of the research, monitoring, and evaluation program. Critical uncertainties fall into several categories policy, legislation, and science. The RM&E will focus primarily on the scientific uncertainties.

8.3.1 Out-of-Subbasin Uncertainties

There are numerous uncertainties regarding out-of-subbasin factors affecting the Rock Creek steelhead population. Successful recovery of steelhead as defined by the regional recovery plan requires achieving specific levels of productivity for populations within the entire DPS, not only acceptable productivity within any single basin that is a part of the DPS. This means that local communities in different watersheds/basins across local and state boundaries are dependent upon each other for successful delisting of these species. Results of actions, monitoring and research associated with NOAA's Estuary Module and 2008 FCRPS Biological Opinion should be coordinated with an appropriate local collaborative Board.

8.3.2 In-Subbasin Uncertainties

Monitoring is needed to establish linkages between specific actions and resultant environmental effects. Those linkages are complex and often not well understood. Understanding them requires input from experts from various fields. It is important that the actions recommended in the Plan to benefit listed fish species in the Rock Creek subbasin be reviewed by fish ecologists, geologists, hydrologists, and other experts familiar with the recovery region to determine how uncertainties may affect the interpretation of results.

Specific benchmark values for the VSP parameters will likely be refined during plan implementation based on new information. The following are examples of questions/research that would significantly enhance the ability to answer the information gaps or other relevant questions by providing new information to reduce uncertainty. These ideas and concerns could be discussed and prioritized during collaborative development of an RM& E plan.

- Conduct surveys to determine steelhead distribution.
- Gather information to calculate abundance and productivity estimates.
- Evaluate population phenotypic and genetic variation.
- Identify major life history strategies.
- Conduct studies to address genetic variation in the population.
- Assess the contribution of hatchery-origin steelhead to the natural spawning opulation.
- Document the 'spawner' contribution/distribution throughout the subbasin.
- Determine the number of Rock Creek steelhead caught in various fisheries.
- Evaluate the importance of 'straying' as a mechanism of maintaining the population.
- Determine survival from egg to fry.
- Further evaluate limiting factors and their causes.
- Evaluate what can be done to reduce stream temperature (Aspect Consulting 2005; Glass 2009).
- Evaluate what can be done to enhance stream flow (Aspect Consulting 2005; Glass 2009).
- Implement genetic research to identify genotypic variation, help establish presence of winter and summer runs in Rock Creek.
- Increase understanding of linkages between physical and biological processes so that managers can predict changes in survival and productivity in response to selected recovery actions.
- Validate the EDT model for Rock Creek with up-to date information, conduct sensitivity analyses for the model, and test assumptions built into the Rock Creek model runs.
- Determine relative performance (survival and productivity) and reproductive success of naturally produced steelhead in the wild.
- Assess population structure.

- Assess steelhead distribution in neighboring subbasins and determine genetic relationship to Rock Creek steelhead population
- Determine the effects of exotic species on recovery of steelhead and the feasibility of actions to eradicate or control numbers of exotic species.
- Evaluate increased predation risks from native and non-native fish and birds.
- Assess eutrophication and aquatic vegetation impacts and determine ecologically sound solutions to address the problems near the mouth of Rock Creek.
- Assess potential of conserving and rehabilitating springs.
- Identify what current water temperatures in the lower river are, and whether fish can survive with higher average mainstem temperatures if in-stream and side channel/floodplain habitats are intact, diverse and provide thermal refugia.

8.4 Existing Monitoring and Research

Many entities have been or will be implementing recovery actions within and downstream from the Rock Creek subbasin. Monitoring programs with which to coordinate include:

- WRIA 31 Watershed Monitoring Program (Klickitat County, EKCD, and the Washington Department of Ecology).
- Yakima Klickitat Fisheries Project,
- Yakama Nation Monitoring,
- NOAA Fisheries RME Program,
- Washington Salmon Recovery Funding Board Program,
- PACFISH/INFISH Monitoring Program,
- Pacific Northwest Interagency Regional Monitoring Program,
- USFWS, USGS, and BOR Monitoring Programs,
- WDFW and Department of Ecology monitoring programs, and
- Local Conservation District monitoring.

It is critical that these programs be consulted to emphasize utility, reduce redundancy, increase efficiency, and minimize costs.

8.5 Additional Needs

Additional monitoring needs may be identified in the future and should be incorporated into the RM&E plan during development or through the implementation of the adaptive management process.

8.6 Data Management

A formal and documented approach to data management is essential to adaptive management. A well-designed data management plan can help to ensure that data of a specified quality and quantity is available, at a specified time, to meet specified data analysis needs. Protocols, metrics, and other data standardization tools such as common data entry methods are a top priority for recovery plans. Coordination across existing monitoring programs and projects will be underpinned by an integrated monitoring and data management framework. The framework would, for example, require the use of common methodologies for sample design, data collection, data validation, and data sharing in order to address common questions. Data management systems should be developed and coordinated with national and regional efforts for consistency with regional and national data standards. Project implementation data management should be consistent with PCSRF protocols where appropriate and guidance from PNAMP's effectiveness work group. Further guidance on data management is provided in the NMFS Guidance document Adaptive Management for Salmon Recovery.

It may be appropriate to incorporate data management with the Yakima Klickitat Fisheries Project, the WRIA 31 Watershed Management Plan implementation (and the WRIA 31 initiating governments), and other regional programs to provide easy comparison with existing large datasets within the DPS. There may be some administrative obstacles to this, but efficiency would dictate that this is likely the most appropriate resource. Storage of new monitoring information and access to existing information will be under contract with the local implementation body of this plan.

8.7 Consistency with Other Monitoring Programs

This recovery plan will utilize existing monitoring programs to evaluate the status/trend and effectiveness of recovery actions within the Rock Creek Basin. Specifically, this approach should incorporate strategies, indicators, and protocols described in the WRIA 31 Watershed Management Plan, the Upper Columbia Monitoring Strategy, the Comprehensive Statewide Monitoring Strategy, and Collaborative Systemwide Monitoring and Evaluation Project (CSMEP). The development of other regional monitoring programs may result in modifications to the monitoring programs used in the Rock Creek basin. These other programs, in various states of development, include such approaches as Pacific Northwest Aquatic Monitoring Partnership (PNAMP). As these programs develop more fully, they will provide guidance on valid sampling and statistical designs, measuring protocols, and data management. This information may be used to refine and improve the existing monitoring and evaluation programs in the Rock Creek basin. The intent is to make monitoring and evaluation programs in Rock Creek consistent with programs throughout the ESUs/DPSs and Columbia Basin.

8.8 Coordination

Many entities have been or will be implementing recovery actions within and downstream from the Rock Creek Basin. Monitoring programs to coordinate with include:

- NOAA Fisheries RME Program,
- Washington Salmon Recovery Funding Board Program,
- PACFISH/INFISH Monitoring Program,
- Pacific Northwest Interagency Regional Monitoring Program,
- USFWS, USGS, and BOR Monitoring Programs,
- WDFW and WDOE Monitoring Programs,
- Local Underwood Conservation District Monitoring, and
- WRIA 31 Implementing Governments.

It is critical that these programs be consulted to emphasize utility, reduce redundancy, increase efficiency, and minimize costs.

8.9 Evaluation Schedule

The Rock Creek subbasin currently has no collaborative regional Board guiding and coordinating recovery implementation. Tracking progress or needs for adaptive management in the Rock Creek subbasin by evaluating information from the recovery plan's research and monitoring programs would be one of the roles of a Washington Gorge Area Regional Board. Appropriate time intervals and triggers/goals need to be established to evaluate project implementation, compliance and effectiveness; the status (and change in status) of a population's viability attributes; the status of a population's limiting factors; and the research needs identified in the recovery plan.

On an annual basis, the Washington Gorge Area Regional Board would review efforts within the Rock Creek subbasin to determine whether funding has been obtained and actions initiated. Further evaluations should occur at intervals coordinated with other subbasin in the DPS. Reviews at this time should start with funding and implementation effectiveness. If funding and implementation have taken place previously, their effectiveness should be reviewed and progress toward the overall implementation of projects within Rock Creek should be measured. Status reviews should be coordinated with NOAA Fisheries five-year status reviews. Progress, or the lack thereof, should be evaluated within context of the entire DPS. In the absence of a Washington Gorge Area Regional board, monitoring efforts would probably continue to be coordinated/implemented through two programs -- Yakama Nation Fisheries, and, WRIA 31 Watershed Planning under Chapter 90.82 RCW, which coordinates state and local efforts.

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Appendix I. Eastern Tributaries in the Washington Gorge Management Unit

Appendix I describes steelhead distribution and current conditions in several small tributaries to the Columbia River that drain areas in eastern Washington State upstream of Rock Creek. These tributaries are included in the Washington Gorge Management Unit of the Middle Columbia River steelhead DPS, which also contains the Rock Creek subbasin. There is very little information available about these small eastern Washington tributaries. NMFS considers them lower priority at this time than restoring the core populations of the Middle Columbia steelhead DPS. These drainages do not have enough historical habitat potential to sustain minimum numbers of spawners over a long time. If there are steelhead present, which has not been established in all cases, the ICTRT believes that the long-term occupancy of these small, relatively isolated streams probably depends on straying from a variety of areas, with the nearest upstream populations likely being the largest contributors of strays.

A summary of the available information is included as an Appendix to the Rock Creek Plan simply to acknowledge that these tributaries are part of the Washington Gorge Management Unit and that some insight into these areas might be useful to scientists and stakeholders in the future.

Introduction

NMFS defined "management units" for salmon and steelhead recovery planning based on jurisdictional boundaries as well as areas where local recovery planning efforts were underway. Several small eastern Washington tributaries of the Columbia River that drain lands to the east of the Rock Creek watershed are included in the Washington Gorge Management Unit and are considered part of the Middle Columbia River steelhead DPS. The management unit includes the White Salmon, Klickitat, and Rock Creek subbasins as well as the following small tributaries to the east: Chapman Creek, Wood Gulch, Pine Creek, Alder Creek, Glade Creek, and Fourmile Canyon (Figure ApI-1).

The Interior Columbia Technical Recovery Team (ICTRT) included these small eastern Washington State tributaries in the independent population boundaries of the Willow Creek and Umatilla populations of the Middle Columbia River steelhead DPS, which were historically the closest upstream independent populations (Figure ApI-1). The Willow Creek population is now considered extirpated (ICTRT 2009).

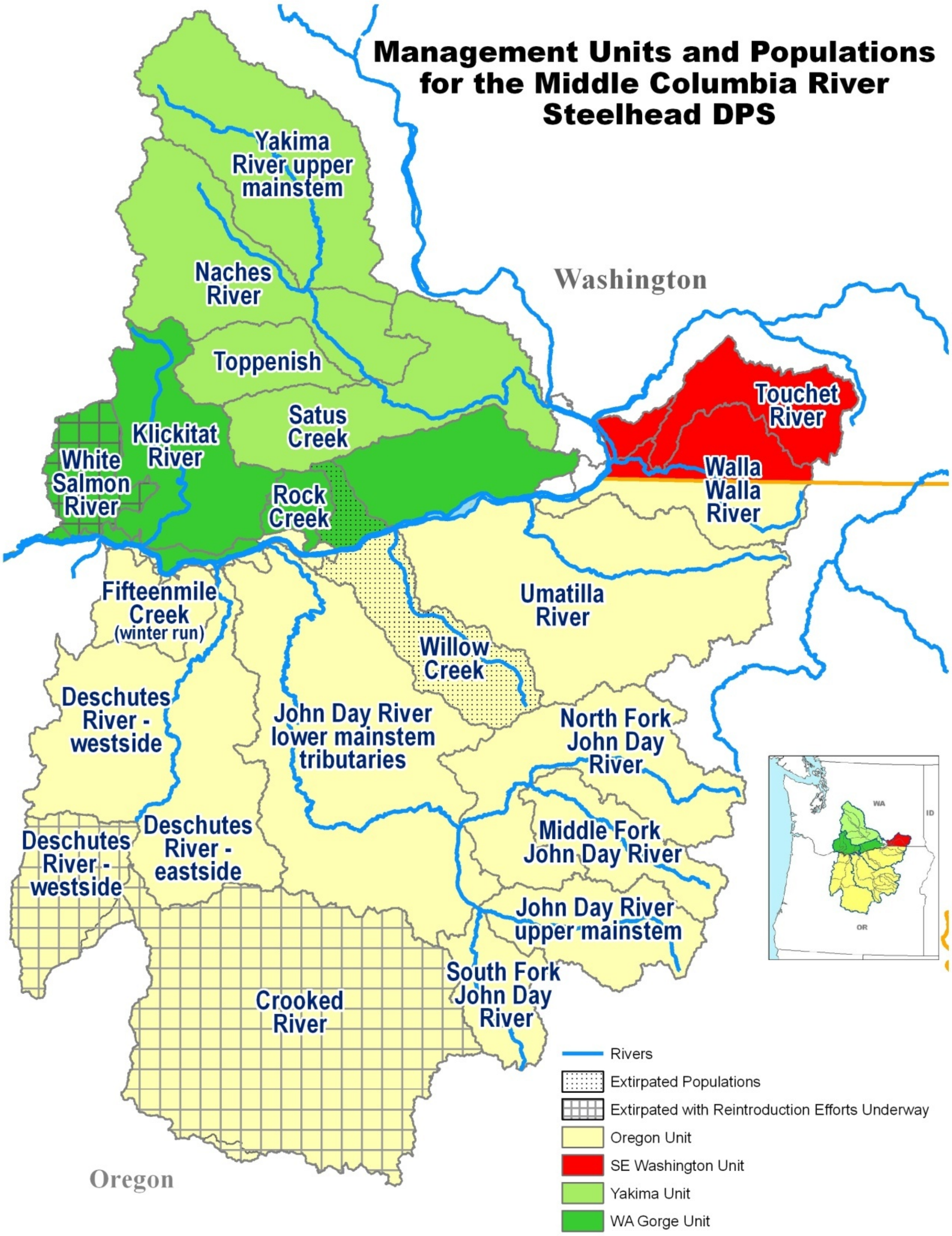

Figure ApI-1 NMFS Management Units for the Middle Columbia Steelhead DPS

The Umatilla and Willow Creek populations are part of the Oregon-Washington bi-state Umatilla/Walla Walla major population group (MPG) of the Middle Columbia River steelhead DPS. The Umatilla/Walla MPG includes three extant populations and one extirpated population. The Umatilla population is classified as a large population, and the other two, the Walla Walla and the Touchet, are classified as intermediate in size. The Umatilla population spawns primarily in Oregon, the Walla Walla population in both Oregon and Washington, and the Touchet population entirely in Washington. The Middle Columbia Steelhead DPS Recovery Plan (NMFS 2009) and the Oregon Middle Columbia River Steelhead Recovery Plan (Carmichael 2009) target the Umatilla population for viability and provide viability criteria, status assessment, limiting factors and threats, strategies and actions for recovery of the Umatilla population. The Willow Creek population is extirpated, and it is not considered to be a potential contributor to recovery of the DPS (NMFS 2009).

The small eastern Washington tributaries do not have enough historical habitat potential to sustain minimum numbers of spawners over a long time. If there are steelhead present, which has not been established in all cases, the ICTRT believes that the long-term occupancy of these small, relatively isolated streams probably depends on straying from a variety of areas, with the nearest upstream population likely being the largest contributor of strays. For that reason, the ICTRT included Alder Creek, Glade Creek, and Fourmile Canyon in the Umatilla population, and by the same logic inferred that steelhead (if any) in Chapman Creek, Wood Gulch, Pine Creek, and Old Lady Canyon historically could have been related to the now-extirpated Willow Creek population. It is unlikely that any current production in those small tributaries on the Washington side reflects Willow Creek. It is much more likely that any current production in those streams is either ephemeral, or linked with a currently producing upstream tributary (e.g., the Umatilla), or the result of straying from other extant steelhead populations/hatchery programs (ICTRT 2003, ICTRT 2009, and Tom Cooney, pers. comm. 2009).

Recovery Goal

NMFS' goal is for the Middle Columbia River Steelhead DPS to be recovered and removed from listed status under the ESA. Biological goals and criteria for the recovery of steelhead populations and MPGs in the Middle Columbia River steelhead DPS were developed by the ICTRT (2009) and described in the Middle Columbia Steelhead DPS Recovery Plan.

According to ICTRT viability criteria (ICTRT 2005, ICTRT 2007a, ICTRT 2007b), the Umatilla/Walla Walla MPG and other MPGs in the DPS should be at low risk (viable) for the Middle Columbia River steelhead DPS to be considered viable. ICTRT criteria recommend, and the Middle Columbia River Steelhead DPS Recovery Plan provides, that for the Umatilla/Walla Walla MPG to be regarded as viable:

1. Two of the historical populations in the MPG should meet at least minimum viability standards.
2. Viable populations within the MPG should include one large and one intermediate sized populations.
3. All major life history strategies present historically should be represented.
4. One population should be highly viable.

5. All populations that do not meet viable status should be maintained.

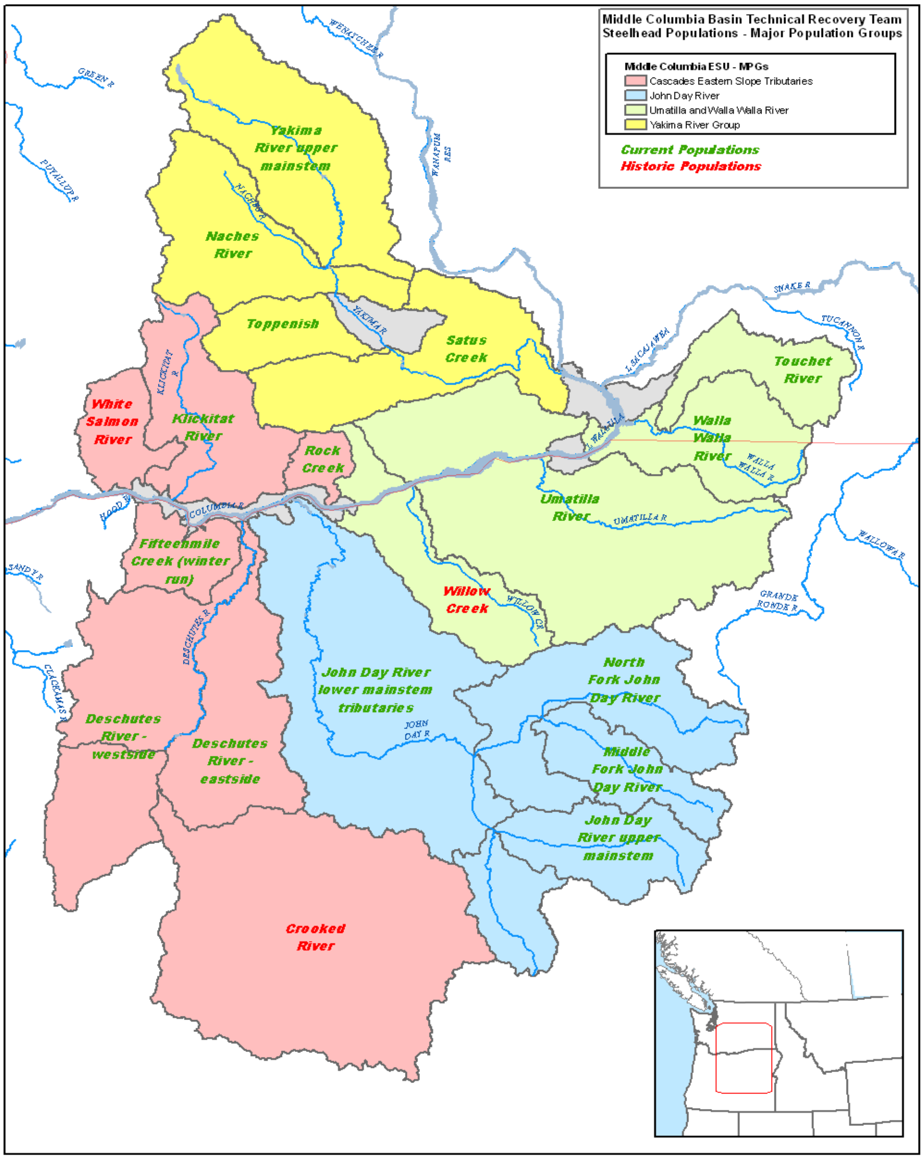

Figure ApI-2 NMFS Populations and Major Population Groups for the Middle Columbia River Steelhead DPS.

To meet the MPG-level viability criteria for the ESA, the Umatilla population should be at least viable (less than 5 percent extinction risk), or highly viable (less than 1 percent extinction risk). Either one of the intermediate populations, the Touchet or Walla Walla, should also reach viable or highly viable status. The remaining extant population should have no more than a 25 percent extinction risk. The Willow Creek population is considered extirpated and is not currently included in the ICTRT's recommended recovery scenario for the Umatilla/Walla Walla MPG (ICTRT 2005, ICTRT 2007a).

Because the Umatilla is a large population, the ICTRT recommended that to be viable, it should reach a minimum abundance threshold of 1,500 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5 percent or less risk of extinction over a 100-year timeframe (ICTRT 2009).

The ICTRT considered Alder Creek, Glade Creek, and Fourmile Canyon to be spawning areas for the Umatilla River steelhead population, and included them in the assessment of spatial structure/diversity for that population (Section 6.1.9 in Carmichael 2009, and ICTRT 2009). However, these small tributaries were not included in the abundance/productivity rating because the Umatilla River drainage contains sufficient intrinsic potential habitat by itself to meet the definition of a large population. The Umatilla drainage is the core production area for the population (ICTRT 2009).

The Umatilla population does not currently meet the recommended viability criteria because its abundance/productivity and spatial structure/diversity risk ratings are both moderate. It does meet criteria for a "maintained" (moderate risk) population.

Recovery strategies and actions for the Umatilla population aim to improve viability by implementing actions to:

- Coordinate between planners, scientists and those implementing recovery actions in Washington and Oregon for sequencing, monitoring and adaptive management.
- Protect and improve freshwater habitat conditions and access for steelhead production. Improvements to freshwater habitat should be targeted to address specific factors in specific areas as described in the Southeast Washington Plan (SE Washington Management Unit Plan) and the Oregon Steelhead Recovery Plan (Oregon Management Unit Plan).
- Improve hatchery management to reduce straying from out-of-DPS hatchery fish onto natural spawning grounds within the Umatilla/Walla Walla subbasins.
- Improve survival in mainstem and estuary through actions detailed in NMFS Estuary Module (NMFS 2007) and FCRPS Biological Opinion (NMFS 2008).

Summary of Existing Information on the Eastern Washington Tributaries

The eastern tributaries that are part of the Umatilla/Walla Walla MPG fall within Washington's Middle Columbia River Salmon Recovery Region, which comprises salmon-bearing streams in Benton, Kittitas, Yakima, and parts of Chelan and Klickitat counties. They are in the state's Rock-Glade Water Resource Inventory Area (WRIA) 31, which is bounded on the south and east by the Columbia River, on the west by the Klickitat River subbasin, and on the north by the Simcoe Mountains and a basalt ridge of the Horse Heaven Hills. They flow in a southerly to southeasterly direction to Lake Umatilla, the portion of the Columbia River impounded by the John Day Lock and Dam. Elevations range from 200 feet at the confluence of Rock Creek and the Columbia River to over 4,000 feet in the Horse Heaven Hills (WSCC 2005).

Wood Gulch and Pine Creek drain an area of Washington State that is dominated by extensive basalt flows having a total thickness of up to 5,000 feet. The erosion-resistant nature of these flows has resulted in the creation of deep (500 to 800 feet), steep-walled canyons and has severely constrained floodplain development along substantial portions of the streams within this area (Aspect Consulting and WPN 2004). Chapman, Alder, Glade, and Fourmile Creeks flow over deep deposits of loess (Aspect Consulting and WPN 2004). Steep-walled canyons are common in these creeks as well because the underlying loess is highly erosive.

The streams appear to have similar geomorphic characteristics. Headwater tributaries flow out of the mountains and across the relatively flat basalt plateau at gradients of generally less than 1 percent; this area is above known anadromous use. Coming off the plateau, streams enter steep-walled canyons; gradients increase to 2 – 4 percent or more. Below the canyon reaches, most of the streams enter alluvial valleys; gradients range between 1 percent and 2 percent near the upper end, dropping to less than 1 percent as streams approach the Columbia.

Climate over the area is typical of that found on the east side of the Cascades; average daily temperatures range from 70°F in the summer (with maximums commonly above 90° F) to 37° F in the winter. Annual precipitation ranges from 14 to 16 inches in the eastern portion of upper Wood Gulch to less than 10 inches over the eastern two-thirds of the area. Most of the precipitation in the area falls between October and April (Aspect Consulting and WPN 2004). Cultivated agriculture is a more dominant land use in those subbasins with deep deposits of loess, including the lower halves of Alder, Glade, and Fourmile Creeks. A large portion of the cultivated land is irrigated in the southern halves of Glade Creek and Fourmile Creek, and to a lesser extent in the Alder Creek tributaries (Aspect Consulting and WPN 2004).

All these streams may have temperature problems: high water temperatures are recorded during summer months. Data suggest that water temperatures in Chapman Creek, Alder Creek, Wood Gulch and Pine Creek have been found to exceed the Washington Department of Ecology standard (17.5°C/63.5°F) (BLM 1986, EKCD 1997, Lautz 2000).

The ICTRT (2007) used regression models based on available stream temperature-elevation data to characterize reach-specific temperature regimes. The ICTRT cautioned that those projections reflect the factors driving stream temperatures during the periods of observation and are not necessarily representative of historical conditions. However, they used temperature mapping, based on those relationships, to identify populations and areas that are subject to relatively high stream temperatures during key rearing (and spawning) periods. Glade Creek and Fourmile Canyon are temperature-limited areas that could potentially have had temperature limitations historically. Alder Creek appears to be only partially temperature limited (ICTRT 2009).

Land use in Wood Gulch and Pine Creek subbasins is largely rangeland. While there is some dryland farming in these subbasins, the subbasins have shallow soils overlying aged basalts and are not well suited for cultivation. Cultivated agriculture is a more dominant land use in those subbasins with deep deposits of loess, including the lower halves of Chapman, Alder, Glade, and Fourmile Creeks. A large portion of the cultivated land is irrigated in the southern halves of

Glade Creek and Fourmile Creek, and to a lesser extent Alder Creek, subbasins (Aspect Consulting and WPN 2004).

Alder Creek

Alder Creek encompasses an area of 199.09 sq. miles (127,418.3 acres). Very little information is available regarding habitat conditions or steelhead distribution in the basin. The lower portion of Alder Creek is perennial as a result of spring water inputs and, in the lower half of the subbasin, irrigation return flow. Despite relatively dense riparian vegetation along the narrow creek, stream temperatures in the summer tend to be warm, with seven-day average temperatures possibly exceeding the state standard. Hill slopes of Sixprong Creek, a tributary to Alder Creek, were found to be up to 50 feet in height, nearly vertical, and of highly erosive material. The stream channel is well-defined in much of the Sixprong Creek, except in the lowest reaches, which contain broad wetlands. Government Land Office (GLO) land survey notes of the late 1800s indicate the steep canyon slopes were present at the time of early settlement (Aspect Consulting and WPN 2004).

Steelhead distribution: No surveys of fish distribution have been completed in the basin. Steelhead adults have reportedly been observed in the lower 1.5 mi. of Alder Creek (Yakama Nation Fisheries, unpublished information).

Habitat Conditions: Geology in the basin is dominated by flood deposits and loess (Aspect Consulting and WPN 2004). The loess is derived from wind-blown sediments and does not contain the gravels and cobbles necessary to form spawning habitat; therefore, there may be little spawning gravel present in the basin.

Glade Creek

The Glade Creek watershed covers 432.7 square miles on a wide, open, largely treeless, gently south-sloping plateau in southeastern Washington known as the Horse Heaven Hills. The majority of the watershed, including the lower half of mainstem Glade Creek, the eastern tributaries of Moore Canyon, East Branch Glade Creek, and Carter Canyon, lies in western Benton County, while the main branch of Glade Creek and Coyote Canyon extend across the northeastern corner of Klickitat County and into the southeast corner of Yakima County. Glade Creek's headwaters drain the east-west trending crest of the Horse Heaven Hills at elevations that range from 3,560 feet at the western end to 1,420 feet. East Branch joins the main branch of Glade Creek at an elevation of 365 feet; the confluence of Glade Creek at the Columbia River is at 266 feet above sea level (Garrigues 1996).

Annual precipitation is typically under 10 inches (Aspect Consulting and WPN 2004). About 90 percent of the precipitation falls between November and April, primarily as snow (Packard et al. 1994).

The Glade Creek watershed is underlain by at least 5,000 feet of basaltic flows forming three basalt formations, each composed of numerous, layered basalt flows with many potential fractured, water-bearing zones. Loess, alluvial, glaciofluvial and lacustrine deposits overlie the basalt and range from less than 5 feet to about 200 feet thick (Packard et al. 1994). Groundwater flow direction in the watershed is determined to a large extent by geologic structure and topography, which combine to funnel groundwater flow toward the lower reaches of Glade Creek (Garrigues 1996). Groundwater recharge in the subbasin is estimated to be roughly 300 percent of pre-development conditions due to irrigation return flows (Aspect Consulting and WPN 2004).

Glade Creek and its tributaries are intermittent streams that, historically, have often been dry in the summer and autumn (Molenaar 1982; Davis 1993). Flow typically only occurs in the precipitation and snow-melt period, based on six crest-stage gauges on central Glade Creek and various tributaries and at a discharge measurement site at the creek's mouth (Molenaar 1982). Under normal precipitation conditions, nearly 100 percent of the flow in Glade Creek comes from baseflow (groundwater discharge), except during spring runoff and peak stream discharges after storm events (Garrigues 1996).

Crop production is the basis of the economy in the Glade Creek watershed. Dryland wheat occupies the greatest crop area, but irrigated lands have increased dramatically since the early 1970s (Packard et al. 1994) The principal groundwater use is for crop irrigation; however, the primary source of water used in the subbasin is surface water imported from the Columbia River (Aspect Consulting and WPN 2004).

Steelhead distribution: During a study conducted in spring of 2009, single pass snorkel surveys were conducted in Glade Creek. *O. mykiss* were not observed in Glade Creek (Glass 2009). Dace were the only species occupying the basin.

Habitat Condition: No suitable spawning habitat was found in the lower 2.5 miles of the stream (Glass 2009). The loess that dominates most of the basin is derived from wind-blown sediments and does not contain the gravels and cobbles necessary to form spawning habitat; therefore, it appears that the lack of spawning habitat is a natural condition. The available information regarding the naturally occurring lack of spawning habitat (Glass 2009) and absence of surface water flow throughout much of the basin (Garringues 1996) suggests that Glade Creek cannot support salmonid populations under naturally occurring conditions.

Fourmile Canyon

No information is available for Fourmile Canyon. A review of available aerial photographs indicate that Fourmile Canyon does not have an outfall into the Columbia or a tributary to the Columbia, suggesting that the canyon cannot support anadromous species (Glass 2009).

Chapman Creek

The Chapman Creek watershed encompasses 24.15 sq. miles (15,453.5 acres). The headwaters and other stream sections are dry for much of the year.

Steelhead distribution: No *O. mykiss* were observed in the one pass snorkel surveys conducted in Chapman Creek in October and November of 2008 (Glass 2009). Speckled dace were the only species observed utilizing habitats in the basin during the survey.

Habitat Condition: No suitable spawning habitat was found in the lower 4.5 miles of the stream, which includes the majority of the wetted area in late summer and fall. The loess which dominates most of the basin is derived from wind-blown sediments and does not contain the gravels and cobbles necessary to form spawning habitat; therefore, it appears that the lack of spawning habitat is a natural condition (Glass 2009). Due to the naturally occurring lack of spawning habitat, it is unlikely that Chapman Creek can support salmonid populations.

Wood Gulch Creek

Wood Gulch encompasses an area of 64.39 sq. miles (41,207.9 acres). The creek runs through a steep, arid canyon, with slopes that extend 500-800 feet up from the valley bottom. Precipitation in the basin ranges from 8 to 16 inches per year, falling primarily from October through April (Aspect Consulting and WPN 2004). The Wood Gulch fire burned 11,640 acres 2007, (www.wsp.wa.gov/fire/docs/mobilization/mobe_history_for_2008.pdf) including several stretches of riparian vegetation.

Human population is sparse in the subbasin. The primary land use in the subbasin is rangeland. Commercial-scale wind energy facilities are also present in the subbasin on the plateaus. Few roads traverse the basin, and most existing jeep trails are located at a distance from the stream, except a few which reach the valley bottom.

***O. Mykiss* distribution:** Single pass snorkel surveys were conducted in Wood Gulch in October and November of 2008 (Glass 2009). *O. Mykiss* were observed between river mile 1 and river mile 9. The majority (58 percent) of these fish were observed between river mile 1 and river mile 5. The proportion of the population that is anadromous is unknown. The size distribution of the *O. Mykiss* in the lower 5 miles of the stream is consistent with sizes expected of juvenile anadromous fish; however, the size distribution of the fish in the upper 4 miles of the fish distribution suggests that those fish may be part of a resident population because there were numerous larger fish (Glass 2009).

Habitat Condition: Twenty-four percent of the stream length surveyed in October and November of 2008 was dry. Dry segments were concentrated in the lower 1 mile of the stream (58.4 percent dry) and in segments upstream of approximately river mile 9 (68.7 percent dry) (Glass 2009). Based on GLO Land Survey notes from June 1867, Wood Gulch Creek was dry at the mouth and intermittent from there to the confluence of Big Horn Canyon, upstream of which perennial water seemed to return and extend to four miles upstream of the confluence with Big Horn Canyon, as well as 2-3 miles upstream into Big Horn Canyon (Aspect Consulting and WPN 2004).

The majority of the spawning habitat in the Wood Gulch basin is located in the lower 5 miles of the stream. The percent fines in the spawning gravels in fall and early winter of 2008 was less than 20 percent in most of the basin, indicating that the quality of spawning gravel was generally good. Sixty-nine percent of the pool (rearing) volume identified in the surveys of 2008 was found in a 0.5 mile segment between river miles 8 and 9. Twenty-eight percent of the *O. mykiss* observed in the basin were found in this short stretch. The portion of the creek extending from river mile 1 to river mile 5 also contained numerous pools that represented 21 percent of the total pool volume in the basin. Fifty-eight percent of the *O. mykiss* observed in the basin were found in these pools (Glass 2009).

Pine Creek

Pine Creek is a small stream with a basin area of approximately 62.64 sq. miles (40,086.8 acres). Pine Creek feeds Lake Umatilla on the Columbia River upstream of John Day Dam in WRIA 31. Average subbasin elevation is 1904 feet; average annual precipitation ranges from 8 to 10 inches near the mouth to 14 to 16 inches in the headwaters of the basin (Aspect Consulting and WPN 2004).

A system of five culverts at the SR 14 highway crossing of Pine Creek was included in the WSDOT Fish Passage Barrier Inventory as of March 2006. The intended entrance is fully submerged at approximately 30 feet depth in Lake Umatilla. The upstream invert of the pipes is several feet above the pool water surface much of the year. A large volume of sediment and debris has filled in the previous creek channel nearly 15 feet, and obstructs the entrance to the submerged culvert. Only a small opening clogged with woody debris passes flow from the stream through the road fill. The constricted culvert entrance has created a barrier to fish passage due to physical obstructions and high water velocities (Harbor Consulting Engineers 2007). The culvert was attributed with 0 percent fish passage by WSDOT (2006). The barrier culverts are slated for replacement in 2012.

***O. Mykiss* Distribution**: Due to the passage barrier at the mouth, all fish in Pine Creek are resident fish. They may have some genetic link to a previous anadromous population, but they are not currently an anadromous population.

The one pass snorkel surveys conducted in the lower 7 miles of the creek in November of 2008. Sixty-nine resident *O. mykiss* were observed distributed throughout the surveyed area (Glass 2009). Forty percent of the *O. mykiss* were observed in a single pool at roughly river mile 1 and thirty-two percent of the fish were observed in a single pool at roughly river mile 8.3. The remaining 19 percent of the fish were scattered throughout the lower 7 miles of the creek. Since *O. mykiss* were found throughout the survey area, additional fish may be present upstream of the surveyed area.

Habitat Condition: Within the area surveyed in November of 2008, 41.6 percent of the survey area was dry. Fifty-nine percent of the lower 5 miles of the stream was dry, but flow was more consistent further upstream where less than 10 percent of the channel length was dry (Glass 2009).

The majority of the spawning habitat in the surveyed portions of the Pine Creek basin is located between river mile 4 and river mile 8 (Glass 2009). The percent fines in the spawning gravels in November of 2008 was less than 20 percent in most of the basin, indicating that the quality of spawning gravel was generally good. The total pool volume in the surveyed area was 182.1 cubic meters. Pool habitat was distributed throughout the survey area. Many of the pools in the lower 5 miles were isolated between dry stretches of channel.

Old Lady Creek

A brief reconnaissance of Old Lady Canyon was completed on 12/16/08, four days after a period of heavy rain (Glass 2009). The basin has several emergent wetlands. Despite the heavy rains, the stream was not flowing. The culverts under Highway 14 near the mouth of the basin is well positioned to carry any flow but were dry and clean suggesting flow occurs rarely, if at all.

Two vertical drops (no water) are along the apparent channel in the first reach of the basin; one is 17 feet high and the second is 16 feet high. There is a 21-foot interval between the two drops where a small depression 0.5 foot deep is present. Both drops would be upstream barriers to fish movement if flow were present in the canyon (Glass 2009).

Appendix I References

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Appendix II. Current Efforts to Improve the Watershed

Many positive steps have already been taken or are currently underway that will improve steelhead habitat and overall watershed function in the Rock Creek drainage, and thus improve the viability of Rock Creek steelhead. The breadth of these efforts illustrates how natural resource managers, local governments, tribes, soil and water conservation districts, non-profit organizations, local land owners and many others are working together to improve watershed conditions that will support a viable Rock Creek steelhead population throughout its freshwater life stage. This appendix describes many of these efforts.

Conservation Efforts

- The Eastern Klickitat Conservation District (EKCD), under a 1996 Memorandum of Agreement with the Washington Department of Ecology, implemented actions to contribute to the protection of water quality, speed riparian recovery, and potentially prevent future flood-related damage in the Rock Creek drainage. In accordance with the MOA, the EKCD monitors water temperatures other water quality parameters (e.g., dissolved oxygen, pH, nitrates). This MOA, however, lapsed in 2004 and has not been renewed, but the EKCD continues to implement its provisions. The EKCD monitors water temperatures other water quality parameters (e.g., dissolved oxygen, pH, nitrates) as well as plant vegetation throughout the watershed. Under a grant from the Washington Conservation Commission (WCC), the EKCD "cost-shares" with landowners for grassland/permanent cover plantings and for no-till seeding throughout the Rock Creek drainage. Under a different grant from the WCC, the EKCD is working with livestock growers throughout the basin to develop and implement BMPs (Best Management Practices) which target restoration and protection of riparian areas (Jim Hill, EKCD District Manager, pers. comm. 2006).

- County governments, state and local agencies and other stakeholders/water resource interests developed a watershed plan under chapter 90.82 RCW for the Rock Creek Basin and elsewhere in Water Resource Inventory Area 31 (WRIA 31). WRIA 31 encompasses the Rock Creek subbasin and other Columbia River tributary systems between the John Day Dam and Kennewick in Washington State. A watershed assessment (http://klickitatcounty.org/NaturalR/Content.asp?fC=29&fD=3) was completed in support of the planning process (Glass 2009). The watershed management plan (http://klickitatcounty.org/NaturalR/Content.asp?fC=31&fD=3), which was approved in April 2009, will guide water resource and habitat management (WRIA 31 Planning Unit 2008). Chapter 90.82 RCW provides for plan implementation in the amounts of $100,000 for each of the first three years, and $50,000 for two additional optional years. The watershed management plan includes a list of prioritized habitat and water resource issues and a suite of strategies to address those issues. Actions undertaken to date to implement the plan include ongoing stream flow monitoring by Washington Department of Ecology and completion of a quantitative instream habitat assessment for Rock Creek and several other streams in the WRIA.

- Washington's water quality and other water resource related funding programs administered by Washington Department of Ecology take local priorities and consistency with WRIA watershed plans into consideration when determining whether to fund proposed projects through grants and/or low interest loans. The WRIA 31 watershed planning unit serves as the body that develops the local statement of agreed priority for projects proposed within Rock Creek and other areas of WRIA 31.

- The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

- The Nature Conservancy has acquired land and conservations easements within the watershed. The Conservancy is working with Federal, state and private adjoining landowners to protect native habitats and significant plant and animal species, and to restore sites as functional ecosystems within the watershed.

- The Yakama Nation has provided basic monitoring and recently received a small grant to perform fencing and riparian plantings in lower Rock Creek. These actions will begin to address at a small scale the following limiting factors: loss of riparian vegetation, altered food web, altered channel morphology. A small grant was recently awarded the YN to conduct water quality/quantity measures, habitat surveys, and Ecosystem Diagnosis and Treatment (EDT) modeling in Rock Creek. Complementing this effort, the YN has proposed assessing Rock Creek's current and potential steelhead production by assessing the juvenile salmonid abundance, growth, life histories, and genetics. Data collected through assessment activities to determine steelhead distribution, diversity, relative abundance, and movement within or out of the watershed will help feed modeling efforts, which in turn will help prioritize restoration activities.

Regulatory Protection

Various state, tribal and county regulatory mechanisms are in place to protect riparian areas from current and future threats posed to listed species through habitat loss and degradation caused by human land uses and development. These mechanisms include Washington State forest and fish regulations, state and county shoreline development regulations and the Yakama Nation Forest Management Plan. In addition, some areas receive special protection through designation, such as Wild and Scenic River reaches, primitive areas, and wildlife refuges.

Washington State Forest Practices Regulations

The Washington Forests & Fish Law (ESHB 2091) was signed into law in 1999 as part of The Washington State Forest Practices Act (Title 76.09 RCW), passed in 1974. The Forests & Fish Law, based on the Forests & Fish Report, resulted in changes to forest practices rules to protect riparian and aquatic resources on more than eight million acres of private forestland. It is intended to meet the provisions of the Federal Clean Water Act concerning nonpoint source silvicultural practices. Changes to the law included:

- Updates of the stream typing system in the state to improve mapping of fish-bearing waters,
- Increases in buffer widths along fish bearing and non fish bearing streams,
- Changes in forest practices to protect against landslides
- Mandatory requirements to update the forest road system to hydrologically disconnect roads from streams and minimize sediment delivered to streams,
- New regulations on pesticide applications to prevent or avoid drift of chemicals into streams,
- Increased protection of wetlands
- Changes in enforcement,
- Establishment of a scientifically based adaptive management and monitoring process for evaluating the impact of forest practices on aquatic resources,
- Establishment of a process for amending the forest practices rules to incorporate new information as it becomes available, and
- Establishment of a small landowner office to assist non-industrial landowners.

The Forest Practices Rules prescribe how forest practices such as logging, road building, and applying chemicals are to be conducted in ways that protect public resources. When operators or landowners do not follow the rules, the WDNR issues enforcement orders and may also issue a civil (monetary) penalty. A civil penalty is most often issued when the violation caused significant environmental damage, when an operator or landowner does not comply with the department's enforcement orders, or when the operator or landowner has a history of repeated violations. All civil penalties become final orders of the department unless appealed. Although violators are notified and/or fined, the infractions are usually addressed after they have already been committed, and the fines are often relatively insignificant compared to the value of the timber harvested.

Additional information regarding the Forest Practices rules can be found at: http://www.dnr.wa.gov/forestpractices.

The Washington Department of Natural Resources, on behalf of the State of Washington, submitted applications to NMFS and the U.S. Fish and Wildlife Service for incidental take permits under section 10 of the Endangered Species Act. Issuance of these permits would provide assurances that all forest practices activities in compliance with the state forest practices rules and administrative program will satisfy ESA requirements for aquatic species. The two services released the final HCP, environmental impact statement (FEIS), and implementing agreement in a *Federal Register* notice on Jan. 27, 2006. This notice provides an opportunity for the public to review the final documents and the responses to public comments on the draft documents.

Klickitat County Shorelines Master Plan

The Klickitat County's Shorelines Master Plan (SMP) regulates "development" within the "shorelines" of Rock Creek and other water bodies in Klickitat County's jurisdiction. "Development" is broadly defined as: construction or exterior alteration of existing structures; dredging; drilling; dumping; filling; removal of any sand, gravel or minerals; bulkheading; driving of piling; placing of obstructions; or any project of a permanent or temporary nature which interferes with the normal public use of the surface of the waters overlying lands subject to the SMP regulations at any state of water level. "Shorelines" are those lands extending landward for 200 feet in all directions as measured from the ordinary high water mark, floodways and contiguous floodplain areas landward 200 feet from such floodways, and all wetlands and river deltas associated with the streams and lakes. The SMP applies to the shorelines of the main stem of the Klickitat River as well as the shorelines of all tributaries with a mean annual flow of 20 cfs or more.

The SMP designates various shorelines as "environments", which determine the level of protection that is warranted. Rock Creek is designated "Conservancy Environment", which allows a limited scope of development, subject to conditions (i.e. shoreline conditional use permit).

Each development proposal is subject to review pursuant to the shoreline environment within which it is to be located. One or more shoreline permits must be secured prior to implementation: Substantial Development Permits (SDPs) are required for any development for which the total cost or fair market value exceeds $5,000, or any development which materially interferes with the normal public use of the water or shorelines; Shoreline Conditional Use Permits (CUPs) are required for development types that warrant conditions to ensure consistency with the SMP; and Variances (VARs) are issued to grant relief from specific bulk, dimensional, or performance standards of the SMP in order to avoid unnecessary hardship, provided that extraordinary circumstances are shown to exist and the public interest shall suffer no substantial detrimental effect. Some types of development, such as a single-family residence, normal maintenance and repair, or construction of a normal protective bulkhead for a single family residence, are exempt from the requirement of a substantial development permit, but are still subject to all other provisions of the SMP.

Klickitat County's SMP was first adopted in the mid-1970s pursuant to the Washington State Shoreline Management Act of 1971, and has been updated periodically since then. Existing structures and developments that were established prior to adoption of the SMP are considered legally established "nonconforming" uses. Since adoption of the SMP, all developments within shorelines, including modifications to nonconforming uses, have been reviewed by the County and Washington Department of Ecology (Ecology) to ensure compliance with the goals and requirements of the SMP.

The Department of Ecology reviews County permit decisions and has final authority to approve or deny conditional use permits and variances. Persons may appeal the final decision to the Shorelines Hearings Board.

Klickitat County Critical Areas Ordinance

Klickitat County adopted a Critical Areas Ordinance (CAO) in 2001 and, with the concurrence of Washington Departments of Fish and Wildlife, Community Trade and Economic Development, and Ecology, amended it in 2004. The CAO extends beyond the geographical scope of the County's SMP to protect wetlands, critical fish/wildlife habitat, geologically hazardous areas, aquifer recharge areas, and frequently flooded areas. The CAO is, in effect, an overlay on existing land use regulations. The CAO provides for standard setbacks of 300' from Category I wetlands; 200' from Category II; and 75' from Category III and IV. The CAO provides for standard buffers of 200' from Type 1 & 2 waters; 150' from Type 3 waters; 50' from Type 4 waters; and 25' from Type 5 waters. A wildlife habitat management plan is required for new development that will likely impair habitat functions and values. As with the SMP, developments and uses that existed prior to the adoption of the CAO are considered legally established "nonconforming" uses.

Klickitat County Floodplain Management Ordinance

The Klickitat County Floodplain Management Ordinance (FPO) regulates all development and activities that may increase flood hazards. A permit is required for development within areas of special flood hazard (with at least 1 percent chance of flooding). The applicant for a non-residential structure must include a certification and flood analysis conducted by a professional engineer. In general, development that will does not meet the specific criteria in the ordinance for development in these areas, to protect public health and safety, will be denied.

Klickitat County Zoning Ordinance

The Klickitat County Zoning Ordinance (CZO) was adopted in 1979 and has been amended over time. Much of the Rock Creek watershed is zoned by the CZO as "extensive agriculture" which requires a 20-acre minimum lot size for the purpose of dividing properties, and new development/uses are restricted to resource management uses/activities and other compatible uses. One permanent residential dwelling is allowed per lot. Some areas of the watershed are zoned for residential development. The allowable minimum lot size for new lots is either 1 or 2 acres; and one residential dwelling is allowed per lot. Other than residential development, most new development/uses in these zones is either prohibited or allowed per a zoning conditional use permit.

Klickitat County Environmental Ordinance (CEO)

The Klickitat County Environmental Ordinance (CEO) was adopted pursuant to the State Environmental Policy Act (SEPA). The CEO and SEPA require an analysis of probable significant adverse environmental impacts that may result from a proposed development. The CEO and SEPA require a threshold determination for each proposed development that is not exempt. The threshold determination is a determination that a project will or will not have probable significant adverse environmental impacts. If a project has probable significant adverse impacts, and environmental impact statement (EIS) is prepared. Any proposed development/use that is not specifically exempt in SEPA, chapter 43.21C RCW, or the SEPA rules adopted by the Department of Ecology, chapter 197-11 WAC, is required to comply with SEPA. Klickitat County provides applicable state agencies and tribes, as well as the public, the opportunity to review threshold determinations and EISs.

Washington State Water Pollution Control Act (Chapter 90.48 RCW)

This act gives Ecology the authority to protect water quality in the state and to promulgate regulations as needed to achieve this goal. The Act makes discharges of pollutants into waters of the state unlawful and has provisions for enforcement of violations, including the authority and process for issuing compliance orders and civil penalties, and for seeking criminal penalties. The Act also provides for permitting processes, cooperation with other entities, water quality monitoring, grants, and numerous other subjects regarding management of water quality issues in the state.

Washington's Statewide Monitoring Program

In 2001, Substitute Senate Bill (SSB) 5637 was signed into law. This act related to monitoring of watershed health and salmon recovery. The Monitoring Oversight Committee developed a comprehensive statewide strategy that addresses the actions identified in SSB 5637 (Monitoring Oversight Committee 2002). Among other things, the Plan is intended to provide information regarding trends in fish, water, and habitat conditions and assess effectiveness of actions taken to improve watershed health and provide for salmon recovery. The strategy includes documentation of fish population trends in some areas of the state; however, the Rock Creek Subbasin is not one of the areas included to date in that monitoring effort. The strategy is also monitoring the effectiveness of habitat restoration efforts funded by the State. The monitoring of project effectiveness follows the Monitoring and Evaluation Strategy that was developed by the Washington Salmon Recovery Funding Board in support of the Comprehensive Statewide Strategy. The Monitoring and Evaluation Strategy specified methods to assess a wide range of restoration and protection projects.

On-Site Sewage Systems

Chapter 246-272 of the Washington Administrative Code (WAC) regulates the on site disposal of sewage in the state. The law is applicable to septic systems as well as larger on-site systems. The rule addresses location of systems, site evaluations, design, installation, inspection, operation and maintenance, repair, abandonment, and other areas of concern. The rule helps to prevent the discharge of sewage into fish-bearing streams.

Hydraulic Code

Chapter 75.20 RCW governs construction projects within the waters of the state. The law requires hydraulic project approvals from the Department of Fish and Wildlife for wharves, bulkheads, bridges, culverts, fish habitat restoration projects, and other construction activities within the ordinary high water mark. This regulation helps to protect fish and fish habitat during construction.

Regulation of Dairy Farms

Chapter 90.64 RCW, the Dairy Nutrient Management Act, includes a number of requirements designed to protect water quality from dairy operations. These are in addition to NPDES requirements in the Federal and State Clear Water Acts for concentrated animal feeding operations. The Act requires inspection of all dairy farms, implementation of dairy nutrient management plans, technical assistance and enforcement (including civil penalties) against significant polluters. The intent of the regulation is to protect water quality and, subsequently, fish habitat. Ecology is the primary regulatory authority under this Act.

Other Rules and Regulations

There are over 100 additional rules and regulations applicable to the protection of water quality and fish habitat in the State of Washington. These rules cover a broad range of subjects such as groundwater quality standards, application of pesticides, well construction, motor oil disposal, utilities, solid waste disposal and recycling, water supply facilities, mining, energy facilities, dikes and levies, aquiculture, etcetera. Lists of applicable laws and rules and links to the specific requirements of those laws and rules can be found at www.ecy.wa.gov/laws-rules.

Voluntary Programs

A number of voluntary programs have been developed to encourage landowners to implement conservation programs on their lands and to assist landowners with habitat improvement actions. Some of these programs are described below. The list includes only the larger programs. Other programs exist and new programs may be developed in the future that can be used to assist with conservation actions on private lands.

Lead Entity Process

In 1998 the Washington State Legislature enacted chapter 77.85 RCW to empower citizens at the community level to engage in salmon recovery through a locally driven habitat protection and restoration program. The legislation recognized that active local participation is the key to ensuring public participation in, and support for, salmon recovery. Through this legislation, local "Lead Entities" were identified and funded to implement chapter 77.85 RCW. Lead Entities prioritize projects for PCSRF funding administered by Washington State's Salmon Recovery Funding Board. A lead entity has not been established for the Rock Creek subbasin, therefore PCSRF funds are not accessible at this time for habitat protection or restoration projects in the subbasin.

Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program is a voluntary program designed to establish forested buffers along streams where riparian habitat is poorly developed. Land enrolled in CREP is removed from production and grazing under 10 to 15-year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments. The CREP program is administered by the Farm Service Agency and the State of Washington.

Conservation Reserve Program (CRP)

The Conservation Reserve Program provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands. The program encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of a multi-year contract. The program is funded by the Farm Service Agency with technical assistance from the National Resource Conservation Service (NRCS).

Continuous Conservation Reserve Program (CCRP)

The Continuous Conservation Reserve Program is a voluntary program that protects soil, improves air and water quality, and enhances fish and wildlife habitat through the use of buffers, filter strips, and wind breaks. Contract periods range from 10 to 15 years. Cost shares and yearly payments are provided as incentives for participation in the program. The program is run by the Farm Services Agency.

The Grassland Reserve Program (GRP)

The Grassland Reserve Program is a voluntary program that helps landowners and operators restore and protect grassland, including rangeland, pastureland, shrubland, and certain other lands, while maintaining the areas as grazing lands. The program includes options for permanent or 30-year easements. Landowners receive payment for the easements. The Natural Resources Conservation Service (NRCS) administers the program in cooperation with the Forest Service.

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program was re-authorized by the 2002 Farm Bill to promote agricultural production and environmental quality as compatible national goals. The program is administered by NRCS. Management incentive payments and cost share benefits are available to support implementation of practices directly affecting the health of soils, water, animals, plants, and air.

The Conservation Security Program (CSP)

The Conservation Security Program is a voluntary program that provides financial and technical assistance to producers who practice good stewardship on their agricultural lands and incentive to those that want to improve or expand their conservation measures. Lands that can be placed into the program include cropland, pastureland, prairie, rangeland, and incidental forested land. The contract period and cost-share payments are based on a three-tier approach, with increasing compensation associated with increased natural resource protection. The program is run by the NRCS.

Wildlife Habitat Incentive Program (WHIP)

The Wildlife Habitat Incentive Program is a voluntary program that encourages creation of high quality wildlife habitats that support populations of National, State, tribal, and local significance. Through WHIP, the NRCS provides technical and financial assistance to landowners to develop upland, wetland, riparian, and aquatic habitat areas on their properties. Participants voluntarily limit future use of the land for a period of time, but retain private ownership. Agreements are usually five to ten years in duration.

The Healthy Forest Reserve Program (HFRP)

The Healthy Forest Reserve Program is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to promote the recovery of threatened and endangered species, improve biodiversity, and enhance carbon sequestrations. The program offers three enrollment options including a 10-year agreement, a 30-year easement, and a longer term easement. The compensation to landowners increases with the term of the easement agreement. The program is administered by the U.S. Department of Agriculture and through the Conservation District.

Wetlands Reserve Program (WRP)

The Wetlands Reserve Program is a voluntary program that provides technical and financial assistance to landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands. The landowner receives financial incentives to restore, protect, and enhance wetlands or lands that have been historically modified for agricultural production in exchange for retiring marginal land from agriculture. Easements are either permanent or 30-year agreements. The NRCS administers the program.

Forestry Riparian Easement Program (FREP)

The Forestry Riparian Easement Program was developed to partially compensate eligible small forest landowners in exchange for a 50-year easement on timber that is required to be left under the forest practices rules. The landowner still owns the property and retains full access, but has “leased” the trees and their associated riparian function to the State. WDNR administers this program.

Yakama Nation Forest Management Plan

The Yakama Nation has voluntarily adopted the Yakama Nation Forest Management Plan, which is used to guide management of timber harvest and road construction and maintenance on tribal land.

Conservation Designations

Badger Gulch Natural Area Preserve

The Washington Department of Natural Resources (WDNR) established the 180-acre Badger Gulch Natural Area Preserve in 1982 to protect four important native plant communities and three rare plants. The Natural Area Preserve lies within Klickitat County about 6.8 miles north of the Columbia River and 13 miles east of Goldendale on the Goldendale-Bickleton road. The preserve includes a 2-mile long portion of Badger Gulch, a narrow, steep-walled canyon that contains Badger Creek, which empties into Rock Creek near RM 15. The four protected native plant communities (Idaho fescue, houndstongue hawkweed, Oregon white oak-ponderosa pine, bluebunch wheatgrass-Sandberg's bluegrass and white alder riparian) and three rare plant species (porcupine sedge, shining flatsedge, and beaked cryptantha) play an important ecological role in protecting the subbasin's water quality and many vertebrate and invertebrate species (WDNR 1998).

In 1998, Washington Department of Natural Resources' Southeast Region developed the "Badger Gulch Natural Area Preserve Management Plan." The purpose of the management plan is "to permit natural ecological and physical processes to predominate, while controlling activities that directly or indirectly modify these processes" on the preserve. The WDNR 1998 'Plan' defines all aspects of management for the site from public use to monitoring and research activities (WDNR 1998).

Klickitat Oaks Preserve

Adjoining the Badger Gulch Natural Area Preserve is The Nature Conservancy (TNC) of Washington's Klickitat Oaks Preserve. The current TNC Klickitat Oaks Preserve 414-acre site conserves/preserves native habitats and significant plant and animal species as a functional ecosystem within the upper Rock Creek watershed. This area has been a major conservation site for the TNC since the ecological significance of the area was identified in the 1980s. The Conservancy is currently negotiating the purchase of an additional 120-acre plot and, with another private landowner, a 1,500-acre limited development conservation easement. Working with Federal, state and private adjoining landowners, the TNC's purpose is to protect all of the native habitats and significant plant and animal species of the site as a functional ecosystem within the upper Rock Creek watershed.

The Nature Conservancy has developed an initial preserve design and an in-depth Site Conservation Plan for the area. The Nature Conservancy's conservation plan is a cooperative management strategy for the upper Rock Creek watershed involving the U.S. Bureau of Land Management, WDNR, and resident private landowners. The Nature

Conservancy has made a long-term commitment to the site and is currently involved in restoration and management work on the ground, including exotic species control, plant and animal inventory and assessment, and long-term restoration planning.

Appendix II References

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