Attachment 4

Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment

2009

Section 1 Executive Summary

This plan serves as a blueprint for the recovery of ten Middle Columbia River (Mid-C) steelhead populations that occupy Oregon tributaries to the Columbia River. The steelhead populations spawn and rear in the Fifteenmile Creek, Deschutes, John Day, Umatilla and Walla Walla river basins and are part of the Mid-C steelhead (*Oncorhynchus mykiss)* Distinct Population Segment (DPS). The DPS, which is listed as threatened under the Endangered Species Act (ESA), includes all steelhead populations in Oregon and Washington tributaries to the Columbia River upstream of the Hood and Wind river systems, up to and including the Yakima River.

The plan seeks to remove or minimize threats to the long-term persistence of Oregon's Mid-C steelhead populations and improve their viability to levels that will allow removal of the DPS from the threatened and endangered species list. The long-term goals, however, reach well beyond achieving DPS delisting. They aim to recover the populations and their habitats to levels that are not only viable, but also provide sustainable fisheries and other ecological, cultural, social and economic benefits for future generations.

Improving the status of Oregon's Mid-C steelhead populations is critical to DPS recovery. The populations play essential roles in achieving viability for three of four major population groups within the DPS. Status of most of the populations needs to improve to achieve viability criteria. The plan's recovery strategies and actions seek to remove threats to the long-term persistence of the populations and improve biological status so the populations meet viability requirements and support DPS recovery. Strategies and actions focus primarily on addressing threats to the populations posed by tributary habitat degradation, out-of-DPS hatchery strays, and hydrosystem development and operations — considered the main obstacles to recovery.

The plan provides information required by NOAA's National Marine Fisheries Service (NMFS) to satisfy the requirements of section 4(f) of the ESA and the State of Oregon's Conservation Plan requirements. It describes: 1) recovery goals and objective, measurable criteria which, when met, will result in a determination that the species be removed from the threatened and endangered species list; 2) site-specific management actions necessary to achieve the plan's goals; 3) estimates of the time required and cost to carry out the actions needed to achieve the plan's goals; and 4) direction for monitoring and evaluation and adaptive management to fine-tune our course towards recovery when needed.

The document contains:

- The institutional framework and rationale for recovery plans
- How NOAA's National Marine Fisheries Service expects to use the plan
- The regional context within which recovery plans in the Columbia Basin are written
- The relation of this plan to other planning processes and other ESA mandates
- Desired status—delisting and broad sense recovery goals; viability criteria
- The current status of listed Oregon Mid-C steelhead populations
- Gaps between current status and viable status
- Limiting factors and threats
- Recovery strategies and actions for the Oregon portion of the Mid-C steelhead DPS
- Management action effectiveness and expected outcomes
- Cost analysis
- A framework for implementation, monitoring and evaluation, and adaptive management

Still, the plan is not a regulatory document. The ESA does not require any agency or entity to implement the recovery strategies or specific actions in the recovery plan unless otherwise legally mandated (NMFS 2006a). It depends on the social and regulatory structure that currently exists for habitat, hydropower, harvest, hatchery and predation management and models the existing and expected changes for these important factors in the future. The plan identifies actions deemed necessary to achieve recovery goals, focusing on where changes can be accomplished that build upon and adapt from the existing social and regulatory programs. This approach acknowledges the policy choices that have been made in the past to maintain hydropower in the Columbia Region as well as other choices to sustain social and economic interests, while identifying actions necessary to reach recovery goals. If and when there are major changes in the underlying policy choices, this plan will need to be updated to clearly reflect these changes. While this plan identifies needed actions and priority locations, it also gives implementing agencies and citizens the flexibility to design creative, yet scientifically sound approaches that reflect site-specific conditions and support local interests.

This conservation and recovery plan will be considered a "living document." As new information becomes available, such as the outcome of the Federal Columbia River Power System Biological Opinion process, or as new information reveals the need for adaptive change, revised and additional actions will be added to the plan.

1.1 Background and Regional Context

Historically, Mid-C steelhead spawned and reared throughout central Oregon and south-central Washington. They occupied nine major Columbia River tributaries draining the east side of the Cascades Mountains, as well as numerous smaller systems. Major river systems include the White Salmon, Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima rivers and Fifteenmile, Rock, and Willow creeks (Figure 1-1).

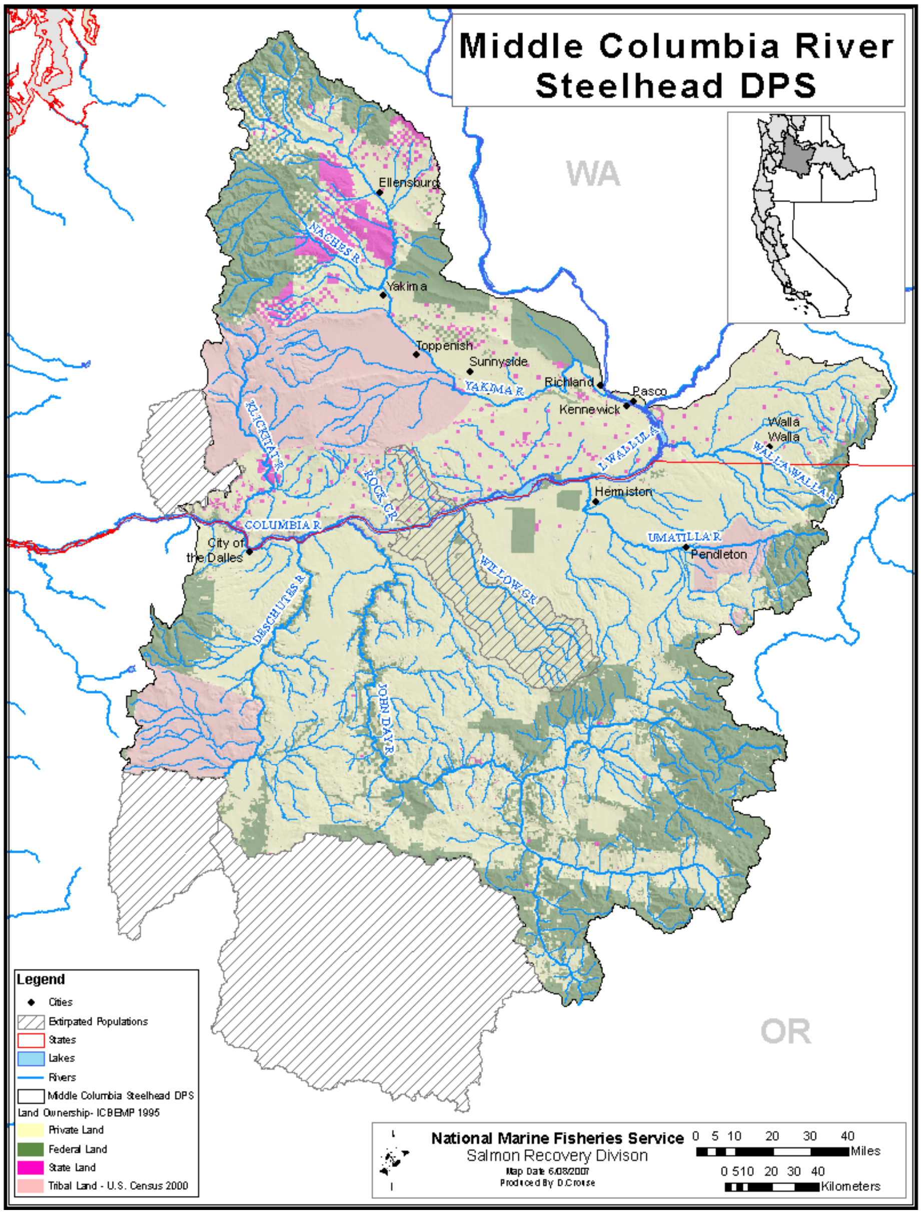

Figure 1-1. The Middle Columbia River Steelhead DPS. Areas marked as extirpated represent absence of only the anadromous form of *O. mykiss*.

By the late 1900s, Mid-C steelhead populations had experienced significant declines in abundance as a result of loss, damage or change to their natural environment. On March 25, 1999, NMFS listed Oregon's Mid-C steelhead populations as threatened under the Endangered Species Act as part of the Middle Columbia River steelhead Evolutionarily Significant Unit (ESU) (69 FR 33101). The ESU included both anadromous and resident forms of the biological species *Oncorhynchus mykiss (O.mykiss).* Recently, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS). NMFS listed the Middle Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). The DPS consists of all historical 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. It is one of 17 ESUs and DPSs of salmon and steelhead in the Pacific Northwest listed under the ESA.

The populations remain highly valued by Native Americans and many other people in the Pacific Northwest. The steelhead populations have long had important tribal subsistence, ceremonial and commercial values for Native Americans, including the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Warm Springs Reservation of Oregon. Native Americans continue to maintain strong cultural values for steelhead and salmon species. Northwest Indian tribes hold legally enforceable treaty rights reserving to them a share of the salmon harvest. Local communities and others in the region also treasure the steelhead populations and their habitats as important resources, and want to see them rebuilt to sustainable, harvestable levels. All of these rights and expectations will not necessarily be fully met by achieving only the basic purpose of the ESA and delisting of the species, although it will lead to major improvements in the current situation. The recovery plan's broad sense goals and objectives address these and other issues.

1.2 A Cooperative Effort

This conservation and recovery plan is one piece of a larger, integrated recovery plan for the entire DPS. It addresses factors limiting the viability of Mid-C steelhead populations within the State of Oregon (Figure 1-2). The DPS-level recovery plan also includes individual recovery plans for the other areas in the DPS.

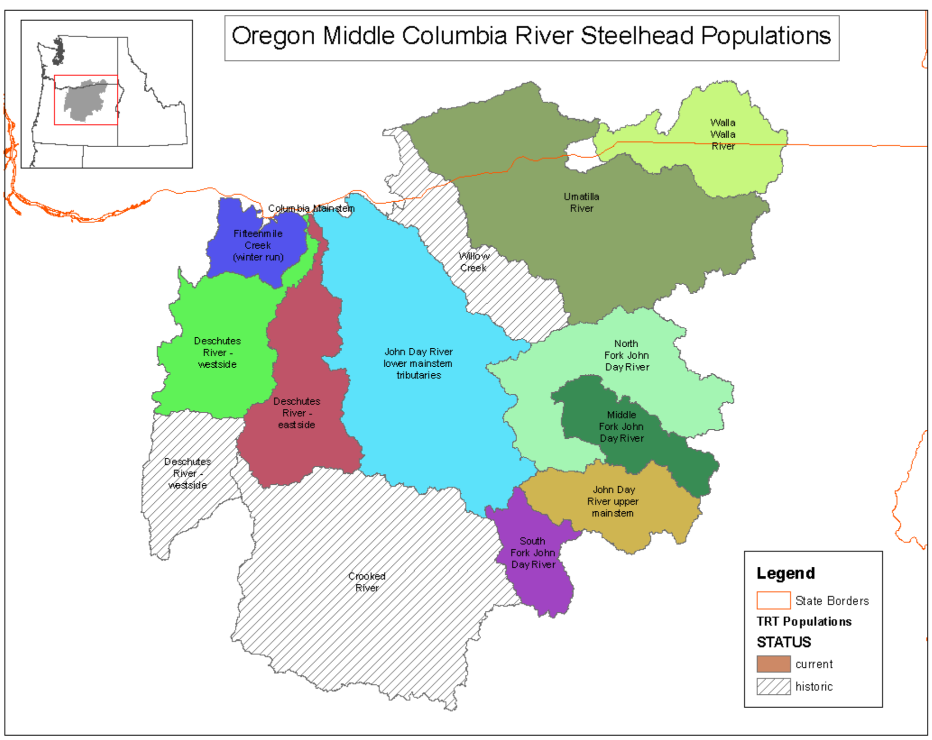

Figure 1-2. Oregon populations in the Mid-C Steelhead DPS.

State of Oregon Recovery Planning

The State of Oregon led the development of this recovery plan for Oregon Mid-C steelhead in partnership with NMFS, other natural resource agencies, the tribes, and local communities. The State's approach to recovery planning is grounded in an understanding that the challenges of steelhead recovery are immense—particularly in the face of growing human populations and demands for clean water and other precious resources. The recovery plan was developed to parallel and build from the Oregon Plan and the Oregon Conservation Strategy.

The Oregon Department of Fish and Wildlife facilitated the plan's development through a collaborative process with broad technical, stakeholder and public involvement. We have involved critical players at each stage in the decision-making process. Oregon's recovery planning forums include the Middle Columbia Sounding Board, the Mid-Columbia Recovery Planning Team, and Management Action Teams. We are relying heavily on these different players to make sure that our recovery strategy for Oregon Mid-C steelhead in scientifically sound and defendable. This involvement is vital for the plan's successful implementation.

- *Middle Columbia Sounding Board (MCSB).* The MCSB consists of representatives of local communities, agricultural and timber interests, land managers, governing bodies, tribes, and industry and environmental interests. The MCSB provides policy guidance in the development of all aspects of the plan and ensures selection of locally appropriate and locally supported recovery actions needed to achieve species recovery goals. The MCSB was particularly instrumental in the development of broad sense recovery goals, recovery scenarios, recovery strategies, strategic guidance for development and prioritization of management actions, and implementation planning.

- *Mid-Columbia Recovery Planning Team.* The recovery planning team includes state, federal, tribal, and watershed council technical representatives across the DPS. The team provided technical guidance and writing for all aspects of the plan.

- *Management Action Teams.* The three management action teams include local experts representing state and federal natural resource agencies, the tribes, watershed councils and Portland General Electric. The teams developed management actions for the ten steelhead populations.

Oregon recovery planners also incorporated findings from groups with broader areas of responsibility than the Mid-Columbia, including the Interior Columbia Technical Recovery Team and the Oregon Expert Panel.

- *Interior Columbia Technical Recovery Team (ICTRT).* The ICTRT, appointed by NMFS, provides geographic and species expertise for the entire Interior Columbia domain. The team includes biologists from NMFS, state, tribal and local entities, academic institutions, and private consulting firms. The ICTRT plays an important role in recovery planning, including developing ESU/DPS and population viability criteria that will be used, along with threats-based criteria, to determine whether a species has recovered sufficiently to be downlisted to threatened (if endangered) or delisted.

- *Oregon Expert Panel.* The Expert Panel was created by the Oregon Department of Fish and Wildlife for purposes of recovery planning and consisted of biologists with significant knowledge of the limiting factors and threats influencing Oregon's listed salmon and steelhead populations. Panelists identified common key and secondary threat themes for the populations.

Involvement by these different entities helps ensure that recovery goals and actions are consistent and compatible with the goals and direction adopted in related efforts. This integrated approach establishes partnerships that allow actions to be implemented effectively and efficiently.

1.3 Delisting the DPS

The overarching aim of this recovery plan is removal of the Middle Columbia River steelhead DPS from the threatened and endangered species list. Section 4(a) (1) of the ESA and NMFS implementing regulations (50 CFR part 424) establish procedures for listing species. According to this direction, the Secretary of Commerce must determine if a species is endangered or threatened because of any one or a combination of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

Listing Factors

In its initial determination to list the species, NMFS found (1996, 1997) that all five listing factors had played a role in the decline of the West Coast salmon and steelhead ESUs. These factors may or may not still be limiting recovery in the future when NMFS reevaluates the status of the species to determine whether the protections of the ESA are no longer warranted and the species may be "delisted." Findings leading to the listing of West Coast salmon and steelhead, including Mid-C steelhead, include:

1. *The present or threatened destruction, modification, or curtailment of its habitat or range*. Salmon and steelhead have experienced declines in abundance over the past several decades as a result of loss, damage or change to their natural environment. Water diversions, forestry, agriculture, mining, and urbanization have eliminated, degraded, simplified, and fragmented habitat. Hydroelectric development on the mainstem Columbia River modified natural flow regimes and impaired fish passage. Tributary obstructions also restrict or block salmon and steelhead access to historical habitats.

2. *Overutilization for commercial, recreational, scientific, or educational purposes.* Overfishing in the early days of European settlement led to the depletion of many salmonid stocks before extensive modifications and degradation of natural habitats, and exploitation rates following the degradation of many aquatic and riparian ecosystems were higher than many populations could sustain. Today, steelhead harvest continues on

the Columbia River, tributaries and Pacific Ocean; however, fishery impacts have declined significantly because of changes in fishery management.

3. *Disease or predation.* Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous rivers. Predators on adult and juvenile steelhead include seabirds, such as Caspian terns, walleye and California sea lions.

4. *Inadequacy of existing regulatory mechanisms.* Various federal, state, county and tribal regulatory mechanisms are in place to reduce habitat loss and degradation caused by human use and development. Many of these mechanisms have been improved over the years to slow the habitat degradation and destruction. Protective efforts directed toward addressing the many factors that adversely impact Mid-C steelhead and habitat—water quality and quantity, safe migration, riparian vegetation, food, predation dynamics and complex stream channels, and floodplain connectivity—will aid in improving these factors.

5. *Other natural or human-made factors affecting its continued existence*. Variability in ocean and freshwater conditions can have profound impacts on the productivity of salmonid populations and, at different times, have exacerbated or mitigated the problems associated with degraded and altered riverine and estuarine habitats.

NMFS listed the Middle Columbia River ESU in response to a biological review that concluded that summer steelhead in the ESU were “likely to become endangered in the foreseeable future” (NMFS 1999). Prominent features leading NMFS to list the ESU included: (1) declines in abundance of wild steelhead populations, (2) levels of abundance well below historical levels, (3) large numbers of hatchery-origin steelhead entering the Deschutes River basin, and a lack of information regarding this phenomenon, (4) large numbers of hatchery steelhead relative to wild steelhead and a general lack of information regarding the impacts of hatchery steelhead on wild steelhead populations throughout the region, (5) a lack of information regarding the interactions between resident rainbow trout and anadromous steelhead, and (6) habitat alterations in the region resulting in a loss of spawning and rearing habitat for steelhead, including habitat changes that have exterminated some steelhead runs (Busby et al. 1996; NMFS 1999).

Critical Habitat

NMFS designated critical habitat for Mid-C steelhead and 12 other ESUs of salmon and steelhead in a final rule that took effect on January 2, 2006. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water, velocity, space, and safe passage. The Critical Habitat Assessment Review Team (CHART) has rated the conservation value of all 5th-field HUCs supporting populations of Mid-C steelhead. Section 3 of the draft recovery plan discusses the physical and biological primary constituent elements (PCEs) identified as essential to the conservation of the species and shows streams designated critical habitat for Mid-C steelhead.

1.4 DPS Structure — A Hierarchical Steelhead Organization

Our approach to recovery recognizes that a hierarchical steelhead organization structure exists in the DPS. This hierarchical structure extends from the DPS level to a level below the independent population, with individual steelhead in the DPS often sharing more genetic and life history similarities with their closest neighbors than with steelhead from other parts of the DPS. The homing propensity, distribution across the landscape, and the diverse genetic, life history and morphological characteristics that evolve contribute significantly to this hierarchical structure and the species long-term persistence.

The ICTRT has identified three levels in this hierarchy that reflect genetic, geographic (hydrographic) and habitat considerations in the DPS (ICTRT 2003). The State of Oregon adopted this biological hierarchy for purposes of Mid-C steelhead recovery planning.

- *Evolutionarily Significant Units and Distinct Population Segments* listed under the ESA must be substantially reproductively isolated from other nonspecific units, and represent an important component of the evolutionary legacy of the species (Waples 1991).

- *Major Population Groups (MPGs)* are independent populations in an ESU or DPS that share similar genetic, geographic (hydrographic and ecoregion), and/or habitat characteristics (ICTRT 2003). The ICTRT defined a grouping as a Major Population Group (MPG), which is analogous to "strata" as defined by the Lower Columbia-Upper Willamette TRT and "geographic region" described by the Puget Sound TRT.

- *Independent Population* as defined by McElhany et al. (2000) is "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."

The ICTRT divided the Mid-Columbia steelhead DPS into four major population groups: Cascades Eastern Slope Tributaries MPG, Yakima River MPG, John Day River MPG and Umatilla/Walla Walla Rivers MPG (Figure 1-3). Three of these MPGs contain Mid-C steelhead from Oregon tributaries.

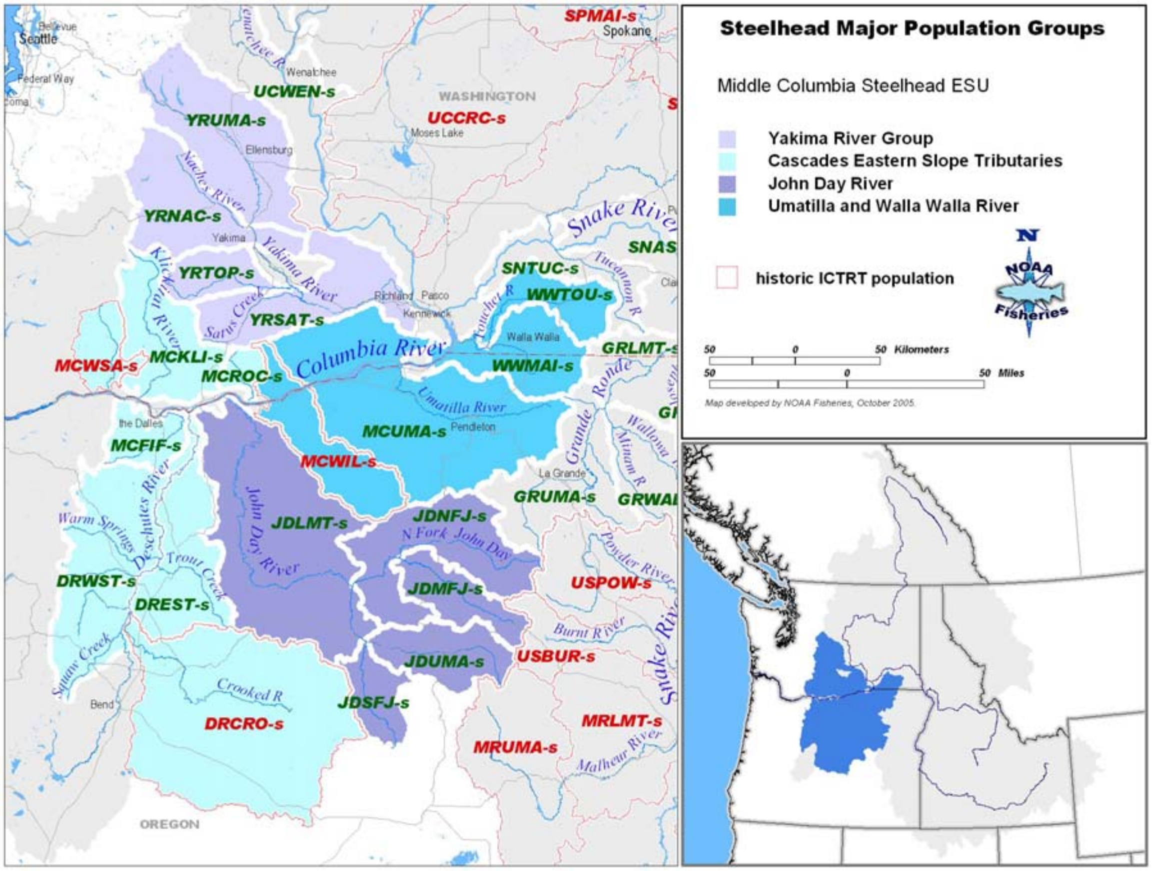

Figure 1-3. Mid-C Steelhead DPS major population groups and independent populations.

Major Population Groups and Oregon Populations

The three MPGs that support Oregon Mid-C steelhead, and the Oregon populations within them, are the focus of this recovery plan and are discussed below. Independent populations are the units that will be combined to form alternative recovery scenarios for MPG and DPS viability.

Cascades Eastern Slope Tributaries MPG

The Cascades Eastern Slope Tributaries MPG contains five extant populations (Fifteenmile Creek, Deschutes River Westside, Deschutes River Eastside, Klickitat and Rock Creek) and two extinct populations (White Salmon and Crooked River). Populations in this MPG are united primarily by geographic proximity. The Columbia River tributaries that support them generally drain the eastern slope of the Cascades and the dry Columbia Plateau, and display varied habitat conditions. The MPG supports summer and winter run life history forms of steelhead. It contains three extant and one extinct Oregon populations:

1. The *Fifteenmile Creek* population occupies Fifteenmile Creek and its tributaries, Fivemile, Eightmile and Ramsey creeks. It also includes five drainages outside of the Fifteenmile Creek watershed, Threemile, Mill, Chenoweth, Mosier, and Rock creeks, that flow directly into the Columbia River. Fifteenmile Creek steelhead are exclusively

winter run fish and are considered the easternmost distribution of winter steelhead in the Columbia basin.

2. The *Deschutes River Eastside* population encompasses the mainstem Deschutes River from its mouth to the confluence of Trout Creek and the tributaries entering the Deschutes from the east, including Buck Hollow, Bakeoven, and Trout creeks. Steelhead in this population are exclusively summer run fish.

3. The *Deschutes River Westside* population covers the mainstem Deschutes River upstream from the mouth of Trout Creek and tributaries entering the Deschutes from the west. Current steelhead access extends from Trout Creek to the Pelton Re-regulating Dam on the mainstem Deschutes and into the Warm Springs River, Shitike Creek and several smaller tributaries. Pelton Dam, a hydroelectric dam at RM 100 on the Deschutes River, blocks all anadromous fish passage to historical habitat above the dam, including areas in the Metolius River and Whychus Creek. The population is a summer run. It is separated from the eastside tributary population based on habitat and life history characteristics.

4. The *Deschutes Crooked River* population once occupied the Crooked River drainage, a major watershed in the Deschutes basin. The population is now extinct because of the lack of passage above Pelton Dam. A current management agreement and plan aim to re-establish steelhead production within the population's boundaries.

John Day River MPG

The John Day River MPG covers Oregon's John Day River drainage. The MPG contains five extant populations (Lower Mainstem John Day, North Fork John Day, Middle Fork John Day, South Fork John Day and Upper Mainstem John Day). Steelhead in these populations are exclusively summer steelhead. The MPG is one of the few remaining summer steelhead groups in the Interior Columbia basin that has had no intentional influence from introduced hatchery steelhead and that has recently been classified as strong or healthy (Lee et al. 1997; Huntington et al. 1994). Spawning is widely distributed across tributary and mainstem habitats.

1. The *Lower Mainstem John Day River* population includes tributaries to the John Day River downstream of the South Fork John Day River. This widespread population is the most differentiated ecologically from other populations, occupying the lower, drier, Columbia Plateau ecoregion.

2. The *North Fork John Day River* population occupies the highest elevation, wettest area in the John Day basin. Population boundaries include the main stem and tributaries of the North Fork John Day River. The population was defined based on habitat characteristics, basin topography, and demographic patterns.

3. The *Middle Fork John Day River* population resides in the Middle Fork John Day and all its tributaries. Spawning areas in the Middle Fork John Day River are separated substantially from all other spawning areas; except for those in the North Fork John Day, that exhibit different habitat characteristics.

4. The *South Fork John Day River* population occupies the South Fork John Day River drainage. The independent population was defined based on genetic information and basin topography.

5. The *Upper Mainstem John Day River* population includes the mainstem John Day River and tributaries upstream from the South Fork. It is separated from the lower mainstem based on habitat differences and from the South Fork because of topography.

Umatilla/Walla Walla Rivers MPG
This major group includes three extant populations (Umatilla River, Walla Walla River and the Touchet River, a tributary of the Walla Walla River in Washington State) and one extinct population (Willow Creek). The Umatilla and Walla Walla rivers drain the northwestern slopes of the Blue Mountains, with lower reaches in the warmer, drier habitats of the Columbia Plateau. Genetic information, distance between spawning aggregates and ecoregional classifications contributed to ICTRT population delineations within this major group. The entire Umatilla drainage and part of the Walla Walla lie within the State of Oregon's borders and are addressed in this plan.

1. The *Umatilla River* population spawns and rears in the Umatilla watershed and several small tributaries to the Columbia River in eastern Washington State. The population is separated from the Walla Walla River based on genetic analysis and distance.

2. The *Walla Walla River* population occupies much of the Walla Walla drainage. One major tributary to the Walla Walla River, the Touchet River, is considered a separate population based on genetic analyses.

3. The *Willow Creek* population is extinct. It was designated as an independent population based on geographic distance from other populations and capacity sufficient to support an independent population.

1.5 Desired Status — Delisting and Broad Sense Recovery

The desired status for Oregon's Mid-C steelhead populations is two-tiered. First, the populations must reach desired levels of biological viability to support removal of the DPS from the threatened and endangered species list. Second, the State of Oregon and the Middle Columbia Sounding Board seek to rebuild the populations to provide for sustainable fisheries and other ecological, cultural, social and economic benefits. The recovery goals, viability criteria and potential recovery scenarios described in the plan are summarized below.

Delisting Goal

Our primary goal is to support removal of the Mid-C steelhead DPS from the threatened and endangered species list. This requires that the populations must reach the levels of biological viability defined by the ICTRT and adopted by the State of Oregon in this plan as delisting criteria. In the context of recovery, delisting criteria and viability criteria are considered synonymous. Achieving ICTRT biological viability status at the population and MPG levels is needed before the DPS can be considered at low risk of extinction and a candidate for delisting.

To attain viability at the MPG level, the populations included in the viable MPG-level scenarios must be at or above viable status as defined by the ICTRT's viability criteria (ICTRT 2006). In addition, the criteria require that other extant populations within a MPG must be maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery so that overall MPG productivity does not fall below replacement. Further, this plan recommends a staged, adaptive approach to recovery planning and implementation. Such an approach gives highest priory initially to implementing actions within currently occupied areas and, thus, to improving the status of extant populations and MPGs.

Broad Sense Recovery Goal

After achieving steelhead recovery under the ESA, the State of Oregon aims to rebuild Oregon's Mid-C steelhead populations to levels that will provide for sustainable fisheries and other ecological, cultural and social benefits consistent with achievement of the goals of the Oregon Plan for Salmon and Watersheds. Although broader than the definition of delisting provided by the ESA, these broad sense goals incorporate many of the traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest.

Oregon's broad sense recovery goal for Mid-C steelhead is founded on a belief that citizens throughout the region value and enjoy the substantial ecological, cultural, social, and economic benefits that are derived from having healthy, diverse populations of steelhead. The Middle Columbia Sounding Board (2006) identified the following broad sense recovery goal:

> *Oregon's Mid-Columbia River natural steelhead populations are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) so that they provide significant ecological, social, cultural, and economic benefits.*

Recovery of Mid-Columbia steelhead populations will require actions that preserve, enhance and restore healthy watershed conditions where ecosystem functions, processes and dynamics are intact, including instream conditions, riparian habitat diversity and complexity, and upland watershed health, in concert with complementary management of harvest, hatcheries and hydropower. Recovery is a process that leads to steelhead populations that are not only viable, but that also provide a harvestable surplus for the treaty tribes and for all other citizens of the region.

This vision for broad-sense recovery incorporates ESA delisting goals in the sense that delisting would be achieved *first* during an extended and stepwise process of achieving broad sense recovery goals. ESA delisting criteria are entirely science-based and establish the biologically-based standards required to sustain the DPS. In contrast, broad-sense recovery represents a level of population and DPS performance that will considerably exceed the delisting level.

Recovery Objectives

By the year 2050, proponents of Oregon's Mid-Columbia River Steelhead Recovery Plan intend to achieve the following objectives:

1. Middle Columbia steelhead are viable throughout the historical range and no longer need protection under the ESA;
2. All currently extant Middle Columbia steelhead populations are highly viable;
3. Extirpated populations (e.g. Willow Creek, Crooked River) are restored in a manner that engages landowner cooperation and does not subject landowners to ESA regulation based on the presence of previously extirpated populations until the introduced populations are self-sustaining and become part of the listed DPS;
4. All extant populations of Middle Columbia steelhead are capable of contributing ecological, social, cultural, and economic benefits on a regular and sustainable basis;
5. Working in concert with existing agreements and collaboratively with landowners and resource managers NOAA will define a suite of additional land and water resource management principles and practices that when followed will alleviate liability for possible ESA regulatory consequences to landowners and resource managers;
6. Out-of-basin limiting factors are addressed equitably and in concert with in-basin limiting factors;
7. Landowners, land managers and agencies are provided with guidance on the protection and management of habitats to promote the recovery of Mid-C steelhead; and,
8. Land and resource managers work with communities and other interests in a coordinated manner to achieve broad sense recovery through a shared vision of conservation where options and choices are preserved for future generations.

Viability Criteria and Approach

The ICTRT's biologically based viability criteria provided the stepping stones for assessing the status of populations in the DPS and identifying future conditions that, when met, would describe viable populations. The State of Oregon adopted the ICTRT's viability criteria as its delisting criteria.

Under the approach, viability assessments are first conducted for the independent populations. The population-level assessments provide the basis for evaluating viability at the next hierarchical level, the MPG. The MPGs then need to meet viability criteria for the DPS to be rated as viable. This approach is consistent with the Viable Salmonid Populations (VSP) guidelines (McElhany et al. 2000), as well as related applications by the Puget Sound and Willamette/Lower Columbia TRTs and the Upper Columbia QAR, and information reviewed for listed Interior Columbia ESU and DPS populations. Section 5.1 describes the ICTRT's viability criteria that address these abundance, productivity, spatial structure and diversity considerations. The ICTRT recommends that the criteria be met to remove the DPS from its listed status under the ESA.

Population-level Viability Criteria

According to McElhany et al. (2000): "*A viable population should be large enough to: 1) have high probability of surviving environmental variation observed in the past and expected in the future; 2) be resilient to environmental and anthropogenic disturbances; 3) maintain genetic diversity; and, 4) support/provide ecosystem functions.*"

The viability criteria address four VSP parameters at the population level:

- *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 these parameters into two categories: 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 VSP parameters.

Population Abundance and Productivity Parameters

The ICTRT's objective for abundance and productivity criteria is that: abundance should be high enough that 1) in combination with intrinsic productivity, declines to critically low levels would be unlikely assuming recent historical patterns of environmental variability; 2) compensatory processes provide resilience to the effects of short term perturbations; and, 3) subpopulation structure is maintained (e.g., multiple spawning tributaries, spawning patches, life history patterns) (ICTRT 2007).

The ICTRT used the viability curve concept (e.g., LC/W TRT 2003) as a framework for defining population-specific abundance and productivity levels to meet the objective. A viability curve shows the extinction risks posed by different combinations of abundance and productivity. The ICTRT generated viability curves for each population to identify the combinations of abundance and productivity corresponding to a range of extinction risks—1% (very low), 5% (low), and 25% (moderate) over a 100-year period (Figure 1-4). It targeted population level recovery strategies to achieve less than a 5% (low) risk of extinction in a 100-year period. This is consistent with the VSP guidelines and conservation literature (McElhany et al. 2000; NRC 1995).

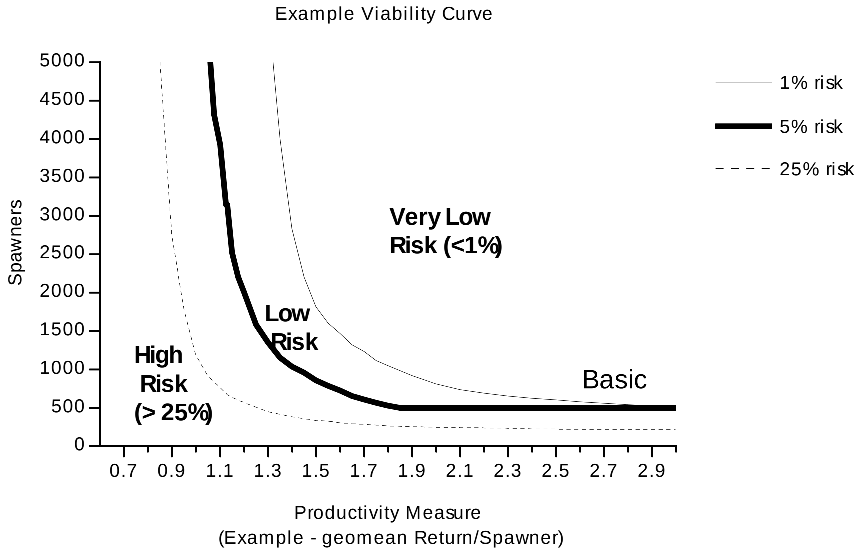

Figure 1-4. Example of Abundance/Productivity viability curve.

The ICTRT established a minimum abundance threshold of 500 individuals for a Basic size population based on its determination that abundance levels below 500 individuals for any population would pose unacceptable risk for inbreeding depression and other genetic concerns. It established higher minimum abundance thresholds incrementally for the three larger population sizes — Intermediate (1,000 spawners), Large (1,500 spawners) and Very Large (2,250 spawners). Viability curves for all four size categories were truncated at the minimum abundance threshold level. The ICTRT also categorized the populations by historical spatial distribution pattern and complexity (Table 1-1).

Table 1-1. Population characteristics and minimum abundance and productivity (at the threshold abundance level) values that represent levels needed to achieve a 95% probability of persistence over 100 years for Oregon Mid-C steelhead populations.

Population	Extant/ Extinct	Life History	Size	Spatial Category	Threshold Abundance	Minimum Productivity
Cascades Eastern Slope Tributaries MPG						
Fifteenmile Creek	Extant	Winter	Basic	C-Trellis	500	1.56
Deschutes River E.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Deschutes River W.	Extant	Summer	Large (Inter.) [a]	B-Dendritic	1,500 (1,000)	1.35
Deschutes/Crooked	Extinct	Summer	Very Large	B-Dendritic	2,250	1.19
John Day River MPG						
L. Main John Day R.	Extant	Summer	Very Large	B-Dendritic	2,250	1.19
NF John Day R.	Extant	Summer	Large	B-Dendritic	1,500	1.26
MF John Day R.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
SF John Day R.	Extant	Summer	Basic	B-Dendritic	500	1.56
U. Main John Day R.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla/Walla Walla Rivers MPG						
Willow Creek	Extinct	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla River	Extant	Summer	Large	B-Dendritic	1,500	1.26
Walla Walla River	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35

[a] Large size category is for historically accessible area; intermediate size category is for currently accessible area.

Spatial Structure and Diversity Parameters

The ICTRT identified two primary goals that spatial structure and diversity criteria should address: 1) maintain natural rates and levels of spatially mediated processes, and 2) maintain natural patterns of variation. It also identified mechanisms, factors and metrics for assessing a population's spatial structure and diversity. Mechanisms are biological or ecological processes that contribute to achieving the goals, factors are characteristics of a population or its environment that influence mechanisms, and metrics are conditions that can be measured and assessed at regular intervals to determine whether a population has achieved goals or to evaluate its current risk level.

Goal 1: *Maintain natural rates and levels of spatially-mediated processes.*
Metrics:

a. Number and distribution of spawning areas
b. Spatial extent and range relative to historical
c. Changes in gaps between spawning areas

Goal 2: *Maintain natural levels of variation.*
Metrics:

a. Changes and loss of major life history strategies
b. Variation and loss of phenotypic traits, run timing
c. Genetic variation
d. Spawner composition, proportion and origin of natural spawning hatchery fish
e. Changes in use of major habitat types (ecoregions)
f. Selective mortality factors: Hydrosystem, Hatcheries, Harvest, Habitat

Section 5.1 provides a more detailed discussion of these goals and the mechanisms, factors and metrics for rating spatial structure and diversity risks.

Integrating the Four Parameters

The ICTRT's population level criteria allowed us to identify populations performing at Viable or Highly Viable levels. We identified these populations by using a simple matrix approach that integrates all four viable salmonid population parameters. The abundance/productivity (A/P) risk level combines the abundance and productivity criteria using a viability curve. The spatial structure/diversity (SS/D) risk level integrates across the measures of spatial structure and diversity.

Under this approach, Viable and Highly Viable populations are rated directly as specific combinations of A/P and SS/D risk ratings (Figure 1-5). Populations with a Very Low rating for A/P and at least a Low rating for SS/D are considered to be Highly Viable. Population rated at Moderate or High risk for A/P, or High risk for SS/D have a risk of extinction greater than 5% and are not considered Viable. These individual population ratings are then integrated to determine viability at the MPG level. ICTRT criteria require a minimum number of populations within an MPG to be at or above viable status, with additional MPG populations maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery.

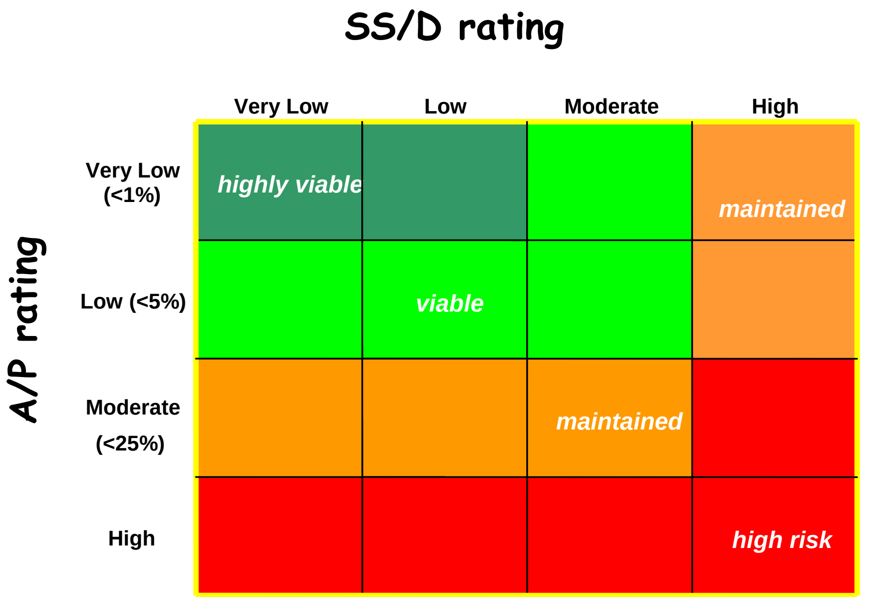

Figure 1-5. Matrix used to integrate Viable Salmonid Population parameter risk ratings and determine overall viability level.

DPS and MPG-level Viability Criteria

The ICTRT framed its ESU/DPS and MPG-level viability criteria to ensure preservation of basic historical metapopulation processes within the DPS, including 1) genetic exchange across populations 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 so that they are not all susceptible to a specific localized catastrophic event (ICTRT 2007). Its ESU/DPS-level viability criterion recognizes that MPGs within the DPS likely functioned historically as metapopulations.

DPS-level viability criteria

The ICTRT provided the following criterion to describe the biological characteristics of a viable ESU or DPS:

> All extant MPGs and any extirpated MPGs critical for proper functioning of the ESU or DPS should be at low risk.

MPG-level viability criteria

The ICTRT defined five criteria that a MPG must meet to be regarded as at low risk:

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) must meet viability standards.
2. At least one population must be categorized as being "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 Large and Large populations should be at or above their composite historical fraction within each MPG.

4. Populations not meeting viability standards should be maintained with a) sufficient productivity so the overall MPG productivity does not fall below replacement, and b) sufficient spatial structure and diversity demonstrated by achieving Maintained standards.
5. All major life history strategies (e.g., summer and winter run-timing) that were present historically within the MPG must be represented in populations meeting viability requirements.

The population level assessments provide the basis for evaluating viability at the MPG level and, in turn, the DPS as a whole. The combined effects of requiring each MPG to sustain a minimum number of viable populations, a representation of larger size classes of populations and major life history patterns, and the maintenance requirement provide for a network of populations that would sustain the DPS. Revisiting population delineation and viability criteria when new information becomes available is considered an essential element of the adaptive management plan that guides implementation.

Threats Criteria

The listing factor (threats) criteria are the measures that NMFS will use to reevaluate the status of the Mid-C steelhead DPS. They are based on 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. Recovery plans are required to contain these criteria. At the time of a delisting decision, NMFS will use the criteria to determine whether the section 4(a)(1) listing factors have been adequately addressed, i.e., whether the underlying causes of decline have been addressed and mitigated and are not likely to re-emerge. The listing factor (threats) criteria, which will be used to reevaluate the status of Oregon's Mid-C steelhead, are included in the DPS-level recovery plan for Mid-C steelhead and are not repeated in this plan. Threats criteria are described in detail in NOAA's Mid-C DPS Recovery Plan.

Potential MPG-level Recovery Scenarios

Several scenarios or combinations of populations would satisfy the MPG level viability criteria for the three MPGs containing Oregon Mid-C steelhead populations. The populations included in each of these scenarios were selected based on unique characteristics (e.g. run timing, population size, genetic characteristics), major production areas in the MPG, and spatial distribution of the populations.

The State of Oregon aims to improve more than the minimum number of populations identified in the recovery scenarios for viability. We acknowledge that targeting only the minimum number of populations would likely result in failure to achieve our goals. There is considerable uncertainty in the management actions and how effective they will be in improving population viability. This uncertainty will result in some targeted populations not achieving the desired status. To hedge against this uncertainty, more than the minimum number of populations must be targeted for viable status. Therefore, we also seek to improve all extant Oregon populations in the MPGs to be maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery. This is consistent with ICTRT criteria that recommend that more than the minimum number of populations be improved to a viable status.

Cascades Eastern Slope Tributaries MPG
The following recovery scenario exists for the Cascades Eastern Slope Tributaries MPG:

Population Characteristics:

Independent Populations	Size Category	Life History Type
White Salmon (extirpated)	Basic	Unknown
Klickitat River	Intermediate	Summer/winter
Deschutes River Eastside	Intermediate	Summer
Deschutes River Westside	Large	Summer
Crooked River (extirpated)	Very Large	Summer
Fifteenmile Creek	Basic	Winter
Rock Creek	Basic	summer

Recovery Scenario:
- Four populations must meet viability criteria, one of which must meet highly viable criteria.
- Fifteenmile Creek is the only winter population and thus must meet viability criteria.
- One Large or Very Large population must meet viability criteria. Deschutes River Westside is the only extant population that can meet this criterion.
- Two Intermediate populations must meet viability criteria. Deschutes River Eastside and Klickitat River are the only populations that can meet this criterion.

Recommendations: To achieve viable status in the Cascades Eastern Slope Tributaries MPG, the Fifteenmile Creek, Deschutes River Eastside, Deschutes River Westside, and Klickitat populations must all achieve viable status. One of these populations must be highly viable. The Rock Creek population must be maintained.

John Day River MPG
Recovery scenarios for the John Day River MPG are presented below:

Population Characteristics:

Independent Populations	Size Category	Life History Type
Lower Mainstem John Day River	Very Large	Summer
South Fork John Day River	Basic	Summer
Middle Fork John Day River	Intermediate	Summer
North Fork John Day River	Large	Summer
Upper Mainstem John Day River	Intermediate	Summer

Recovery Scenario:
- Three populations must meet viability criteria, one of which must meet highly viable criteria.

- Two Large or Very Large populations must meet viability criteria. Lower John Day and North Fork John Day are the only populations that can meet this criterion.
- One Intermediate population must meet viability criteria. The Upper Mainstem John Day or Middle Fork John Day populations could meet this criterion.

Recommendations: To achieve viable status in the John Day River MPG, the Lower Mainstem John Day River, North Fork John Day River, and either the Middle Fork John Day River or Upper Mainstem John Day River populations must achieve viable status. One of these populations must be highly viable. The South Fork John Day River population must be maintained.

Umatilla/Walla Walla Rivers MPG
The following recovery scenarios exist for the Umatilla/Walla Walla MPG:

Population Characteristics:

Independent Populations	Size Category	Life History Type
Willow Creek (extirpated)		
Umatilla River	Large	Summer
Walla Walla River	Intermediate	Summer
Touchet River	Intermediate	Summer

Recovery Scenario:
- Two populations must meet viability criteria, one of which must meet highly viable criteria.
- One Large or Very Large population must meet viability criteria. The Umatilla River is the only population that can meet this criterion.

Recommendations: To achieve viable status in the Umatilla/Walla Walla Rivers MPG, the Umatilla River population and either the Walla Walla River or Touchet River population must achieve viable status. One of these populations must be highly viable. All remaining extant populations must be maintained.

1.6 Current Population Status

Assessing the current status of the populations according to the viability criteria is a critical first step in determining a path towards MPG and DPS viability. Following ICTRT guidelines, we completed viability assessments for Oregon’s ten extant Mid-C steelhead populations. The assessments describe the current status of the populations relative to the abundance/productivity and spatial structure/diversity viability criteria.

Overall, the viability assessments show that only three of Oregon’s Mid-C steelhead populations currently meet the viability criteria. The North Fork John Day population is highly viable and the Fifteenmile Creek and Deschutes River Eastside populations are viable. The remaining populations rated as either maintained or extinct. Assessment findings are provided for each of the ten populations in the population summaries (later in this section-1.14) and in Section 6 of the recovery plan. Appendix B contains the detailed individual population viability assessments, including population-specific data sources and methods used to estimate abundance.

We also completed viability assessments for the three MPGs containing the Oregon populations. The assessment findings indicate that the three MPGs are currently below viable status based on the status of the constituent populations. These findings are shown below in Tables 1-2 through 1-4.

Cascades Eastern Slope Tributaries MPG

Findings: The Cascades Eastern Slope Tributaries MPG is currently below viable status. The Fifteenmile Creek and the Deschutes River Eastside are viable. The Deschutes River Westside population does not meet viability criteria. The Deschutes Crooked River population is extinct.

Table 1-2. Viability assessment results for Mid-C steelhead populations in the Cascades Eastern Slope Tributaries MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Fifteenmile Creek	Extant	703	481	1.82	1.23	Low	Very Low	Low	Low	Viable
Deschutes River Eastside	Extant	1,599	896	1.89	1.10	Low	Low	Moderate	Moderate	Viable
Deschutes River Westside	Extant	456	306	1.05	0.76	High	Low	Moderate	Moderate	High Risk
Deschutes Crooked River	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct

John Day River MPG

Findings: The John Day River MPG is currently below viable status. The North Fork population is highly viable; however, all of the other John Day River populations were below viable status.

Table 1-3. Viability assessment results for Mid-C steelhead populations in the John Day River MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Lower Mainstem John Day River	Extant	1,800	1,065	2.99	1.91	Moderate	Very Low	Moderate	Moderate	Maintained
North Fork John Day River	Extant	1,740	1,375	2.41	1.62	Very Low	Very Low	Low	Low	Highly Viable
Middle Fork John Day River	Extant	756	508	2.45	1.81	Moderate	Low	Low	Low	Maintained
South Fork John Day River	Extant	259	168	2.06	1.26	Moderate	Very Low	Low	Low	Maintained
Upper Mainstem John Day River	Extant	524	399	2.14	1.15	Moderate	Very Low	Moderate	Moderate	Maintained

Umatilla/Walla Walla Rivers MPG

Findings: The Umatilla/Walla Walla Rivers MPG is currently below viable status because the Umatilla and Walla Walla populations do not meet viability criteria.

Table 1-4. Viability assessment results for Mid-C steelhead populations in the Umatilla/Walla Walla Rivers MPG.

Population	Extant/ Extinct	Abundance Mean	Abundance Lower 90% CI	Productivity Mean	Productivity Lower 90% CI	A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
Willow Creek	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct
Umatilla River	Extant	1,472	988	1.50	1.11	Moderate	Moderate	Moderate	Moderate	Maintained
Walla Walla River	Extant	650	459	1.34	1.05	Moderate	Low	Moderate	Moderate	Maintained

1.7 Gap Analysis

The viability assessment results were used to determine the "gap" between the current status and the status required to meet the viability criteria. The gap analysis addresses the four VSP parameters: abundance, productivity, spatial structure and diversity. This analysis allowed us to identify viability impairments at the population level and inform development of appropriate actions to address impairments and, thus, "close the gaps."

The ICTRT conducted the abundance/productivity gap analyses for Mid-Columbia steelhead populations. The ICTRT defined the abundance/productivity gap as the quantitative relative amount of change in survival or capacity that is required for a population to improve from current status to a specific viability level. The gap analysis provides estimates of the magnitude of survival or capacity change that are needed to reach viability criteria for 25%, 5% and 1% probability of extinction over a 100-year timeframe as defined by the viability curves.

Our recovery planners performed the spatial structure/diversity gap analyses for the Oregon populations. The analyses included several steps: 1) for each population, we identified all spatial structure and diversity metrics with ratings of moderate or high risk; 2) for the metrics rated moderate, we determined if the rating was a result of changed status from intrinsic conditions or if the rating was a result of an intrinsic moderate risk for the metric; and 3) we characterized spatial structure and diversity gaps for each population as those metrics that rated high risk and those metrics that rated moderate risk because the current status is impaired relative to the intrinsic condition.

Gap analysis results for individual populations are provided in the population summaries (later in this section-1.14) and in Section 7.

1.8 Limiting Factors and Threats

Section 8 describes limiting factors and threats to the viability of Mid-C steelhead in Oregon. The findings were identified based on many sources of information, including the Mid-C steelhead Expert Panel's report, subbasin plans, ODEQ reports, ICTRT reports, NOAA's limiting factors modules, ODFW reports, hydrosystem biological opinion remand documents, and numerous other sources. The limiting factors and threats analyses serve as an essential foundation for the development and prioritization of management actions across the entire lifecycle. We used the following definitions of limiting factors and threats for our assessment.

> *Limiting Factors*: The physical, biological, or chemical conditions of the environment and associated ecological processes and interactions (e.g., habitat connectivity, water quality, physical habitat quality, etc.) that influence Mid-C steelhead viable salmonid population parameters, including abundance, productivity, spatial structure, and diversity.
>
> *Threats:* Threats are human actions (e.g., fishing, operation of hatcheries, operation of hydrosystem, land use practices, etc.) or natural events (e.g., flood, drought, volcano, etc.) that cause or contribute to limiting factors. Threats may influence one or multiple life stages and may occur in the present or future or have occurred in the past.

Key findings are summarized below and population-specific limiting factors and threats are identified in the population summaries in Section 1.14. Section 8.1 provides a broad level perspective of the primary limiting factors and threats across and within Oregon's Mid-C steelhead populations. This broader look is followed by more detailed, in-depth discussions of limiting factors and threats in Section 8.2 (Tributary Habitat), 8.3 (Hydrosystem), 8.4 (Estuarine and Plume Habitat), 8.5 (Harvest), 8.6 (Hatchery), and 8.7 (Predation and Competition).

Land Use

Tributary habitat degradation from past and/or present land use remains a key concern for all populations. Steelhead have been adversely affected by modified and reduced streamflows, impaired water quality due to elevated water temperatures and agricultural chemicals, impaired upstream and downstream fish passage, degraded channel structure and complexity (including riffles, pools and large woody debris), loss of riparian vegetation, reduced floodplain connectivity, and excessive levels of fine sediments caused by altered sediment routing. Threats contributing to these factors include agricultural, forestry and grazing practices that negatively impact steelhead growth and survival, dams and other barriers, water withdrawals, roads and channel manipulations. The Mid-C Expert Panel identified land use as having the most key concerns of any of the threat categories because, for most populations, the greatest impairment to viability has resulted from changes to the tributary spawning, rearing, and migration habitats.

We examined seven general types of tributary habitat limiting factors during our analysis. The factors are often interrelated.

- *Degraded floodplain connectivity and function*: Loss, impairment or degradation of floodplain connectivity; access to previously available habitats (seasonal wetlands, off-channel habitat, side channels); and a connected and functional hypotheic zone. Includes reduced overwinter habitat and channel habitat. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded channel structure and complexity*: Loss, impairment or degradation of channels; a suitable distribution of riffles and functional pools; functional amounts and sizes of large woody debris or other channel structure. Includes reduced summer rearing habitat, degraded spawning habitat, reduced diversity and structure (wood, boulders, etc.), inadequate quantity or depth of pools, loss of side and braided channels. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded riparian areas and LWD recruitment*: Loss, degradation or impairment of riparian conditions important for production of food organisms and organic material, shading, bank stabilizing by roots, nutrient and chemical mediation, control of surface erosion, and production of large-sized woody material. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Altered hydrology*: Changes in the hydrograph that alter the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions that inhibit the development and survival of salmonids. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded water quality*: Degraded or impaired water quality due to abnormal temperature, or levels of suspended fine sediment, dissolved oxygen, nutrients from agricultural runoff, heavy metals, pesticides, herbicides and other contaminants (toxics). Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Altered sediment routing*: Altered sediment routing leading to an overabundance of fine-grained sediments, excess of course-grained sediments, inadequate course-grained sediments and/or contaminated sediment. Includes excessive fine sediment that reduces spawning gravel or increases embeddedness. Life stages affected: egg-to-parr survival.

- *Impaired fish passage*: The total or partial human-caused blockage to previously accessible habitat that eliminates or decreases migration ability or alters the range of conditions under which migration is possible. This may include seasonal or periodic total migration blockage. Includes dams, culverts, seasonal push up dams, unscreened diversions, and entrainment in irrigation diversions. Life stages affected: smolt migration, adult migration, juvenile upstream migration due to thermal blockage or water availability.

Climate change is expected to increase the loss and degradation of steelhead habitat. Many of the environmental attributes that will be influenced by climate change (temperature and hydrograph) are those that have already been influenced significantly by past land use and are currently considered key limiting factors. Environmental changes associated with climate change that pose particular threats to salmonid viability include: increased air and stream temperatures; reduced snow pack and a shift in precipitation from snow to rain; altered hydrographs with earlier and higher peak flows, and lower summer-fall flows; more frequent extreme storm events; increased periods of drought; changing ocean temperatures and current patterns; and more frequent and severe fire events (O'Neal 2002; Mote et al. 2003; ISAB 2007a; Michael and O'Brien 2008). Such environmental changes will impact all life stages of Oregon's Mid-Columbia River steelhead. The magnitude of environmental change will vary considerable across ecoregions; however, habitats at lower elevations east of the Cascade Mountains in the southern portion of the Columbia River basin will generally experience the greatest level of change (ISAB 2007a).

Hydrosystem

The mainstem Columbia River hydrosystem is considered a primary threat to the viability of Oregon's Mid-C steelhead populations. Specific viability concerns identified by the Mid-C Expert Panel related primarily to effects of delayed upstream passage (adults), direct and indirect mortality on downstream migrants (juveniles), alteration of the hydrograph (mainstem and estuary flow regime), depletion of historically available nutrients, and degraded rearing and food resources for both presmolts and smolts in the Columbia River.

Results of the BiOp Framework Work Group support this conclusion. NMFS created the work group to provide scientific expertise during development of its Biological Opinion (BiOp) evaluating effects of operations of the FCRPS — including estimating the relative magnitude of human-caused mortality factors influencing Mid-C steelhead and other Interior Columbia River salmon and steelhead populations. During this evaluation, the work group found that the FCRPS hydrosystem had the greatest relative impact on the Mid-C steelhead populations compared with other human-induced mortality effects (Step 4 Report 2006) (Table 8-1). The ICTRT reached a similar conclusion in September 2006, when members rated the mainstem Columbia River hydrosystem as a major limiting factor for all populations in the DPS. Oregon's recovery planning team also determined that the mainstem hydropower system represents a primary threat to the viability of Oregon Mid-C steelhead populations. The Expert Panel's findings were generally consistent with the BiOp Framework Work Group's findings on magnitude of human-induced mortality, however, the Expert Panel considered the mainstem Columbia hydrosystem a threat of moderate concern to the populations and generally considered legacy and current land use as a greater threat than the hydrosystem.

Impacts from the mainstem Columbia River hydrosystem increase somewhat for each of the populations in direct relation to the number of dams the fish must pass during their migration to and from the Pacific Ocean. Mid-Columbia steelhead populations pass one to four Columbia River dams: the Fifteenmile Creek population passes one dam; Deschutes River populations pass two dams; John Day River and Umatilla River populations pass three dams; and the Walla Walla River population passes four dams.

Several hydroelectric dams on Columbia River tributaries also pose significant threats to the viability of specific populations. The Pelton-Round Butte Complex on the Deschutes River at RM 100 significantly affects the Deschutes Westside population and to a lesser extent the Deschutes Eastside population. It blocks all passage to historical habitat above the dam, particularly in Whychus Creek, Metolius River and Crooked River. The Boyd Hydro Project on the Umatilla River and Twin Reservoirs Hydro Project on Mill Creek, a tributary to the Walla Walla River affect the Umatilla and Walla Walla steelhead populations.

Estuarine and Plume Habitat

The Columbia River estuary and plume have changed considerably over the last 200 years. The estuary tidal prism is now about 20% smaller, due mostly to dike and filling practices used to convert the floodplain to agricultural, industrial, commercial, and residential uses. Instream flows entering the estuary also have changed dramatically—there has been a 44% decrease in spring freshets or floods, and the annual timing, magnitude, and duration of flows no longer resemble those of the historical hydrograph in the Columbia River (Jay and Kukulka 2002).

Scientists generally believe that steelhead and other stream-type salmonids are particularly affected by changes in plume habitat conditions and by predation in the estuary and plume (Lower Columbia River Estuary Partnership (LCREP) 2006). The plume is believed to function as habitat, as a transitional saltwater area, and as refugia for juvenile salmonids as they prepare for ocean life (Fresh et al. 2005; LCREP 2006). Changes in the Columbia River hydrograph alter both the size and structure of the plume during the spring and summer months (NPCC 2000). Changes in the hydrograph also affect plume habitat by reducing fine-sediment inputs leaving the estuary.

Harvest

Steelhead are affected by harvest during several life stages from pre-smolts taken in trout fisheries to adults taken in commercial, recreational and tribal fisheries primarily in the mainstem Columbia River and tributaries. However, given current management regulations for mainstem Columbia River and tributary fisheries, harvest is not considered a primary or secondary threat due to the low impact on viability. The ICTRT identified harvest-related effects as a secondary level limiting factor and the Mid-C Expert Panel did not identify harvest as either a key or secondary concern for Oregon's Mid-C steelhead populations. The panel, however, did express concerns over the impact that mortality associated with catch and release fisheries have on Westside and Eastside Deschutes populations.

Hatcheries

Out-of-DPS hatchery strays pose significant risk to many of Oregon's Mid-C steelhead populations, particularly to the Eastside and Westside Deschutes and John Day populations. Viability assessments, summarized in Section 6 of this document and presented in Appendix B, identified that a significant proportion of spawners in the Deschutes River and John Day River populations were out-of-DPS strays. In addition, these populations were rated at high risk for spawner composition due to the abundance of strays. Biologists remain especially concerned regarding the continuing detrimental impact of stray out-of-DPS hatchery fish in natural spawning areas on the genetic traits and productivity of these natural populations. Hatchery programs operated within the Mid-C steelhead DPS — including the Umatilla, Walla Walla and Westside Deschutes subbasins — also create some risks. The Mid-C Expert Panel ranked the impact of hatchery strays as a key concern to the Eastside and Westside Deschutes and Lower John Day populations, and as a secondary concern to the Umatilla and Walla Walla populations.

Predation

The Expert Panel listed predation is a primary concern for juvenile and adult steelhead in the Columbia River estuary and plume. Estuary habitat modifications have increased the number and/or predation effectiveness of Caspian terns, cormorants, and gull species (Fresh et al. 2005). The increasing abundance of native pinnipeds has resulted in increased predation on adult salmonids to a point of concern. Panelists identified predation by non-native piscivorous fish on pre-smolts and smolts in the mainstem Columbia as a secondary concern for all Mid-C steelhead populations.

Climate Change

Climate change will alter environmental conditions across the entire life cycle for all life stages of Oregon's Mid-Columbia River steelhead. There remains considerable uncertainty regarding the magnitude of loss and degradation of salmonid habitat in the Columbia Basin that will result from climate change. The magnitude of environmental change will vary considerable across ecoregions and thus will have different impacts on viability of steelhead populations within the Mid-C DPS. In general, habitats at lower elevations east of the Cascade Mountains in the southern portion of the Columbia River basin, which encompasses the Oregon Mid-C area, will experience the greatest level of change (ISAB 2007a).

Many of the environmental attributes that will be influenced by climate change (temperature and hydrograph) are those that have already been influenced significantly by past land use and are currently considered key limiting factors. The degree to which climate change will impact a given population is partially dependent on the degree to which natural processes have already been altered. A number of reviews have recently been completed that characterize potential climate change impacts in the Pacific Northwest (O'Neal 2002; Mote et al. 2003; ISAB 2007a; Michael and O'Brien 2008). The environmental changes most often described as significant threats to salmonid viability include:

- Increased air and stream temperatures
- Reduced snow pack and a shift in precipitation from snow to rain
- Altered hydrographs with earlier and higher peak flows, and lower summer-fall flows
- More frequent extreme storm events
- Increased periods of drought
- Changing ocean temperatures and current patterns
- More frequent and severe fire events

We conducted an analysis to assess population-specific vulnerability to climate change. We developed a climate change potential vulnerability risk index based on projected future springtime water availability, projected future stream temperatures, and historical variation in precipitation. Our analysis indicates that few of the HUC6s in Oregon's Mid-C populations are at low or very low risk. Many populations have the entire geographic area within the population boundaries rated as moderate or high risk. The combination of environmental characteristics that are forecasted to change under future climate scenarios will threaten capacity, productivity, diversity, and spatial structure from both lower elevations upward and higher elevations downward. Temperature changes will influence lower elevation areas significantly while higher elevation areas will be influenced most by hydrograph changes.

1.9 Recovery Strategies and Actions

Achieving recovery for the DPS will depend on restoring the viability of extant populations in major population groups to levels that support the proper functioning of the DPS. Recovery strategies for Oregon's Mid-C steelhead populations involve substantial reductions in the threats across all categories (tributary habitat, hydrosystem, estuary and plume habitat, harvest, hatcheries, and predation and competition).

An Integrated Approach

The delisting and broad sense recovery goals, assessments of current status and viability gaps, and limiting factors and threats analysis served as essential building blocks for identifying recovery strategies and actions. The plan's strategies and actions address the multiple limiting factors and threats that affect steelhead viability throughout their life cycle:

- Tributary habitat strategies and actions (Section 9.3) call for the protection of the highest quality habitats, maintenance of existing unimpaired habitats and ecosystem functions that support population viability, and habitat restoration through passive and active measures. Restoration strategies are linked directly to the limiting factors and aim to improve tributary spawning, rearing and migration conditions by restoring instream, riparian and upland habitat conditions, providing passage and floodplain connectivity, and addressing water quality and flow concerns. Actions identified under each strategy define the specific work needed to fill the gap between current conditions and what is needed in the long term to fully achieve the strategy. Actions differ from strategies in that they address specific needs for a specified geographic area, program deficiencies, as well as biophysical habitat impairments and threats. Together, the strategies and actions represent a complete list of needs, somewhat unconstrained by logistic and financial concerns.

- Hydrosystem strategies and actions (Section 9.4) primarily address configurations and operations of the Columbia River hydropower system. They range from improving juvenile and adult steelhead passage and survival at particular dams to addressing flow and temperature issues. These strategies and actions may be revised before completion of the final recovery plan to be consistent with adopted revisions of the 2004 FCRPS BiOp Remand.

  The section also identifies strategies and actions to adjust hydropower operations and facilities in the Umatilla and Walla Walla river systems, and to increase the quantity of spawning and rearing habitat available to Deschutes River Westside steelhead, and to a lesser extent Deschutes River Eastside steelhead, by restoring passage to historical habitats in the middle and upper Deschutes drainage. Strategies and actions will also restore steelhead access to blocked historical habitats in the Crooked River area.

- Estuarine and plume habitat strategies and actions (Section 9.5) improve steelhead rearing conditions and survival in the Columbia River estuary and plume by restoring estuarine riparian conditions, removing dikes and protecting off-channel habitats.

- Harvest strategies and actions (Section 9.6) protect steelhead in the ocean, mainstem Columbia River and tributaries by maintaining low impact fisheries and attempting to increase harvest of stray hatchery spawners, thus reducing abundance of out-of-DPS hatchery strays.

- Hatchery strategies and actions (Section 9.7) address ecological and genetic effects on Oregon Mid-C steelhead from hatchery management programs in and outside the DPS. They include reducing the abundance and proportion of out-of-DPS hatchery strays spawning naturally in Oregon's Mid-C steelhead populations. They also help restore natural production in historically utilized habitats of the Deschutes Westside, Crooked River, and Umatilla River population areas.

- Predation and competition strategies and actions (Section 9.8) seek to reduce predation by pinnipeds, birds, and piscivorous fish on salmon and steelhead in the Columbia River estuary and mainstem.

Together, the strategies and actions are framed to close viability gaps, reach delisting status, and progress toward broad sense recovery goals. Table 1-5 shows the strategies and types of actions that will be implemented to address all factors limiting recovery of Oregon Mid-C steelhead populations throughout their lifecycle. The highest priority tributary-level strategies, actions and priority areas are also identified for each population (later in this section-1.14).

Table 1-5. Integrated approach to address all factors limiting recovery of Oregon's Mid-C steelhead populations.

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
Tributary Habitat			
Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	All populations	Protect highest quality habitats through acquisition and conservation. Adopt and manage Cooperative Agreements. Conserve rare and unique functioning habitats. Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation, and LWD recruitment)
Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	All populations	Provide passage at Pelton-Round Butte Complex. Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures. Provide screening at 100% of irrigation diversions. Replace screens that do not meet criteria.	Loss of historical habitat because of blocked or impaired fish passage (dams, culverts, unscreened diversions)
Maintain and restore floodplain connectivity and function.	All populations	Reconnect side channels and off-channel habitats to stream channels. Restore wet meadows. Reconnect floodplain to channel.	Degraded floodplain connectivity and function (loss of off-channel habitat, side channels, connected hypotheic zone)

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
Restore degraded and maintain properly functioning channel structure and complexity.	All populations	Place stable wood and other large organic debris in streambeds. Stabilize streambanks. Restore natural channel form.	Degraded channel structure and complexity (loss of spawning and rearing habitat, LWD, pools)
Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	All populations	Restore natural riparian vegetative communities. Develop grazing strategies that promote riparian recovery.	Degraded riparian condition (native riparian vegetative communities, LWD recruitment)
Restore natural hydrograph to provide sufficient flow during critical periods	All populations	Implement agricultural water conservation measures. Improve irrigation conveyance and efficiency. Lease or acquire water rights and convert to instream.	Altered hydrology (low flow, scouring peak flows due to degraded watershed conditions, streamflow alterations and/or withdrawals for irrigation and other uses)
Improve degraded water quality and maintain unimpaired water quality	All populations	Reduce chemical pollution inputs. Apply BMPs to animal feeding operations. Restore natural functions and processes through above remediation actions.	Degraded water quality (high temperatures, nutrients, pesticides and other chemicals)
Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	All populations	Achieve 95% conversion to no till farming. Upgrade or remove problem forest roads. Restore native upland plant communities. Employ BMPs to forest practices, livestock grazing, road management and agricultural practices.	Altered sediment routing and runoff patterns due to upland management activities.
Estuarine and Plume Habitat			
Restore degraded estuarine and plume habitats and associated ecological processes.	All populations	Protect/restore riparian areas Remove pile dikes Protect remaining high-quality off-channel habitat Breach or lower dikes and levees Identify and reduce sources of pollutants Monitor and restore contaminated sites	Degraded estuarine and nearshore marine habitat reduces refugia available to juvenile steelhead in Columbia River estuary and plume as they prepare for ocean life.
Hydropower Systems			
Operate the FCRPS to more closely approximate the shape of the natural hydrograph to enhance flows and water quality to improve juvenile and adult fish survival.	All populations	Draft storage reservoirs (Libby, Hungry Horse, Grand Coulee, and Dworshak) in attempt to meet seasonal and weekly flow objectives in the lower Columbia River during July and August. Pursue negotiations with Canada to provide 1 million acre feet of storage to augment summer flows. Meet Non-Treaty storage refill responsibilities and pursue a new long-term agreement on use of non-treaty space in Canadian reservoirs. Implement drafts and other measures to improve flows during the lowest 20th percentile years. Implement Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake rivers.	Altered steelhead migration conditions and delayed passage due to hydrosystem development and operations in mainstem Columbia River.
Modify Columbia and Snake River dams to maximize juvenile and adult survival.	All populations.	Implement project specific configurations and operations at the eight mainstem dams on the lower Snake and Columbia rivers.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Implement spill and juvenile transportation improvements at Columbia and Snake rivers dams.	All populations.	Provide spill to improve juvenile fish passage. Implement interim transportation program to improve survival of transported fish.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Operate and maintain juvenile and adult fish passage facilities at Corps mainstem projects to maintain biological performance.	All populations.	Corps will operate juvenile and adult passage facilities year around with the regionally coordinate Fish Passage Plan.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Restore sustainable natural steelhead production to	Deschutes Westside Deschutes Eastside	Develop downstream collection and passage through Pelton-Round Butte Complex.	Tributary hydrosystem operations and configurations block access

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
blocked habitats in the Deschutes River Westside, Deschutes River Eastside and extinct Crooked River populations.	Crooked River	Improve flow patterns through reservoir for juvenile migration. Modify hydro operations to restore water quality.	to historical habitats and alter habitat conditions.
Improve hydrosystem operations and facilities to enhance steelhead survival and viability.	Umatilla River Walla Walla River	Modify bypass flows at Boyd Project as needed to mimic instream water right. Modify fish passage facilities at Boyd Project to meet current standards. Remove weir panels from diversion dam at Boyd Project during non-operation. Maintain trash racks at Boyd Project. Modify fishway at Twin Reservoirs Project to meet juvenile fish passage standards.	Tributary hydrosystem operations and configurations impair passage and alter habitat conditions.
Harvest			
Manage to maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	All populations	Maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	Commercial, recreational and tribal fisheries in ocean, mainstem Columbia River and tributaries
Utilize tributary harvest to reduce abundance and proportion of stray hatchery spawners.	Deschutes Westside Deschutes Eastside John Day MPG	Develop educational outreach program to promote use of selective recreational fisheries to reduce the number of out-of-basin hatchery strays.	Straying of out-of-DPS hatchery spawners into tributary spawning grounds.
Reduce catch and release mortality on natural-origin fish in John Day Basin.	John Day MPG	Promote voluntary curtailment of fishing at higher water temperatures (above 21°C) to reduce hook-and-release mortality	Adverse effects of tributary harvest on natural steelhead.
Improve quality of harvest information and impacts on natural-origin fish in John Day Basin.	John Day MPG	Expand the creel surveys to monitor fisheries effort and catch.	Adverse effects of tributary harvest on natural steelhead.
Hatchery			
Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Potential risk for all populations. Significant risk for Deschutes Eastside, Deschutes Westside and Lower John Day populations.	Implement representative coded-wire-tagging program so all hatchery stocks have adequate CWT groups released annually.	Straying of out-of-DPS hatchery fish into natural spawning grounds.
Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally.	Fifteenmile Creek Deschutes Eastside All John Day populations	Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys and other methods.	Straying of out-of-DPS hatchery fish into natural spawning areas.
Reduce abundance and proportion of stray hatchery fish that spawn naturally.	Deschutes Eastside Deschutes Westside Umatilla River Walla Walla River	Construct, improve trapping facilities and expand operations to remove strays. Eliminate adult hatchery strays above Nursery Bridge Dam. Recommend development of alternative broodstocks to reduce stray rates for programs that contribute significantly to stray problem.	Straying of out-of-DPS hatchery fish into natural spawning areas.
Reduce genetic risks associated with Round Butte Hatchery Program.	Deschutes Westside	Investigate opportunities and risks associated with incorporating naturally produced Deschutes River summer steelhead into RBH broodstock.	Inside-DPS hatchery genetic risks
Restore natural production into historically utilized habitats.	Deschutes Westside Crooked River Umatilla River	Develop plan for steelhead reintroduction into historical habitat above Pelton-Round Butte Complex when passage is restored. Re-establish natural production in Little Butter and Butter creeks and some minor spawning areas.	Risks related to steelhead reintroductions to historical habitat using inside-DPS hatchery fish.
Reduce genetic influence of hatchery fish in hatchery	Umatilla River	Eliminate use of hatchery produced adults in the broodstock.	Potential divergence in genetic and phenotypic traits between

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
broodstock.			hatchery and natural-origin steelhead.
Reduce interactions between residual hatchery steelhead and natural steelhead.	Umatilla River	Assess degree of impact.	Risk of hatchery fish competing with and preying on natural steelhead juveniles
Reduce potential negative ecological interactions between coho salmon and natural steelhead.	Umatilla River	Reduce number of hatchery coho released in Umatilla River and relocate releases downstream to areas not currently important to steelhead production.	Potential for coho smolts to compete with juvenile steelhead for prey resources and space
Predation and Competition			
Reduce predation and competition in the Columbia River mainstem, estuary and plume.	All populations	Reduce predation by pinnipeds Redistribute Caspian terns Redistribute cormorants	Increased predation on steelhead due to degraded estuarine and plume habitats, and to hydrosystem development and operations in mainstem Columbia River.

Building on Current Efforts

We recognize that reversing the decline of populations, life histories and habitats requires use of well-formulated, scientifically sound approaches. In many areas, effective steps have already been taken or are currently underway that will improve the status of different Oregon Mid-C steelhead populations. In tributary watersheds state and federal natural resource managers, tribes, local governments, watershed councils, soil and water conservation districts, non-profit organizations, local land owners and others continue to improve stream conditions to enhance steelhead populations throughout their freshwater life stages. They are also improving land use practices on uplands and floodplains that are allowing natural ecosystem functions and processes to recover.

Similar efforts are underway to address other threats. In the Columbia River estuary, various parties are working to improve estuarine and plume habitat conditions and reduce predation. In the mainstem Columbia River, hydrosystem managers and fish resource managers continue to refine hydropower system operations to address some needs for survival and recovery of the Mid-C steelhead DPS and other ESA-listed salmon and steelhead. Hatchery programs operated within the DPS have also been modified over the past 10 years to reduce threats and improve contribution to recovery. In addition, extensive harvest management changes in both the mainstem and tributaries have been implemented to reduce the impacts of fisheries.

This plan is designed to build on these past and current efforts. Section 9 identifies many of these efforts along with their sufficiency and areas in need of improvement so that future actions expand from and improve their effectiveness. Spreading the responsibility among a range of parties lessens the cost to any one group, increases the certainty of success, and compounds the benefits of moderate improvements in each factor.

Strategic Guidance and Prioritization Considerations for Plan Implementation

Achieving recovery for the Mid-C steelhead DPS will require intensive effort by individuals at the regional, watershed and local levels. Many recovery efforts will need to be conducted in concert to address overlapping causes that impair population viability and disrupt ecosystem functions.

Unfortunately, all of the management actions needed to reach recovery goals cannot be implemented at the same time due to various constraints. In addition, setting priorities can often be difficult because of the scientific complexity and diverse policy strategies. Although priorities must be science based, they are ultimately policy choices. Section 9.1 provides guidance for the development and implementation of management strategies and actions to recover Oregon's Mid-C steelhead populations. This guidance was adopted by Oregon's Middle Columbia Sounding Board. The characteristics of highest priority actions are identified below. Section 9.1 identifies other high priority actions, though less than highest, as well as other prioritization considerations.

Highest Priority Actions

- Provide long-term protection of habitat conditions and conservation of natural ecological processes that support the viability of priority extant populations and their primary life history strategies throughout their entire life cycle. A population is considered a priority if it is critical for MPG or DPS viability.

- Protect or enhance viability of multiple steelhead populations.

- Support conservation of unique and rare functioning habitats, habitat diversity, life histories and genetic attributes.

- Target the key limiting factors and that contribute the most to closing the gap between current status and desired future status of priority populations.

- Provide critical information needed for assessing success and making adaptive management decisions.

1.10 Management Action Effectiveness

Section 10 presents an analysis of the effects of the proposed actions on the performance of Oregon populations in the Mid-Columbia River steelhead DPS. The analysis was performed in sequential steps, first by projecting outcomes for tributary actions alone, then sequentially adding in hatchery fish genetic effects, then types of out-of-subbasin actions, and finally actions to manage stray hatchery fish. The results at each step provided a means for comparing relative benefits of the proposed actions.

Approach

The analysis of action effectiveness was performed using two modeling platforms, Ecosystem Diagnosis and Treatment (EDT) and the All-H-Analyzer (AHA), that address different types of limiting factors affecting salmonid population performance during the life cycle. Linking the two models provided a way of projecting benefits measured at the end of the life cycle for a wide range of potential actions, regardless of what life stage an action affects. We made a number of changes to both models to improve the application to our analyses.

Modified EDT Model

The EDT model was used to analyze the potential benefits of tributary habitat actions. The model is designed to estimate salmonid population performance based on characteristics of the aquatic habitat. Four scenarios were modeled using the EDT model, reflecting two priorities for where actions would be implemented at two future times: 1) High priority actions and locations only at 25 years in the future; 2) High priority actions and locations only at 100 years in the future; 3) All actions and locations at 25 years in the future; and 4) All actions and locations at 100 years in the future. In addition, the Deschutes Westside population was modeled with and without passage/reintroduction at the Pelton-Round Butte Complex to illustrate the added benefit of providing passage.

A two-part process was used to determine action effectiveness. Part 1 asked the question: What stream reaches would be affected by each of the actions? This was answered by linking stream reaches in each of the five subbasins to the actions. Part 2 consisted of explicitly defining distinct elements—or factors—that are used to compose the overall effectiveness value applied in the analysis. Five elements of action effectiveness were recognized, each acting as a scalar to determine how effective an action would be in moving an attribute's current baseline rating back toward the undeveloped state: *Effect*, the potential effectiveness of action; *Intensity,* the scale at which an action is to be applied; *Lag,* how much of the potential effectiveness of an action will be achieved at a time in the future (25 or 100 years in the future); *Schedule,* an implementation schedule effect, i.e., whether implementation is delayed to some point in the future, whereby the amount of the potential effectiveness of an action would be reduced at a time in the future; and A*ttribute,* the potential effectiveness of an action due to an attribute effect.

Modified AHA Model

The AHA model linked the analyses of tributary habitat actions to prospective recovery actions involving hatchery fish and the mainstem Columbia River; integrating the effects of various types of actions over the full life cycle. A set of scenarios was modeled using AHA, representing baseline conditions, current conditions, and combinations of actions aimed at tributary habitat, mainstem Columbia River factors, and hatchery fish management. AHA scenarios were run in a stepwise fashion, starting with baseline, then current condition, then adding in actions sequentially, each being added to the previous scenario.

Importantly, the AHA model allowed incorporation of potential effects of hatchery programs on the genetic fitness of the natural populations. The model incorporates key concepts and assumptions about the effects of genetic interactions between hatchery and natural fish built on the work of Lynch and O'Hely (2001) and Ford (2002), with further development of those ideas by geneticists working with the Hatchery Scientific Review Group (HSRG)(Mobrand – Jones & Stokes 2005). Fitness is computed in the model using Ford's (2002) modeling equations. It was used to evaluate potential genetic effects on the natural populations due to interactions between out-of-DPS stray hatchery fish and from the Umatilla supplementation hatchery program.

Several prospective actions to be taken in the mainstem Columbia River were also modeled using AHA, including: predator management – aimed at reducing predation rates caused by terns and northern pikeminnow; downstream juvenile passage improvements – measures to improve survival at each of the mainstem dams; Columbia estuary habitat improvements – measures to enhance habitat conditions within the Columbia estuary; and harvest – regulatory measures to reduce or hold harvest impacts in the mainstem Columbia River to current levels. We used survival improvement estimates provided in the recent BiOp (NOAA Fisheries 2007a) for predation, hydrosystem, and estuary actions. The use of these values in no way implies endorsement of the validity of the estimates or the adequacy of the actions. At this time, these are the only estimates available for the proposed actions.

The output from AHA, also expressed as Beverton-Holt population parameters, represents the expectation for population performance when all actions are integrated together. These parameters were then converted to the percent change in each parameter value compared to baseline conditions and multiplied by the ICTRT's baseline population measures to compute expected ICTRT-equivalent parameter values reflecting the effects of all actions.

Summary of Findings

Overall, analysis results show that population performance, as measured by both productivity and spawner abundance, increases markedly for all populations under the recovery action scenarios.

Results of All-H integration analysis are summarized below for each population and presented in Section 10. Changes in performance measures associated with each action scenario are presented for intrinsic productivity and equilibrium spawner abundance. The results are comparable to population metrics presented in Section 6 for baseline performance, as derived empirically by the ICTRT, and to minimum productivity (at the threshold abundance level) and abundance viability thresholds at the 5% risk level.

Fifteenmile Creek Population

Population performance is increased markedly for all scenario combinations analyzed. By far, the largest contribution to performance improvements results from tributary habitat actions. Relatively small increases are attributable to mainstem actions. Viability thresholds are exceeded for all scenarios.

Deschutes River Eastside Population

Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Very substantial benefits to both population productivity and natural-origin spawner abundance also occur as a result of reducing the number of stray hatchery fish spawning with natural-origin fish. Viability thresholds are exceeded for all scenarios.

Deschutes River Westside Population
The largest increases in population performance associated with the range of scenario combinations analyzed occur as a result of decreasing the number of stray hatchery fish and/or by providing passage at the Pelton-Round Butte Complex (includes passage at Whychus Creek barriers). In the absence of the removal of strays or passage, benefits are much reduced. For those scenario combinations lacking removal of strays and passage, beneficial effects of tributary actions are greatest, though beneficial cumulative effects of adding in mainstem actions are clearly evident. The viability threshold for productivity is exceeded for all action scenarios. The minimum abundance threshold was not achieved for any scenario.

Lower Mainstem John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

North Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Middle Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

South Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. The viability threshold for productivity is exceeded for all action scenarios. The abundance threshold is reached in about 30% of the action scenarios.

Upper Mainstem John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with

greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Umatilla River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements results from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Walla Walla River Population
Population performance is increased markedly for all scenario combinations analyzed. Relatively small differences exist between scenario results at 25 and 100 years. The largest contribution to performance improvements is estimated to be due to tributary habitat actions. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

1.11 Time and Cost Estimates

Section 11 summarizes the time and partial costs expected for recovery of Oregon Mid-C steelhead populations. Appendix I discusses the costs of implementing the various actions identified in Section 9 in more detail.

Currently, we estimate the overall total cost for implementation of proposed actions that we were able to estimate for all ten Oregon Mid-C steelhead populations at $512,843,328. This estimate reflects preliminary summary partial costs for recovery of the populations based on implementation of identified management actions, where available information was sufficient to do so. The draft cost estimates (Table I-1) were prepared by a NMFS economist at the Northwest Fisheries Science Center in Seattle using a regional recovery cost database, together with input and review from ODFW, regional experts, and the Mid-Columbia Sounding Board in 2007. The total cost will increase when unit cost estimates, scale of projects, and costs for all actions are determined. Costs for some of the expensive actions like land acquisition, flow enhancement, land leases, and RM&E have yet to be determined.

Estimated costs for different projects range widely from relatively less expensive fish passage projects to more expensive projects, such as restoring stream channel structure and complexity. The Lower John Day ($116,192,806) and Deschutes River Westside ($114,110,501) populations have the most expensive estimated total project costs, while the South Fork John Day ($8,656,103) and Fifteenmile ($28,358,906) populations have the smallest total costs. These total cost differences may be due to many factors such as size of the population, extent to which current conditions need to be improved, scale of projects, number of projects identified, and the availability of recovery action cost information by population at this time.

NMFS estimates that implementation of the recovery actions for the Mid-Columbia steelhead DPS, like recovery for most of the ESA-listed Pacific Northwest salmon and steelhead, could take 50 to 100 years. While this recovery plan contains an extensive list of actions that need to be undertaken to recover Oregon's Mid-Columbia steelhead populations, there are many uncertainties involved in predicting the course of recovery and in estimating total costs. These include uncertainties regarding biological and ecosystem responses to recovery actions, as well as uncertainties regarding long-term and future funding. Given the uncertainties in developing recovery cost estimates, Oregon is not able to estimate total or 10-year implementation costs to recover Oregon's populations in the Mid-Columbia steelhead DPS. Table I-2 in Appendix I, however, provides current average expenditures on habitat projects expected during the next five-year period. These projected five-year habitat project expenditures total approximately $102 million.

In early 2008, Oregon, NOAA, and other partners will develop a plan for recovery project implementation that will include project cost estimates. The implementation plan will identify what entity or individual will carry out the recovery actions and the timeline for implementation. Recovery costs will be revised in the future as specific project budgets are completed.

1.12 Implementation Plan and Adaptive Management Framework

The successful implementation of the Oregon Mid-Columbia Steelhead Conservation and Recovery Plan recovery actions, research, monitoring and evaluation, and adaptive management process will require significant funds and the coordinated work of ODFW, state agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NMFS, U.S. Forest Service, BLM, other federal agencies, local residents, citizen groups, utilities, other agencies, and individuals. ODFW, in coordination with the Oregon Governor's Office and NMFS, has taken the lead in developing this recovery plan; all will continue to be instrumental in its implementation.

Oregon's recovery plan implementation framework is intended to provide a collaborative approach to implementation, science guidance and policy direction, as well as facilitate information exchange and coordination from local-level action entities to upper level decision makers and provide linkage to state, DPS and regional forums. Existing forums, groups, partnerships and involved citizens make this implementation structure possible, but additional resources and funding will be needed to make it work effectively and successfully. The basic components of Oregon's implementation framework include a Recovery Team, an Implementation Coordinator, an Implementation Team, a Technical Team, and Watershed Teams. These teams will interface with and potentially strengthen the various state agency teams associated with the Oregon Plan for Salmon and Watersheds that provide for policy, management, and monitoring of interagency Oregon Plan programs for the conservation and restoration of habitat, water quality, and salmon. In addition, these teams will function to coordinate within the DPS implementation and adaptive management framework. The implementation framework will adapt and change as necessary to adjust to funding, available resources, and implementation needs.

Mid-C steelhead have a complex life cycle that traverses habitats from high elevation tributaries to the open ocean. Life history strategies and life stage specific habitat requirements are complex. There are many limiting factors and threats that influence the viability of Oregon's

Mid-C steelhead at all life stages. The suite of proposed management actions to address primary limiting factors and threats across the entire life cycle is extensive and diverse. Although the limiting factors and threats, as well as the management actions, have been developed based on the best available science, there remains considerable uncertainty regarding the outcomes and effectiveness of the proposed management actions as well as the status of the populations. It is this uncertainty which generates the essential need for an effective adaptive management process.

A successful adaptive management process requires that we understand how and why steelhead and their associated habitats respond to the management actions we take to address key limiting factors and threats. In addition, success requires a decision framework and process which considers new information in the development and implementation of future management actions.

One of the great challenges facing the development and implementation of an effective adaptive management strategy for Oregon's Mid-C steelhead is the extensive number of organizations that implement management actions, as well as the complexity in jurisdictional and management decision authority. There are many different organizations including state agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NOAA, U.S. Forest Service, BLM, other federal agencies, local residents, citizen groups, utilities and others that implement management actions.

Along with this implementation complexity is a parallel level of jurisdictional, management decision authority, and process complexity. There is no one single decision body that holds decision authority for management actions across all the H's. Decision authority for management actions resides across many entities including state, tribal, federal, county as well as others. Those diverse decision frameworks and processes, many independent of others, create coordination and collaboration challenges. We acknowledge that it is unreasonable to expect centralization and integration of all authorities and decision processes into a single decision framework. Our approach is to develop a collaboration and coordination process that uses the implementation structures and allows for sharing of information and decisions that influence recovery of Mid-C steelhead.

1.13 Research, Monitoring and Evaluation

Section 13 presents a detailed monitoring and evaluation (M&E) plan that covers the Oregon portion of the Mid-C steelhead DPS. It describes the types of monitoring approaches that are used, current efforts underway, and additional M&E recommended for assessing the status and trends in population viability and for evaluating the success of management actions implemented to recover these steelhead populations. Logistical and monetary limitations are understood to exist; however, a comprehensive M&E plan should help to focus efforts towards the common goal of assessing success in population and DPS recovery.

The M&E plan is based in part on principles and concepts laid out in the NMFS guidance document, *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. It also borrows from RM&E plans that were developed for Mid-Columbia subbasins and other Columbia Basin regions.

The plan also follows the principles of adaptive management, the process of adjusting management actions and/or directions based on new information. Adaptive management is considered crucial for salmonid recovery programs because of the length and complexity of the salmonid life cycle, and the uncertainties involved in improving salmonid survival and status. The plan addresses adaptive management by linking monitoring and evaluation to biological and physical responses, and using these results to better design and implement of management actions.

Types of Monitoring Programs

Several types of monitoring are needed to support adaptive management and to allow managers to make sound decisions:

- **Status and Trends Monitoring.** Status monitoring includes measures of the current state or condition of the population at any given time. Trend monitoring tracks these conditions to provide a measure of the increasing, decreasing, or steady state of a status measure through time. Status and trends monitoring includes the collection of standardized basic information used to monitor broad-scale trends over time in the status of fish populations, habitat conditions, and other ecosystem factors affecting fish. This information is the basis for evaluating the cumulative effects of management actions on fish and the aquatic and terrestrial ecosystem.

- **Action Effectiveness Monitoring.** Action effectiveness monitoring involves project-scale monitoring of local conditions to determine if implemented actions were effective in creating the desired proximate change. Action effectiveness monitoring typically is used to determine whether project- or program-specific goals were met. This type of monitoring also includes post-project monitoring to see whether the actions continue to function as they were designed or intended. Note that status and trend monitoring may be appropriate for fulfilling these needs but that project effectiveness monitoring generally requires focused evaluations of more specific parameters directly associated with actions. Specific indicators and metrics need to be developed in plans for each category of action. Specific plans will include measurable variables or parameters to address each objective, study design (spatial and temporal scale, tests and controls, statistical criteria, etc.), data collection methods and reference examples, and analyses and decisions in response to results.

- **Implementation and Compliance Monitoring.** Implementation and compliance monitoring involves monitoring of management actions to determine if they were implemented as planned and meet established benchmarks. This monitoring is typically conducted by the groups implementing the management and restoration actions.

- **Uncertainties Research.** Uncertainties research includes scientific investigations of critical assumptions and unknowns that constrain effective recovery plan implementation. Uncertainties include unavailable pieces of information required for informed decision making as well as studies to establish or verify cause-and-effect and identification and analysis of limiting factors.

Population-Specific Research, Monitoring and Evaluation Needs

The plan addresses each major population group separately. In some cases, specific objectives are provided at the population scale to characterize unique monitoring needs. Specific approaches are presented that address each objective. A brief sampling design, including the spatial and temporal scale of application, is provided for each objective. Measurement variables protocols and a description of the analysis are presented. Existing and potential funding sources are identified and finally, implementation and coordination details are discussed. The techniques described for each population are not necessarily exhaustive, but are meant to be representative of those actions considered to have potential while recognizing logistical and monetary constraints.

In general, population research, monitoring and evaluation activities are designed to gain information needed to improve knowledge of population viability. They examine status and trends in abundance and productivity of natural spawners; status of spatial structure based on current and historically utilized habitat; status and trend in condition of current and historically utilized habitat; freshwater and full life cycle productivity, and primary factors limiting freshwater production; current status, and change in future status of population life history and phenotypic diversity; effect of disease and predation on population abundance, productivity, diversity, and distribution; effect of harvest on population abundance, productivity, and diversity; effect of hydropower on population abundance, productivity, diversity, and distribution; and effect of habitat degradation and habitat restoration activities on population abundance, productivity, and distribution.

Following are specific research, monitoring and evaluation needs for each population in addition to the general types of activities described above:

Fifteenmile Creek population
- Improved estimates of abundance of stray hatchery fish
- Determine life history characteristics

Deschutes River Eastside and Westside populations
- Effectiveness of passage at Pelton-Round Butte Complex
- Effectiveness of reintroduction into Whychus Creek and the Crooked River population
- Extent of mainstem spawning
- Impact of Snake River strays on viability
- Fall back rate of natural and hatchery fish that pass Sherars Falls
- Spawning distribution of hatchery-origin strays
- Genetic characteristics of natural populations and the degree of introgression of hatchery strays

- Steelhead-resident rainbow relationship in Westside population and impact on steelhead capacity

Crooked River population
- Assess the success of restoring natural production within the Crooked River population boundaries
-

John Day River populations
- Improved estimates of abundance of hatchery-origin strays
- Spawning distribution of hatchery-origin strays

Umatilla River population
- Hatchery supplementation effectiveness
- Relative reproductive success of hatchery fish
- Spawning distribution of hatchery-origin fish
- Effectiveness of major flow enhancement actions (Phase 3)

Walla Walla River population
- Improved estimates of abundance of hatchery-origin strays
- Spawning distribution of hatchery-origin strays
- Proportion of population spawning below Nursery Bridge
- Effectiveness of major flow enhancement and passage improvement actions

Out of Basin Research, Monitoring and Evaluation Needs

The following types of RM&E actions are needed to support assessment of recovery of the Mid-C steelhead DPS and its Oregon populations:

- Survival improvements from hydrosystem actions
- Survival improvements from predator control actions
- Survival improvements from estuary actions
- Population specific mainstem harvest rates
- Marine survival estimates and variation through time
- Influence of transportation on Snake River hatchery steelhead straying

1.14 Population Summaries

Tables 1-6 through 1-16 summarize vital information related to the recovery of each of Oregon's ten Mid-C steelhead populations. For each population, the summaries identify: key population attributes, minimum viability levels for a low risk recovery scenario, viability assessment results, the viability gap, major limiting factors and threats, and the highest priority tributary habitat strategies and actions.

Table 1-6. Summary of Recovery Information for Fifteenmile Creek Population.

Key Population Attributes The population occupies the entire Fifteenmile Subbasin and several smaller subbasins—including the Rock, Mosier, Chenoweth, Mill, and Threemile watersheds—which enter the Columbia River directly downstream from Fifteenmile Creek. Current spawning distribution is similar to historical with major production areas in Fifteenmile, Ramsey, Eightmile, and Fivemile creeks. Recent year natural spawners include only natural-origin fish. Hatchery strays in the Fifteenmile Creek population have rarely been documented. The population contains three MaSAs, all located in the Fifteenmile Creek watershed: Upper Fifteenmile, Eightmile and Fivemile. It also contains five MiSAs: Mill, Chenoweth, Threemile, Mosier and Lower Fifteenmile. It is the only Mid-C steelhead population that is classified as an entirely winter run life history type. It is part of the Cascade Eastern Slope Tributaries MPG. The population is considered a Basic size population with a mean minimum abundance threshold of 500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk) *Abundance:* Minimum abundance threshold of 500 spawners. *Productivity:* Minimum productivity level of 1.56 recruits per spawner at the threshold abundance.
Viability Assessment Results *Abundance/Productivity*: Population is at low risk based on current abundance and productivity. The Abundance/Productivity point estimate resides above the 1% risk curve, but the population is not considered to be at very low risk because of uncertainty criteria, the 98% confidence interval (CI) extends below the 25% risk curve. These A/P results should be viewed with caution, as abundance and productivity estimates for the Fifteenmile population are based on 15 years of spawner/recruit data. *Spatial Structure/Diversity:* The integrated SS/D rating is low risk for the population. There has been little change in distribution relative to the historical distribution. The absence of major reductions in distribution resulted in a rating of very low risk for spatial structure metrics. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels to moderate. There are few hatchery fish in the population resulting in low risk for spawner composition. *Overall Viability Rating:* Population *currently meets viability criteria* because both A/P and SS/D are rated at low risk. A relatively small increase in productivity is required to move this population into “highly viable” status. Monitoring should be continued to allow analysis of a longer data time series.
Viability Gap *Abundance/Productivity:* The recent 10-year geomean natural-origin abundance of 703 exceeds the minimum threshold abundance of 500. The current productivity estimate of 1.82 recruits per spawner resides between the 5% and 1% risk curves. There is no observed gap or uncertainty gap for the 5% risk level. The observed and uncertainty gaps for the 1% risk level are 0.03 and 0.09 respectively. *Spatial Structure/Diversity:* There are no gaps for SS/D since all the SS/D metrics rated very low or low risk.
Limiting Factors and Threats *Primary Limiting Factors: Tributary Habitat:* low flows, high water temperatures, degraded riparian condition, sediment routing, degraded floodplain, degraded channel structure (channel confinement and overall habitat diversity); *Hydro:* mainstem passage. *Primary Threats:* Current land use practices (including roads, residential development, and agricultural and forest practices) and the Columbia River mainstem hydrosystem. *Primary Life Stages Affected:* Fry, summer parr, winter parr, smolts. *VSP Characteristics Impacted:* Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy*: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water

conservation measures, improve irrigation conveyance and efficiency.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, riparian fencing.

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks.

High Priority Areas for all strategies: Fifteenmile Cr - Mouth to FS boundary; Ramsey Cr - Mouth to new FS boundary; Eightmile Cr - Hwy 197 to FS boundary; Fivemile Cr - Mouth to FS boundary.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions*: increased monitoring of hatchery fish on spawning grounds.

Table 1-7. Summary of Recovery Information for Deschutes River Eastside Population.

Key Population Attributes

The Deschutes River Eastside population occupies the Deschutes River from its mouth to Trout Creek and all tributaries flowing in from the east side, including Willow Creek above Pelton Dam.

Spawners in the population include natural-origin returns, hatchery returns from Deschutes River-origin fish produced at Round Butte Hatchery and out-of-DPS hatchery strays primarily from the Snake River Basin. Hatchery-origin fish comprise a significant proportion of the natural spawners.

The population contains six MaSAs: Buck Hollow, Bakeoven, Ward/Antelope/Cold, Lower Trout, Upper Trout and Willow. It contains two MiSAs: Jones Canyon and Campbell.

The population exhibits a summer life history strategy and is part of the Cascade Eastern Slope Tributaries MPG.

The ICTRT considers it an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,000 spawners.

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The population is at low risk based on current abundance and productivity. The point estimate on the viability curve resides above the 1% curve, but the population is not considered to be at very low risk since the 99% CI extends below the 25% risk curve.

Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the population. The rating for Goal A “allowing natural rates and levels of spatially mediated processes” was low risk. However, the population’s spawning distribution is reduced from the historical distribution, primarily from loss of spawning in the Willow Creek drainage. The population remains broadly distributed with little changes in gaps and good continuity within the current accessible habitat. The rating for Goal B “maintaining natural levels of variation” was moderate risk. Habitat changes in key tributary production areas have likely resulted in limitations to life history diversity and reduction in phenotypic expression. Also, a significant proportion of natural spawners are out-of-DPS strays which resulted in a high risk rating for spawner composition.

Overall Viability Rating: The Deschutes River Eastside population *currently meets the recommendation for viable status.* The SS/D rating is moderate risk primarily because of the influence of habitat changes on life history and phenotypic expression, as well as out-of-DPS hatchery spawners.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,599 substantially exceeds the minimum threshold abundance of 1,000. The current productivity estimate of 1.89 resides in the very low risk zone and thus there are no observed abundance/productivity gaps. The lower end of the productivity 99% confidence interval is below the 25% risk curve resulting in a 0.05 gap to meet uncertainty criteria for 1% risk level. The abundance/productivity dataset is a relatively short time series which results in a larger 90% CI than is typical of most other Oregon Mid-C populations.

Spatial Structure/Diversity: Spatial structure/diversity gaps were identified for the following metrics: *Phenotypic variation*: moderate risk due to likely reduction in juvenile and adult migration patterns resulting from flow and temperature changes in tributary production areas; *Spawner composition*: Out-of-DPS spawners rated high risk due to the high proportion of Snake River strays spawning naturally in the population. Out-of-population within MPG spawners rated moderate risk due to the proportion of Round Butte Hatchery fish spawning naturally in the population.
Limiting Factors and Threats *Primary Limiting Factors: Tributary Habitat:* degraded riparian condition, low flows, high water temperatures, degraded channel structure/complexity and floodplain connectivity, impaired fish passage. *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage. *Primary Threats:* Hatchery production which results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydrosystem. *Primary Life Stages Affected:* Spawners, fry, summer parr, winter parr, smolts. *VSP Characteristics Impacted:* Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy:* Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Bakeoven Cr (mouth to Deep Cr), Buck Hollow Cr (mouth to Macken Canyon), Trout Cr (Little Trout Cr. to headwaters) *Strategy*: Restore passage and connectivity. *Key actions*: Remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Bakeoven Cr, Mud Springs Cr., Hay Cr *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Trout Cr (mouth to Clover Cr), Antelope Cr *Strategy:* Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Trout Cr (Little Trout Cr to Clover Cr, sections from mouth to Antelope Cr), Antelope Cr, Hay Cr *Strategy:* Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: same as for riparian strategy. *Hydrosystem Strategies* *Strategy:* Improve flow patterns through Pelton-Round Butte Complex (PRBC), restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC). *Harvest Strategies* *Strategy:* Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries. *Hatchery Strategies* *Strategy:* Reduce uncertainty regarding hatchery strays and reduce abundance and proportion of stray hatchery fish spawning naturally. *Key actions*: coded-wire-tagging program, development of alternative broodstocks for programs contributing strays, increased monitoring on spawning grounds and trap and removal of strays.

Table 1-8. Summary of Recovery Information for Deschutes River Westside Population.

Key Population Attributes The Deschutes River Westside population occupies the mainstem Deschutes River from Trout Creek to the Pelton-Round Butte Complex (PRBC) at RM 100 and tributaries joining the Deschutes from the Westside, including the Warm Springs River and Shitike Creek below the hydroelectric complex and the Metolius River and Whychus Creek drainages above the complex. The Warm Springs watershed and Shitike Creek currently provide most spawning habitat. Whychus Creek was once a major steelhead producer for the population. Recent year natural spawners include returns originating from naturally spawning parents, strays from the Deschutes Subbasin Round Butte Hatchery program, and a significant number of out-of-DPS hatchery strays from the Snake

River. Natural-origin spawners have comprised an average of 82% of natural spawning fish since 1978.

The population contains six MaSAs: Upper Warm Springs, Whychus, Upper Metolius, Mill, Beaver and Shitike; and nine MiSAs.

The population exhibits a summer life history strategy and is part of the Cascades Eastern Slope Tributaries MPG.

The ICTRT considers it a 'large' population with a mean minimum abundance threshold of 1,500 spawners. Access to a considerable amount of historical habitat is blocked by PRBC, with current spawning only below the barrier. The minimum abundance threshold is 1,000 spawners for currently available habitat.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,500 spawners (1,000 for currently accessible habitat).

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold level.

Viability Assessment Results

Abundance/Productivity: Population is at high risk based on current abundance and productivity. The point estimate on the viability curve resides below the 25% risk curve.

Spatial Structure/Diversity: The integrated spatial structure/diversity rating is high risk for the population. It rates at moderate risk for two of the spatial distribution metrics because the current distribution is substantially reduced from the historical intrinsic distribution due to blocked passages to areas above the Pelton-Round Butte Complex. Ratings for two metrics related to Goal B "maintaining natural patterns of variation" resulted in a moderate rating for Goal B and the overall moderate rating. Genetic variation rated moderate due to limited data and the lack of differentiation between the Deschutes samples and outside-basin hatchery samples. Samples collected in 2005-2007 will better inform the risk associated with genetic variation. The proportion of out-of-DPS hatchery strays resulted in a high risk rating for spawner composition. Most of these strays originate from the Snake River Basin.

Overall Viability Rating: The Deschutes River Westside *population does not currently meet recommendations for viability and is below maintained status*. However, it is the only extant Large or Very Large population in the MPG and should be recovered to meet the viability criteria. A substantial increase in productivity will be required to raise the A/P values to the low risk level. Genetics information presently being collected will better inform the genetics variation risk level in the future. A reduction in the out-of-ESU hatchery stray proportion will be needed to reduce the risk rating for the spawner composition metric.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 456 is well below the abundance threshold of 1,000, the threshold abundance for currently available habitat. The current productivity estimate of 1.05 recruits per spawner is well below the minimum of 1.35 required at the threshold abundance. The observed gaps, which are greater than uncertainty gaps, for the 5% and 1% risk levels are 0.78 and 0.92 respectively. This gap is by far the largest observed gap of all the Oregon Mid-C populations. The large gap results from the substantial difference in the equilibrium abundance (448) and the threshold abundance, as well as the low productivity.

Spatial Structure/Diversity: Spatial structure/diversity gaps were identified for the following metrics: *Spatial extent and range of population*: moderate risk because spawner distribution is substantially reduced from historical due to blocked access to Whychus Creek and the Metolius River; *Genetic variation:* moderate risk because there are limited genetics data available and the samples that have been analyzed show similarity to out-of-DPS hatchery strays; *Spawner composition: O*ut-of-DPS spawners rated high risk because out-of-DPS strays have comprised a significant proportion of the natural spawners in this population for many generations.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity, altered sediment routing, high water temperature, low flows and lack of fish passage over PRBC; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage and tributary passage to blocked areas above Pelton-Round Butte Complex.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydrosystem, Pelton-Round Butte Complex.

Primary Life Stages Affected: Spawners, fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

<u>*Habitat Strategies*</u>

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas:* Spawning areas in mainstem Deschutes R. below PRBC.

Strategy: Restore passage and connectivity. *Key actions*: Restore passage at PRBC, remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Deschutes R. (RM 100), Warm Springs R, Shitike Cr, Beaver Cr.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Whychus Cr.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Deschutes R. (Eagle Cr to Shitike Cr), Deschutes R (Trout Cr to PBR), Warm Springs R., Shitike Cr., Beaver Cr., Whychus Cr.

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: Deschutes R. (Eagle Cr to Shitike Cr), Deschutes R. (Trout Cr to PBRC), Warm Springs R. (mouth to Badger Cr), Shitike Cr. (mouth to road crossing), Beaver Cr. (mouth to Robinson Park Bridge)

<u>*Hydrosystem Strategies*</u>

Strategy: Restore steelhead production in historical habitats. *Key actions*: develop juvenile collection and passage through PRBC, improve flow patterns through PRBC, restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC).

<u>*Harvest Strategies*</u>

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

<u>*Hatchery Strategies*</u>

Strategy: Reduce uncertainty regarding hatchery strays and reduce abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* coded-wire-tagging program, development of alternative broodstocks, increased monitoring on spawning grounds and trap and removal of strays.

Strategy: Reduce genetic risks associated with Round Butte Hatchery Program. *Key actions*: investigate incorporating naturally produced local steelhead into RBH broodstock.

Strategy: Restore natural production in historically utilized habitats. Key actions: develop plan for steelhead reintroductions above PRBC. *Priority areas*: Metolius R, Whychus Cr, Deschutes R.

Table 1-9. Summary of Recovery Information for Deschutes/Crooked River Population.

Key Population Attributes

The Deschutes/Crooked River population once occupied the Crooked River drainage, a major watershed in the Deschutes basin.

The population is now extinct because of the lack of passage above Pelton Dam.

The population exhibited a summer life history strategy and is part of the Cascade Eastern Slope Tributaries MPG.

The ICTRT considers it a very large population with a mean minimum abundance threshold of 2,250 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

<u>*Abundance*</u>*:* Minimum abundance threshold of 2,250 spawners.

<u>*Productivity:*</u> Minimum productivity level of 1.19 recruits per spawner at the threshold abundance.

Viability Assessment Results

The ICTRT did not complete a viability assessment for the population because it is currently extinct.

<u>*Overall Viability Rating:*</u> The Deschutes/Crooked River population is currently considered extinct.

Viability Gap

A gaps analysis was not completed for the Deschutes/Crooked River population because it is currently extinct.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity and floodplain connectivity, degraded riparian condition, high water temperature, low flows, altered hydrology sediment routing, and lack of fish passage; *Hydro:* Impaired upstream and downstream migration. *Primary Threats:* grazing and agricultural practices, urban development, off highway vehicle (OHV) use, irrigation withdrawal, dams, lack of floodplain connectivity; Pelton-Round Butte Complex on the mainstem Deschutes blocks fish passage. *Primary Life Stages Affected:* All life stages. *VSP Characteristics Impacted:* Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy:* Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Crooked River (RM 6-14, RM 55-70), McKay Cr, Ochoco Cr (below Ochoco Dam) *Strategy*: Restore passage and connectivity. *Key actions*: Remove/replace barriers including dams, road culverts, irrigation structures, infiltration galleries; provide adequate screening of irrigation diversions. *Priority areas*: Rice Baldwin Dam, Stearns Dam, Seamus Dam, Parga Dam, Peoples irrigation diversion *Strategy*: Restore floodplain connectivity and function. *Key actions*: Reconnect floodplain and side channels to channel. *Priority areas:* Crooked River (RM 31-51), McKay Cr *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency, lease/purchase water rights and convert to instream. *Priority areas:* Crooked River (RM 14-55), McKay Cr, Allen Cr, Ochoco Cr (below Ochoco Dam) *Strategy:* Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Crooked River (RM 14-55), McKay Cr, Ochoco Cr (below Ochoco Dam), Allen Cr *Strategy:* Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: Crooked River (RM 31-51), McKay Cr. *Hydrosystem Strategies* *Strategy:* Restore steelhead production in historical habitats. *Key actions*: develop juvenile collection and passage through PRBC, improve flow patterns through PRBC, restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC). *Hatchery Strategies* *Strategy:* Restore natural production to blocked areas above PRBC. *Key actions*: Develop and implement a comprehensive plan for the reintroduction of steelhead into the Crooked River population area.

Table 1-10. Summary of Recovery Information for Lower Mainstem John Day River Population.

Key Population Attributes The population occupies the Lower John Day watershed below the mouth of the South Fork John Day River and the town of Dayville. Steelhead in this population spawn in tributary streams connected to the lower John Day River including Bridge, Butte, Thirtymile, Hay and Rock creeks. Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake River and Columbia River hatchery programs. The population contains 11 MaSAs and 19 MiSAs. Major spawning areas include Bridge, Mountain, Cottonwood, Hay, Middle Rock, Upper Rock, Pine Hollow, Long Rock (Lower John Day) Thirtymile, Butte, and Grass Valley. All 11 MaSAs are currently occupied and 11 of the 19 MiSAs are occupied. The population exhibits a summer life history strategy and is part of the John Day River MPG. It is considered a Very Large population with a mean minimum abundance threshold of 2,250 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk) *Abundance:* Minimum abundance threshold of 2,250 spawners.

Productivity: Minimum productivity level of 1.19 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The population is at moderate risk based on current A/P. The productivity is very low risk because the point estimate is above very low risk and the lower end of the adjusted standard error is above the 5% risk level. The abundance is moderate risk because it resides between the 5% and 25% risk levels.

Spatial Structure/Diversity: The integrated rating is moderate risk for the population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. The current spawner distribution is similar to historical with all MaSAs occupied. The MiSAs that are currently unoccupied have little influence on gaps and continuity, and spawners are spread over a very broad geographic area. The rating for Goal B "maintaining natural levels of variation" was moderate risk. This rating was a result of moderate risk for life history and genetic variation and high risk for spawner composition out-of-DPS hatchery strays. The magnitude and trend in out-of-DPS hatchery strays are of significant concern. Analysis of genetics information will yield considerable insight into the genetic variation and characteristics of this population.

Overall Viability Rating: The Lower Mainstem John Day River population *does not currently meet recommendations for viability*, although it does meet criteria for a "maintained" population. To achieve a viable rating, this population must improve in both A/P and SS/D. Out-of-DPS origin spawners are the most influential factor on diversity risk. Additional population specific data are needed to better quantify the spawner composition in this population to reduce the uncertainty associated with this risk metric.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,800 is 72% of the threshold abundance of 2,250 natural spawners. The current productivity of 2.99 recruits per spawner is well above the minimum required to meet the 1% risk level. The lower end of the 99% CI also resides above the minimum needed to meet the 1% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.11. This gap is a result of the difference in the equilibrium abundance (2,019) and the threshold abundance.

Spatial Structure/Diversity: Gaps were identified for the following spatial structure/diversity metrics: *Major life history strategies:* moderate risk because habitat changes have resulted in reduced juvenile life history diversity and restricted summer rearing distribution. *Genetic variation*: moderate risk because there are no genetics data and due to potential genetic effects of the high proportion of out-of-DPS spawners. *Spawner composition:* Out-of-DPS spawners rated high risk due to high proportion and increasing trend of out-of-DPS spawners.

Limiting Factors and Threats

Primary Limiting Factors: *Tributary Habitat:* degraded channel structure and complexity (habitat quantity and diversity), altered sediment routing, water temperature, and altered hydrology. Impaired fish passage is also a high priority limiting factor in Bridge, Butte, Kahler, Muddy, Rock, and Thirtymile creeks. *Hatchery*: effects of naturally spawning stray hatchery fish on viability. *Hydro:* mainstem passage.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (agricultural and grazing practices, removal of overstory trees and bank vegetation from the riparian corridor, water withdrawals, wetland draining and conversion, and stream channelization and diking; the Columbia River mainstem hydro system.

Primary Life Stages Affected: Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Pine, Bridge, Cottonwood creeks.

Strategy: Restore passage and connectivity. *Key actions*: Remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Rock, Upper Rock, Middle Rock, Lone Rock, Thirtymile, Butte, and Bridge creeks.

Strategy Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Rock, Middle Rock, Thirtymile and Butte creeks.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Rock, Bridge, Rock Mountain, lower Parrish and Kahler creeks

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas:* Lone Rock, Mountain Cr (Wheeler Co), Parrish Cr, Cherry Cr, Kahler Cr, Bridge Cr, Thirtymile Cr, Butte Cr, and upper reaches of Pine Hollow Canyon Cr.

Strategy: Restore passage and connectivity: *Key actions:* Remove or minimize use of push up dams; remove or replace barriers blocking passage; provide screening at all irrigation diversions; replace screens that do not meet criteria. *Priority areas*: Rock, Upper Rock, Middle Rock, Lone Rock, Thirtymile, Butte, and Bridge creeks.

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-11. Summary of Recovery Information for North Fork John Day River Population.

Key Population Attributes

The population occupies the North Fork John Day watershed excluding the Middle Fork drainage. The North Fork John Day is the largest tributary to the John Day River, draining approximately 1,800 mi^2.

Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake and Columbia River hatchery programs.

The population contains 8 MaSAs (Lower North Fork John Day, Potamus, Big Wall, Big, Upper North Fork John Day, Desolation, Granite, and Owens) and seven MiSAs (Bridge, Meadow Brook, two Cabins, Fivemile, Meadow and Ditch).

The population exhibits a summer life history strategy and is part of the John Day River MPG.

The population is considered a Large population with a mean minimum abundance threshold of 1,500 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,500 spawners.

Productivity: Minimum productivity level of 1.26 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The North Fork John Day River population is at very low risk based on current abundance and productivity. The point estimate for abundance and productivity resides above the 1% risk curve and the 99% confidence interval for productivity is above the 25% risk curve.

Spatial Structure/Diversity: The combined integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. Current spawner distribution mimics the intrinsic distribution. The population is distributed broadly across the landscape in numerous MaSAs and MiSAs. Good continuity exists between spawning areas and current gaps between spawning areas are similar to historical gaps. The rating for Goal B "maintaining natural levels of variation" was low risk. However, there remains considerable uncertainty about the ratings for genetic variation and out-of-DPS hatchery strays in the natural spawners. Additional genetic analyses and interpretation is needed to determine if the genetic variation is similar to historical conditions and to examine evidence for degree of stray hatchery fish introgression. The metric for out-of-DPS hatchery strays rated very high. The data used for this rating are a composite from four John Day populations. Additional population specific spawner composition data are needed to improve the certainty of the out-of-DPS stray hatchery risk rating. If there is significant hatchery introgression that is affecting the genetic variation through time then the risk rating for "genetic variation" will increase and the overall risk rating for Goal B and SS/D will also increase.

Overall Viability Rating: The overall viability rating for the North Fork John Day steelhead population *is considered highly viable* as a result of the A/P rating of very low risk, and the SS/D rating of low risk. There remains considerable uncertainty regarding the genetic effect of out-of-DPS strays, as well as the actual proportion of natural spawners that are hatchery strays. Enhanced monitoring efforts should be undertaken to develop better estimates of the composition of North Fork John Day spawners.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,740 exceeds the threshold abundance of 1,500. The current productivity of 2.41 recruits per spawner is well above the value needed to meet the 1% risk level. The lower end of the 90% CI resides above the 1% risk level. No abundance/productivity gaps exist for the 5% or 1% risk levels.

Spatial Structure/Diversity: All metrics rated very low or low risk except for the following: *Spawner composition:* Out-of-DPS spawners rated high risk due to the high estimated proportion of Snake River hatchery strays within this population. There is also considerable uncertainty regarding the hatchery fraction estimates for this population.

Limiting Factors and Threats

Primary Limiting Factors: *Tributary Habitat:* degraded floodplain connectivity and function, degraded channel structure and complexity (key habitat quantity, habitat diversity, channel stability), altered sediment routing, water temperature, and low flows; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydro system.

Primary Life Stages Affected: Parr-to-smolt survival, egg-to-fry survival, smolts.

VSP Characteristics Impacted: Abundance, productivity, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: tributaries within the NF John Day Wilderness, NF John Day River (Big Cr to headwaters), SF Desolation Cr, upper Clear Cr

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Cottonwood Cr below Fox Cr, Camas Cr above Wilkins Cr

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Camas Cr (Wilkins Cr to Cable Cr), Clear Cr below Ruby Cr, Olive Cr below Beaver Cr, Bull Run Cr, Cottonwood Cr below EF Cottonwood

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance and efficiency. *Priority areas:* Cottonwood/Fox, Rudio, Camas Cr above Wilkins Cr

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, marking of all hatchery steelhead in Columbia River Basin, development of alternative broodstocks, reduced transport of hatchery smolts from Snake River.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-12. Summary of Recovery Information for Middle Fork John Day River Population.

Key Population Attributes

The population occupies the Middle Fork drainage, which contains five watersheds, all used by steelhead.

Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake and Columbia River hatchery programs.

Two MaSAs exist in the Middle Fork John Day River population, including Middle Fork John Day and Long Creek, and no MiSAs.

The population exhibits a summer life history strategy and is part of the John Day River MPG.

It is considered an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,000 spawners.

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate is between 5% and 25% risk curves.

Spatial Structure/Diversity: The integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was between very low and low risk. Current spawner distribution mimics the intrinsic distribution. The population is distributed broadly across the landscape, in multiple MaSAs with adequate gaps and good continuity between spawning areas. The rating for Goal B "maintaining natural levels of variation" was low risk; however, additional genetics analyses are needed to better assess genetic variation and hatchery introgression. The population rated high risk for proportion of out-of-DPS hatchery strays based on a limited time series of composite John Day population data. Better population specific spawner composition data are needed to better understand the out-of-DPS hatchery stray influence. If significant hatchery introgression affects genetic variation through time, then the risk rating will increase, thus raising the overall risk rating for Goal B and the overall SS/D rating.

Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. Increased annual abundance would allow this population to achieve a risk rating of low for A/P and raise the overall viability rating to viable.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 756 is 75.6% of the threshold abundance of 1,000. The current productivity of 2.45 recruits per spawner is above the minimum needed at threshold abundance. The lower end of the 90% CI is well above the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.08. This gap is a result of the difference in equilibrium abundance (928) and the threshold abundance.

Spatial Structure/Diversity: All metrics rated very low or low risk except for the following: *Spawner composition:* Out-of-DPS spawners rated high risk due to the high estimated proportion of out-of-DPS strays within this population.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity (habitat quantity and diversity), degraded floodplain function and connectivity, altered sediment routing, altered hydrology, and water temperature; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, passage barriers, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydro system.

Primary Life Stages Affected: fry-to-smolt, egg incubation; egg-to-parr, smolts, adult spawning.

VSP Characteristics Impacted: Abundance, productivity, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs.

Priority areas: Upper reaches of Big, Big Boulder, and Granite Boulder creeks that originate in the Vinegar Hill-Indian Rock Scenic Area.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Mainstem Middle Fork John Day (Crawford to Bridge Cr, Horse to Camp Cr, Long Cr, Camp Cr).

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Middle Fork from mouth of Granite Boulder Cr to Ragged Cr, between Big Boulder Cr and Camp Cr, and near the mouth of Mosquito Cr

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance and efficiency. *Priority areas:* Long Cr and tributaries

<u>*Harvest Strategies*</u>

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest. *Key actions*: expand creel surveys.

<u>*Hatchery Strategies*</u>

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-13. Summary of Recovery Information for South Fork John Day River Population.

Key Population Attributes

The population occupies the South Fork drainage in the John Day River Basin. Steelhead spawn and rear through the lower South Fork John Day up to Izee Falls at RM 28.5 and in Murderers Creek and other South Fork tributaries.

Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake River and Columbia River hatchery programs.

The population includes three MaSAs: Upper South Fork, Lower South Fork and Murderers Creek.

It exhibits a summer life history strategy and is part of the John Day River MPG.

The population is considered a Basic population with a mean minimum abundance threshold of 500 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

<u>*Abundance*</u>*:* Minimum abundance threshold of 500 spawners.

<u>*Productivity:*</u> Minimum productivity level of 1.56 recruits per spawner at the threshold abundance.

Viability Assessment Results

<u>*Abundance/Productivity*</u>: The population is at moderate risk based on current abundance and productivity. The point estimate resides between the 25% and 5% viability curves. The lower bound of the adjusted standard error for both the productivity and abundance extend below the 25% risk level.

<u>*Spatial Structure/Diversity:*</u> The integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" rated midway between very low and low risk. Although the current spawner distribution mimics the intrinsic distribution, only three MaSAs exist within the population. Good continuity exists between spawning areas and gaps between areas have remained relatively unchanged. The rating for Goal B "maintaining natural levels of variation" is low risk. As is the case for all John Day steelhead populations, there is uncertainty in ratings of metrics "genetic variation" and "proportion of spawners that are out-of-DPS strays." Limited genetics data for South Fork steelhead restrict efforts to determine if the current population variation is similar to historical conditions and to examine the degree of hatchery fish introgression. The metric for proportion of out-of-DPS strays rated as high risk. However, the analyses relied on composite data from four John Day populations. Additional population specific spawner composition data are needed to better inform the risk rating and to reduce the associated uncertainty.

<u>*Overall Viability Rating:*</u> The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. Improvement in abundance will allow this population to achieve viable status.

However, while the population received a SS/D rating of low risk, there is considerable uncertainty surrounding the spawner composition data. Enhanced monitoring of the hatchery-wild ratios on the South Fork spawning grounds should be conducted to improve the hatchery fraction estimate and reduce the degree of uncertainty.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 259 is 51.8% of the threshold abundance of 500. The current productivity of 2.00 recruits per spawner is greater than the minimum required at the abundance threshold. The lower end of the 90% CI extends well below the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.22. The uncertainty gap for the 1% risk level is 0.23. The gaps are primarily a result of the difference between the equilibrium abundance (409) and the threshold abundance.

Spatial Structure/Diversity: All metrics rated very low or low risk except the following: *Spawner composition*: Out-of-DPS spawners rated high risk due to the high estimated proportion of out-of-DPS strays within this population.

Limiting Factors and Threats

Primary Limiting Factors: *Tributary Habitat:* altered sediment routing, degraded channel structure and complexity (habitat quantity and diversity), altered hydrology and low flow, water temperature, and impaired fish passage; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, fish passage barriers (culverts, and other seasonal barriers), and irrigation withdrawals); the Columbia River mainstem hydro system.

Primary Life Stages Affected: Juvenile rearing, adult spawning, egg incubation, egg-to-parr survival, smolts.

VSP Characteristics Impacted: Abundance, productivity, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Lower Murderers Cr tributaries draining the south side of Aldrich Mountain.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Upper South Fork River above Izee Falls, SF Murderers Cr, Deer Cr

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: same as for riparian strategy.

Strategy: Restore degraded floodplain connectivity and function. *Key actions*: Reconnect floodplain to channel, reconnect side channels and off-channel habitats, restore wet meadows. *Priority areas:* SF Murderers Cr, Deer Cr, Upper South Fork River above Izee Falls.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance/efficiency. *Priority areas:* SF Murderers Cr, Deer Cr, Upper South Fork River above Izee Falls.

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstock.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and trapping.

Table 1-14. Summary of Recovery Information for Upper Mainstem John Day River Population.

Key Population Attributes
The population occupies the John Day River drainage above the town of Dayville and the mouth of the South Fork John Day River.
Recent year natural spawners include returns originating from naturally spawning parents and a small fraction of strays from the Snake River and Columbia River hatchery programs.
The population includes five MaSAs, Upper John Day, Upper Middle Mainstem John Day, Laycock, Beech and Canyon, and no MiSAs. The MaSAs are located primarily in the upper portions of the population boundaries.
The population exhibits a summer life history strategy and is part of the John Day River MPG.
It is considered an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 1,000 spawners.
Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate for abundance and productivity resides between the 5% and 25% risk curves.
Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the Upper Mainstem John Day River population. The rating for Goal A “allowing natural rates and levels of spatially mediated processes” was very low because the current distribution is nearly identical to the historical distribution. The rating for Goal B “maintaining natural levels of variation” was moderate risk. This risk rating was a result of a moderate rating for changes in major life history strategies. Additional genetics information needs to be assessed to determine current genetic variation and to examine for the degree of introgression of hatchery fish. The population was rated as high risk for out-of-DPS hatchery strays based on a limited time series of composite John Day population hatchery fish observation data. Better population specific spawner composition data are needed to better determine the out-of-DPS hatchery fraction. If there is significant hatchery introgression that affects the genetic variation of this population through time, then the risk rating for Goal B will increase, and the overall risk rating for SS/D will increase.
Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a “maintained” population. An increase in abundance is needed for this population to achieve viable A/P criteria. In addition, the SS/D rating was moderate due to loss in life history diversity and high risk for spawner composition.
Viability Gap
Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 524 is only 52.4% of the threshold abundance of 1,000. The current productivity of 2.14 recruits per spawner is well above the minimum required at the threshold abundance. The lower end of the 90% CI resides above the 25% risk level. The observed A/P gap to reach the 5% and 1% risk levels is 0.37. The uncertainty gaps are less than the observed gaps. The gap is primarily a result of the difference in the equilibrium abundance (730) and the threshold abundance.
Spatial Structure/Diversity: Gaps were identified for the following SS/D metrics: *Major life history strategies:* moderate risk due to reduced opportunities for juvenile movement patterns and reduced summer rearing distribution that has resulted from altered mainstem and tributary habitats. *Spawner composition:* Out-of-DPS spawners rated high risk due to the high proportion of out-of-DPS strays and uncertainty in the estimates of hatchery fraction.
Limiting Factors and Threats
Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity (habitat quantity and diversity), degraded riparian areas and LWD recruitment, altered sediment routing, water temperatures, altered hydrology and degraded floodplain function and connectivity. Impaired fish passage is also a priority limiting factor in Beech and Laycock creeks. *Hatchery:* effects of naturally spawning stray hatchery fish on viability. *Hydro:* mainstem passage.
Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (agricultural practices, livestock overgrazing, removal of large trees from the riparian corridor, wetland draining/conversion, stream channelization/diking); the Columbia River mainstem hydro system.
Primary Life Stages Affected: Juvenile rearing, egg incubation, egg-to-parr survival, smolts, adult spawning.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy*: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: EF and Middle Fork of Canyon Cr, John Day River above Blue Mt. Hot Springs. *Strategy*: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Upper mainstem John Day River, Beech Cr, Bear Cr, lower reaches of Fields Cr, Belshaw Cr and Riley Cr. *Strategy:* Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Mainstem John Day River (Dayville to Blue Mt. Hot Springs), Indian Cr, Pine Cr, lower Beech Cr, middle Canyon Cr, lower Strawberry Cr *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance/efficiency. *Priority areas:* Fields, Indian, Pine, Beech, Strawberry and Laycock creeks, John Day River (Dayville to Mt. Vernon). *Strategy*: Restore passage and connectivity. *Key actions*: Remove or minimize use of push up dams, remove or replace culverts and/or other passage barriers. *Priority areas*: Beech, Canyon, Strawberry, Dixie, and Reynolds creeks. *Harvest Strategies* *Strategy:* Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries. *Strategy:* Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures. *Strategy:* Improve quality of harvest information. *Key actions*: expand creel surveys. *Hatchery Strategies* *Strategy:* Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstocks. *Strategy:* Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and trapping.

Table 1-15. Summary of Recovery Information for Umatilla River Population.

Key Population Attributes The Umatilla River steelhead population occupies the Umatilla watershed and a few smaller streams in Washington State that flow directly into the Columbia River. Recent year natural spawners include returns originating from naturally spawning parents, Umatilla River hatchery-origin fish and out-of-DPS strays, primarily from the Snake River Basin. The ICTRT has identified 13 MaSAs for this steelhead population. Eleven of the MaSAs are within the Umatilla drainage in Oregon: Butter, East Birch, McKay, Meacham, Middle Umatilla, Upper Umatilla, Lower Middle Umatilla, Lower Birch, Lower Umatilla, Wildhorse and West Birch. The population also has three MiSAs: Alkali, Fourmile Canyon, and Cottonwood. Two of the MaSAs, Alder Creek and Glade Creek, are included in the Umatilla population, but are direct tributaries to the Columbia River on the Washington side. Currently only eight of the 13 MaSAs are occupied. The population exhibits a summer life history strategy and is part of the Umatilla/Walla Walla Rivers MPG. It is considered a Large population with a mean minimum abundance threshold of 1,500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk) *Abundance:* Minimum abundance threshold of 1,500 spawners. *Productivity:* Minimum productivity level of 1.26 recruits per spawner at the threshold abundance.
Viability Assessment Results *Abundance/Productivity*: The population is at moderate risk. The productivity is at low risk because the point estimate is above 5% risk level and the adjusted standard error is above the 25% risk level. Abundance is moderate because the point estimate is slightly below the 5% risk level.

Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution relative to intrinsic potential distribution. This reduction has caused significant increases in gaps between spawning areas as well as disrupted continuity. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Habitat changes have been significant in the Umatilla Basin resulting in changes to flow profiles and elevated temperatures. These changes have resulted in impacts to life history diversity and phenotypic trait variation. The out-of-DPS strays in combination with local origin hatchery fish spawning naturally put the population at high risk for spawner composition. Within basin habitat changes have likely resulted in selective mortality of specific components of juvenile and adult life stages resulting in a moderate risk rating.

Overall Viability Rating: The population *does not currently meet the recommended viability criteria* because A/P and SS/D risks ratings are both moderate. It does meet criteria for a "maintained" population. Improvement in many of the SS/D metrics and a small increase in the average abundance will raise the population to viable status.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,472 is 98.1% of the threshold abundance of 1,500. The current productivity of 1.50 recruits per spawner is above the minimum of 1.26 required at the threshold abundance. The lower end of the 90% CI resides slightly above the 25% risk level. The observed A/P gap for the 5% and 1% risk levels is 0.09. The uncertainty gap for the 1% risk level is less than the observed gap.

Spatial Structure/Diversity: Gaps were identified for the following SS/D metrics: *Spatial Extent or Range of Population*: moderate risk because the current spawner distribution is substantially reduced from the historical distribution. Loss of spawning in the Butter and McKay watersheds has resulted in the reduced distribution. *Increase or decrease in gaps and continuities*: moderate risk because of the increased gaps and changed continuity resulting from losses of occupancy in the Butter and McKay watersheds. *Major life history strategies:* moderate risk as a result of reduced opportunity for life history expression for juvenile and adult life stages. This reduced opportunity has resulted from significant habitat changes in the Umatilla Basin. *Phenotypic variation:* moderate risk due to effects of flow and temperature on adult and juvenile migration characteristics. *Spawner composition*: Overall rating is high risk due to two moderate ratings for the component metrics. Out-of-DPS spawners rated as moderate risk due to the estimated level of strays observed at Three-mile Falls Dam over the last three generations. Within-population spawners rated moderate risk due to the proportion and duration of Umatilla Hatchery fish spawning in the basin. *Selective change in Natural Processes-Habitat:* moderate risk due to the selective effects of temperature and flow changes on juvenile and adult characteristics.

Limiting Factors and Threats

Primary Limiting Factors: *Tributary Habitat:* high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity and low flows; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River mainstem hydrosystem.

Primary Life Stages Affected: fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas:* North Fork Umatilla R, Umatilla R (Meacham Cr. to forks), Buck Cr, NF Meacham Cr, E. Meacham Cr, Thomas Cr, W. Birch Cr (Bear Cr to headwaters), E. Birch Cr (California Gulch to headwaters), SF Umatilla R (mouth to Thomas Cr).

Strategy: Restore passage and connectivity. *Key actions*: Remove or replace culverts and/or other passage barriers, construct ladders over existing dams, provide adequate screening at all irrigation diversions. *Priority areas*: Birch Cr, W. Birch Cr, Bridge Cr, and diversions within current steelhead distribution.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Umatilla R (Mission Br to forks), Meacham Cr (mouth to headwaters), Birch Cr, West Birch Cr (mouth to Gorge), East Birch Cr, Bear Cr, Iskuulpa Cr.

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Umatilla R (Mission Br. to forks), Meacham Cr, NF Meacham Cr, Birch Cr, West Birch Cr (mouth to Gorge), East Birch Cr, Bear Cr.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement Umatilla Basin Project Phases I-IIII, implement water conservation measures, improve irrigation conveyance/efficiency. *Priority areas:* Umatilla R (mouth to Thornhollow), Birch C, West Birch Cr (mouth to Gorge), East Birch Cr, Bear Cr.

Hydrosystem Strategies

Strategy: Improve hydrosystem operations and facilities at Boyd Project to enhance steelhead survival and viability. *Key actions:* Modify bypass flows at Project if possible to mimic instream water right, modify fish passage facilities to meet current standards, remove weir panels from diversion dam during non-operation, maintain trash racks. *Priority areas:* At and below Boyd Project.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks for the hatchery programs that produce the strays.

Strategy: Reduce abundance and proportion of out-of-basin stray hatchery fish spawning naturally. *Key actions:* no consensus actions.

Strategy: Re-establish natural production in historically utilized areas. *Key actions*: re-establish natural production in Little Butter and Butter creeks and some MiSAs through adult outplanting and juvenile releases.

Strategy: Reduce genetic influence of hatchery fish in broodstock. *Key actions*: Eliminate use of hatchery produced adults in broodstock.

Strategy: Reduce interactions between residual hatchery steelhead and natural steelhead. *Key actions*: no consensus actions.

Strategy: Reduce potential ecological interactions between coho and natural steelhead. *Key actions*: reduce number of hatchery coho released in Umatilla R. and relocate releases downstream of areas important to steelhead production.

Table 1-16. Summary of Recovery Information for Walla Walla River Population.

Key Population Attributes

The Walla Walla River steelhead population occupies the Walla Walla watershed, with the exception of the Touchet River drainage, which is considered a separate independent steelhead population. The main tributaries of the Walla Walla River are the North and South forks and Couse, Pine, Birch, Cottonwood and Mill creeks. The North and South forks and Couse Creek are entirely within Oregon, but the remaining tributaries span the state line. Two small watersheds that empty directly into the Columbia River below the Walla Walla River confluence are included in the Walla Walla population boundaries.

Recent years natural spawners include returns originating from naturally spawning adults and from outside-DPS strays that originate from Lyons Ferry Hatchery releases in the lower Walla Walla River.

The population is comprised of three MaSAs (Mill, Pine, and Walla Walla) and two MiSAs (Dry and Switzler). Currently two of three MaSAs are occupied, including Walla Walla and Mill. Spawning and rearing occur in the lower reaches of the Pine Creek MaSA.

The population exhibits a summer life history strategy and is part of the Umatilla/Walla Walla Rivers MPG.

It is considered an Intermediate size population with a mean minimum abundance threshold of 1,000 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,000 spawners.

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.

Viability Assessment Results

<u>*Abundance/Productivity*</u>: The population is at moderate risk based on current abundance and productivity. The point estimate falls between the 5% and 25% risk curves. The risk rating should be viewed with caution given two considerations. First, the time series is short, with only eight complete brood years. Second, there is considerable uncertainty associated with the amount of spawning and production that occurs within the population outside of the area above Nursery Bridge Dam, particularly in Mill Creek. Better information relating abundance above Nursery Bridge Dam to the remaining area in the population is needed to reduce these data uncertainties.

<u>*Spatial Structure/Diversity:*</u> The integrated SS/D rating for the population is moderate risk. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution which has resulted in increased gaps and loss of continuity within the population, as well as between the Walla Walla population and other Mid-Columbia steelhead populations. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Water temperature and hydrograph changes, as well as barriers have likely influenced life history diversity and phenotypic expression. Out-of-DPS strays have put the population in the moderate risk category for the spawner composition metric. Within basin habitat changes have likely resulted in selective mortality at multiple life stages resulting in a moderate risk rating.

<u>*Overall Viability Rating:*</u> The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. The A/P values are at moderate risk and the time series is short resulting in considerable uncertainty. Additional brood years are needed to demonstrate sustained recruits per spawner and abundance values above the low risk criteria level. Significant improvements to spatial structure and diversity are needed to improve the risk level.

Viability Gap

<u>*Abundance/Productivity:*</u> The recent 10-year geomean natural-origin abundance of 650 is well below the threshold abundance of 1,000. The current productivity of 1.34 recruits per spawner is slightly less than the minimum of 1.35 required at the threshold abundance. The lower end of the 95% CI extends well below the 25% risk level. The observed gaps for A/P at the 5% and 1% risk levels were 0.34 and 0.45 respectively. The uncertainty gaps at the 5% and 1% risk levels were less than the observed gaps. These gaps should be viewed cautiously because there is only a short data series available to estimate productivity.

<u>*Spatial Structure/Diversity:*</u> Gaps were identified for the following SS/D metrics: *Major life history strategies:* moderate risk due to changes in juvenile and adult movement patterns as well as reduced juvenile rearing distribution relative to historical opportunities. The reduced life history strategies have resulted from significant flow and temperature changes within the basin. *Phenotypic variation:* moderate risk due to the effect of flow and temperature changes on phenotypic variation. Adult and juvenile migration patterns have been significantly altered due to these habitat changes. *Spawner composition:* Out-of-DPS spawners rated moderate risk due to the proportion and duration of out-of-DPS spawners in the population. *Selective change in Natural Processes-Habitat:* moderate risk due primarily flow and temperature effects on migration, movement and rearing patterns.

Limiting Factors and Threats

<u>*Primary Limiting Factors:*</u> *Tributary Habitat:* high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity, degraded floodplain connectivity and function, and low flow; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

<u>*Primary Threats:*</u> Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River mainstem hydrosystem.

<u>*Primary Life Stages Affected:*</u> fry, summer parr, winter parr, smolts.

<u>*VSP Characteristics Impacted:*</u> Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

<u>*Habitat Strategies*</u>

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: SF Walla Walla (Elbow to headwaters), SF Walla Walla Tribs, NF Walla Walla (Little Meadows to headwaters).

Strategy: Restore passage and connectivity. *Key actions*: Remove or replace culverts and/or other passage barriers, construct ladders over existing dams, provide adequate screening at all irrigation diversions. *Priority areas*: Mill Cr., Birch Cr, Couse Cr, and unscreened irrigation diversions within current steelhead distribution.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Walla Walla R (Mill Cr. to forks), SF Walla Walla (mouth to Elbow Cr), NF Walla Walla R (mouth to Little Meadows Cyn).

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority Areas*: Walla Walla R (Mill Cr. to forks), SF Walla Walla (mouth to Elbow Cr), NF Walla Walla R (mouth to Little Meadows Cyn).

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Investigate feasibility of water storage or exchange, implement water conservation measures, and improve irrigation conveyance/efficiency. *Priority Areas:* Walla Walla R (mouth to Little Walla Walla diversion), Walla Walla R. (Mill Cr to forks), NF Walla Walla R (mouth to Little Meadows Cyn).

Hydrosystem Strategies

Strategy: Improve hydro operations and facilities at Twin Reservoirs Project. *Key actions:* Conduct assessment of fishway and modify to meet juvenile fish passage standards.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstocks for the hatchery programs producing strays.

Strategy: Reduce abundance and proportion of hatchery strays spawning naturally. *Key actions:* no consensus actions.

ACRONYMS AND ABBREVIATIONS

AHA	All-H analyzer
A/P	Abundance/productivity
ACEC	Area of Critical Environmental Concern
AgWQM	Agricultural water quality management
BACI	Before-after-control-impact
BIA	Bureau of Indian Affairs
BiOp	Biological opinion
BLM	Bureau of Land Management
BMPs	Best management practices
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
cfs	Cubic feet per second
CAFO	Confined animal feeding operations
CBFWA	Columbia Basin Fish and Wildlife Authority
CCRP	Continuous Conservation Reserve Program
CDs	Conservation districts
CHART	Critical Habitat Assessment Review Team
CI	Confidence interval
CREP	Conservation Reserve Enhancement Program
CRFPO	Columbia River Fisheries Program Office
CRITFC	Columbia River Inter-tribal Fish Commission
CRP	Conservation Reserve Program
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSP	Conservation Security Program
CSS	Comparative survival study
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CTWSRO	Confederated Tribes of the Warms Springs Reservation of Oregon
CWA	Clean Water Act
CWT	**C**oded-wire tag
DART	Data access in real time
DBLT	Deschutes Basin Land Trust
DSL	Oregon Department of State Lands
DPS	Distinct population segment
DRC	Deschutes River Conservancy
EDT	Ecosystem Diagnosis and Treatment
EIS	Environmental impact statement
EMAP	Environmental monitoring and assessment protocol
EPA	Environmental Protection Agency
EQUIP	Environmental Quality Incentive Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FEIS	Final environmental impact statement
FERC	Federal Energy Regulatory Commission
FMEP	Fisheries Management and Evaluation Plan
FPC	Fish Passage Center

FPP	Fish per pound
FS	Forest Service
FSA	Farm Service Agency
FWC	Oregon Fish and Wildlife Commission
FY	Fiscal year
GFID	Gardena Farms Irrigation District #13
GM	Geometric mean
GMA	Growth Management Act
GRP	Grassland Reserve Program
HBDIC	Hudson Bay District Improvement Company
HFRP	Healthy Forest Reserve Program
HGMP	Hatchery and Genetics Management Plan
HID	Hermiston Irrigation District
HPV	Historical Precipitation Variation
HUC	Hydrologic unit code
ICTRT	Interior Columbia Technical Recovery Team
IFIM	Instream flow incremental methodology
IFP	Integrated fruit production
IHNV	Infectious Hematopoietic Necrosis Virus
IMW	Intensively monitored watershed
IRMP	Integrated Resource Management Plan
ISRP	Independent Scientific Review Panel
LBC	Lake Billy Chinook
LCREP	Lower Columbia River Estuary Partnership
LIDAR	Light detecting and ranging
LFH	Lyons Ferry Hatchery
LWD	Large woody debris
MaSA	Major spawning area
MiSA	Minor spawning area
MMPA	Marine Mammal Protection Act
MNF	Malheur National Forest
MOA	Memorandum of agreement
MPG	Major population group
MU	Management unit
NBD	Nursery Bridge Dam
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NFCP	Native Fish Conservation Policy
NGO	Non-government agency
NHD	National Hydrography Dataset
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration-Fisheries
NPMP	Northern Pikeminnow Management Program
NPCC	Northwest Power and Conservation Council
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity unit
NWFP	Northwest Forest Plan
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation

ODEQ	Oregon Department of Environmental Quality
OHV	Off highway vehicle
OPSW	Oregon Plan for Salmon and Watersheds
ORV	Outstandingly remarkable values
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PACFISH	Pacific Anadromous Fish Strategy
PCEs	Primary constituent elements
PCR	Polymerase chain reaction
PCSRF	Pacific Coastal Salmon Recovery Fund
PGE	Portland General Electric
PIT	Passive integrated transponder
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PRBC	Pelton-Round Butte Complex
PTAGIS	PIT Tag Information System
PVA	Population viability analysis
QAR	Quantitative analytical report
RBH	Round Butte Hatchery
RC&D	Resource conservation and development
RHCAs	Riparian habitat conservation areas
RIOG	Regional Implementation and Oversight Group
RM	River-mile
RMEF	Rocky Mountain Elk Foundation
RPA	Reasonable and prudent alternative
RSTs	Rotary screw traps
RSW	Removable spillway weir
SAR	Smolt-to-adult return
SEPA	State Environmental Policy Act
SID	Stanfield Irrigation District
SLEDs	Sea lion excluder devices
SMP	Shorelines Master Plan
SMU	Species Management Units
SNPs	Single nucleotide polymorphisms
SS/D	Spatial structure/diversity
SSB	Substitute Senate Bill
STC	Summer temperature change
SURPH	Survival under proportional hazards
SWAC	Springtime water availability change
SWCD	Soil and water conservation district
SWW	Selective water withdrawal
TDG	Total dissolved gas
TDGS	Total dissolved gas supersaturation
TIR	Thermal infrared
TMDL	Total maximum daily loads
TMFD	Three Mile Falls Dam
TNC	The Nature Conservancy
TRT	Technical Recovery Team
TSID	Three Sisters Irrigation District
TSS	Tri-State Steelheaders
UBWC	Umatilla Basin Watershed Council

UNF	Umatilla National Forest
UPA	Updated proposed action
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S.D.A. Forest Service
USFWS	U.S. Fish and Wildlife Service
UWCIG	University of Washington Climate Impact Group
VARs	Variances
VSP	Viable salmonid population
WAC	Washington administrative code
WCC	Washington Conservation Commission
WDOE	Washington Department of Ecology
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WEID	West Extension Irrigation District
WHP	Wellhead Protection Program
WHIP	Wildlife Habitat Incentive Program
WID	Westland Irrigation District
W/LC TRT	Willamette/Lower Columbia Technical Recovery Team
WSNFH	Warm Springs National Fish Hatchery
WRIA	Water Resources Inventory Area
WRP	Wetlands Reserve Program
WWBWC	Walla Walla Basin Watershed Council
WY	Water years
YN	Yakama Nation