8 Management Plan

Introduction

The management plan integrates the vision for the Lower Mid-Columbia Mainstem (including Rock Creek) Subbasin with the assessment and inventory sections of this document. That vision for the subbasin extends over 10 to 15 years and represents local policy input to the subbasin plan. The selection of objectives and strategies for restoration of fish and wildlife habitat and populations which form the bulk of the management plan is derived from that input.

The scope of the management plan is somewhat narrower than the scope of the assessment or the inventory. The assessment and inventory are designed and may be used to guide restoration and management actions by many parties under their own authorities in the course of ongoing efforts to protect and enhance the fish and wildlife populations and the aquatic and terrestrial ecosystems that exist within the Lower Mid-Columbia Mainstem Subbasin. The management plan is based on the assessment and inventory, but is specifically designed to act as a draft amendment to the Columbia Basin Fish and Wildlife Program, and to be reviewed and approved by the Northwest Power and Conservation Council (NPCC).

The management plan outlines biological objectives and strategies that the planners feel would most efficiently address primary limits to fish and wildlife production in the subbasin. That road map allows the NPCC and BPA to more effectively meet their obligations in the subbasin to mitigate and protect resources affected by the construction and operation of the Federal Columbia River Power System. As such, it is non-regulatory in nature, and is based on the use of BPA ratepayer funds to construct or improve existing infrastructure, to acquire land or protective easements as a means of habitat protection, to fund personnel to improve management of natural resources, to monitor and research the relationships between management actions and the health of the resource, and to fund other actions that protect or restore the health of natural resources that have been negatively impacted by the FCRPS.

This management plan was developed in a relatively short time frame, as the Klickitat, White Salmon and Lower Mid-Columbia Mainstem were among the last subbasins to get started in the NPCC subbasin planning process. This plan was developed with a minimal budget of less than $37,000 and is limited in geographic scope to the north side of the Lower Mid-Columbia Mainstem segment of the Columbia River from the mouth of the Walla Walla River to the mouth of the White Salmon River. Reasons for the limited geographic scope are:

- Unknown management strategies for the Hanford Reach Monument, because the U.S. Fish and Wildlife Service process of developing a management plan for the Reach has not progressed sufficiently to provide guidance to the subbasin planners;
- Uncertainty about the Federal Energy Regulatory Commission determination in response to Grant County PUD’s application to relicense the Priest Rapids Hydroelectric Project, which was filed on Oct. 29, 2003; and
- Lack of current information about the Oregon side of the river other than inventory information supplied by ODFW.

The traceable logic displayed below in table form focuses on strategies that benefit focal wildlife species that inhabit the subbasin's terrain, on three focal fish species that utilize mainstem

tributaries Rock, Pine and Glade creeks and on mainstem dwelling white sturgeon. Aside from those directed at white sturgeon, there are few mainstem strategies or habitat-directed high priorities identified in the subbasin planning process.

8.1.1 Vision

We envision healthy self-sustaining populations of fish and wildlife indigenous to the Columbia Basin that support harvest and other purposes. Decisions and recommendations will be made in a community based, open and cooperative process that respects different points of view, and will adhere to all rights and statutory responsibilities. These efforts will contribute to a robust and sustainable economy.

8.1.2 Biological Objectives and Strategies

The Technical Guide for Subbasin Planners recommends that the Management Plan contain the following elements biological objectives and strategies.

Biological Objectives should:

- Be consistent with basin-level visions, objectives, and strategies adopted in the program.
- Be based on the subbasin assessment and resulting working hypothesis.
- Be consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin, and agreed upon by co-managers in the subbasin. Where there are disagreements among co-managers that translate into differing biological objectives, the differences and the alternative biological objectives should be fully presented.
- Be complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin.
- Be consistent with the Endangered Species Act recovery goals and Clean Water Act requirements as fully as possible.
- Be quantitative and have measurable outcomes.

Strategies must:

- Explain the linkage of the strategies to the subbasin biological objectives, vision and the subbasin assessment Explain how and why the strategies presented were selected over other alternative strategies (e.g. passive restoration strategies v. intervention strategies)
- Describe a proposed sequence and prioritization of strategies
- If necessary, describe additional steps required to compile more complete or detailed assessment

This subbasin plan identifies management actions that promote compliance of the federal Endangered Species and the Clean Water acts. None of the recommended management strategies are intended nor envisioned to compromise or violate any federal, state or local laws or regulations. The intent of these management strategies is to provide local solutions that will

enhance the intent and benefit of these laws and regulations. The Council, Bonneville, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) intend to use adopted subbasin plans to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. NOAA Fisheries and the USFWS have stated their intent to use subbasin plans as a foundation for recovery planning for threatened and endangered species.

Planners chose to use tables to link observed effects in the basin to working hypotheses (potential causes of the effect); hypotheses to objectives (to address the cause of the effect); objectives to strategies (to reverse the cause); or effect to strategies (to mitigate the effect if the cause could not be reversed).

These tables are designed to condense the information in the assessment so that the logic path from key finding to strategy can be more easily discerned.

8.1.3 Management Plan Matrixes -- Identification of Subbasin Goals and Strategies for Fish and Wildlife

The Lower Mid-Columbia Mainstem Subbasin (including Rock Creek) management plan strategies are based on an assessment of the needs of eight focal wildlife species, three focal fish species that utilize mainstem tributaries Rock, Pine and Glade creeks and on mainstem-dwelling white sturgeon. Aside from those directed at white sturgeon, there are few mainstem strategies identified in this subbasin planning process. The other focal fish species identified as being of special significance are steelhead, fall chinook and coho. The Pacific lamprey was chosen as a fish species of special interest.

The focal wildlife species for the Rock Creek watershed are western gray squirrel, mule deer, grasshopper sparrow, Brewer's sparrow, white headed woodpecker, Lewis' woodpecker, beaver, and the yellow warbler. Wildlife strategies were devised based on the condition, availability and potential for restoration of a variety of focal habitat types. Those habitats are interior riparian-wetlands, interior grasslands, shrub steppe and ponderosa pine/Oregon white oak.

A primary need initially is for implementation of ongoing monitoring and evaluation within Rock Creek watershed. There is a high level of certainty associated with several key findings and strategies, but without concerted monitoring and evaluation there is a margin of uncertainty about whether the best strategies achieve the highest possible benefit. Actions suggested in the management plan matrixes below include an extensive monitoring and evaluation effort within Rock Creek that is considered a high priority.

There are a few useful working understandings of Rock Creek watershed that provide context for the planning matrixes. First, changes in land cover as a result of logging, road building and other activities has increased fine sediment delivery in Rock Creek and other subbasin streams. Second, peak flows have subsequently been increased. Third, wetted perennial area in the lower watershed has decreased. Fourth, riparian function in the lower watershed has significantly decreased due to loss of riparian vegetation, hydromodification, and altered channel structure. Fifth, high water temperatures in the lower watershed are extensive and at times lethal.

For terrestrial/wildlife habitat (not necessarily in order of importance) known limiting factors include: 1) reduction in native vegetation; 2) extensive conversion of native habitats (especially shrub steppe); 3) reduction in large diameter, late seral trees, snags, and large woody debris; 4)

increased stand and stem densities (increased fuel load), and 5) fragmentation of wildlife habitat, and 6) reduction in floodplain acreage.

Numerous strategies identified during the subbasin planning process and outlined in management plan's matrixes aim to contribute beneficially to limiting factors in Rock Creek and elsewhere in the subbasin. For instance, there are several actions that focus on riparian function (reconnect side channels, re-establish or enhance native vegetation, increase channel roughness, artificially introduce large woody debris as well as implement practices that allow large woody debris to naturally enter and remain in the system).

These actions would help lower stream temperatures, increase wetted perennial areas in the lower watershed, improve food availability, filter fine sediment levels, attenuate peak flows as well as other environmental benefits. Ideally, a suite of complementary actions would be implemented through project proposals.

The plan matrixes call for an evaluation of Rock Creek steelhead genetics to determine the level of competition there has been between hatchery and wild fish that are part of the Mid-Columbia "evolutionarily significant unit" listed as threatened under the Endangered Species Act. It also outlines strategies for improving the survival of steelhead kelts, mature, spawned out fish that have the potential to spawn again.

Other primary strategies are for an evaluation of lamprey habitat needs and the implementation of restoration actions.

Water quality in the watershed is impacted by increased sedimentation, which can negatively affect steelhead and salmon egg incubation and rearing. Strategies are to assess the relative contribution of the various sources of that increased sedimentation and implement action to reduce sedimentation. Those actions include improved road and off-road vehicle management and the implementation of upland management practices that mimic natural runoff and sediment production.

Factors limiting the productivity of the white sturgeon are, in most respects, related to the existence and operation of the mainstem hydrosystem. Spawning occurs in the mainstem but is limited by hydrograph and water temperatures. The sturgeon are, typically, impounded in individual reservoirs instead of being able to migrate freely as they did historically. Those impounded populations are less productive, more prone to year-class failure and their eggs and larvae more subject to predation than under historic conditions. The population is effectively fragmented with little migration between reservoirs; a majority of the migration that does occur is from upstream reservoirs to reservoirs lower in the Columbia River.

Strategies offered in this document's management plan suggest hydrosystem operational shifts that are expected to increase spawning and first-year survival. This plan urges the supplementation of less productive populations by capturing juveniles below the lowermost dam in the system, Bonneville, then transporting and releasing them upstream.

A general theme across the subbasin is a reduction in the quantity and quality of all types of wildlife habitat that the focal and other species need to flourish.

Riparian wetlands have been lost as floodplain habitats have been converted to human uses. That loss of riparian wetland habitat structure and hydrology reduces ecological function.

This plan's objectives and strategies recommend efforts to restore riparian wetland habitat in order to bring benefit to both fish and wildlife. Those actions involve both restoring habitat by increasing native vegetation and creating adequate hydrological conditions to reconnect habitats in tributary and mainstem floodplain areas.

Primary strategies in both the fish and wildlife portions of this management plans are strategies to restore beaver habitat and, where possible, to prepare for reintroduction of a species whose numbers are greatly reduced from historic levels. The restored habitat would benefit beaver, whose activities would in turn benefit the salmon and steelhead that spend a portion of their life histories in the watershed. Beaver dams result in the creation of off channel habitat and increased channel stability, which would provide a benefit to the fish focal species that utilize the Rock Creek watershed.

Among the causes of the diminution and fragmentation of shrub steppe habitat are agriculture and other human development, altered fire frequencies and invasive weed species. Habitat quality can be improved by supplementing the ability to control fires, restoring more natural fire cycles, encouraging appropriate grazing practices, prioritizing weed control areas, and implementing native plant restoration. Restoration and protection of habitats are key strategies.

Habitat quality and ecological function in Ponderosa pine/Oregon white oak habitat has been reduced because of altered forest species composition and age structure. Harvest practices have resulted in removal of late seral stands and large overstory trees across the landscape.

Objectives for the ponderosa pine/Oregon white oak habitat include retaining any existing late seral stands and large decadent wildlife trees and managing stands to restore functional habitat. Such strategies include identifying areas where thinning and/or prescribed burning would help achieve habitat objectives and thinning appropriate stands to decrease stand density.

The matrixes for focal fish species have been developed in consideration of the assessment's key uncertainties table as well as the reach assessment forms. The wildlife matrixes were similarly constructed, though in the context of focal species in three focal habitat types. The intent of each matrix is to present actions and strategies that may be implemented to address the key findings and limiting factors. Furthermore, to the extent possible, appropriate geographical locations were identified for certain actions and strategies. The geographical locations were then designated as a primary or secondary tier action area. The definitions for these designations are provided at the head of the wildlife and fish management plan matrixes.

Generally, areas and actions identified in the primary tier category are able to be implemented within the next five years and have a high likelihood of achieving the targeted biological effect. The white matrixes are ordered according to the confidence level associated with strategy. The geographical areas in the primary tier of the fish and wildlife matrixes are the most appropriate areas for that strategy to be employed. The actions identified in the secondary tier category may not be implementable within five years, may have less likelihood of achieving a targeted biological effect, and may be a geographical area for which a particular action is less important than primary tier locations.

Because the Rock Creek watershed has had no extensive, continuous monitoring and evaluation in place, much of the knowledge about the watershed originated from unpublished Yakama Nation data, field observations by Yakama Nation and WDFW personnel, and remote methods

such as GIS and orthophoto analysis. QHA was initiated in the Rock Creek watershed, but the quick execution of the subbasin planning process did not afford development of a deliberate, open and cooperative process to discuss and come to consensus with the numerous assumptions necessary in providing rankings for the model.

The observed high numbers of steelhead redds within the lower miles of Rock Creek (35-45 per mile), as well as the extensive distribution of redds throughout the watershed suggest a need for modeling of abundance and capacity within the watershed. EDT is the best tool currently available for that purpose. EDT modeling in the Rock Creek watershed would provide a significant contribution to the understanding and future opportunities within the Rock Creek watershed. It was within the basic EDT definitions and approach that the reach assessment forms were produced. Therefore, when particular reaches are identified they have had a preliminary application of the EDT conceptual framework applied to them. For wildlife a lack of extensive species and habitat monitoring and evaluation also exists, so key findings, limiting factors and proposed actions were created using best scientific judgment with the help of local, residential knowledge.

In general, the strategies in the fish management plan matrix attempt to address the above-mentioned five working understandings of the watershed. Biological objectives were not identified because insufficient data and confidence was present for technical committee and planning committee members to identify quantitative measures. Some objectives may have been more clearly identified with a longer planning timeline, with the goal of reaching physical habitat capacities, but were unavailable within the current limitations.

Therefore, the left column of the fish matrixes contains strategies and types of actions that address key findings rather than quantitative biological objectives. New assessment activities, comprehensive monitoring and evaluation, and an EDT analysis would be necessary to present quantitative biological objectives with a high level of confidence.

8.2 Wildlife

8.2.1 Interior Riparian Wetlands Objectives and Strategies

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Table 41 Wildlife objectives and strategies for Interior Riparian Wetlands

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
	F=From Fish Data	**L = Local Residential Information**	**H = Habitat Database**

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	**Secondary**	
O: Restore riparian habitat quality by increasing native vegetation in degraded riparian habitat. S: Develop and continue riparian weed control programs.	Displacement of Native Riparian Vegetation by Non-Native Vegetation	Rock Creek 2, 3 and 4, Luna Gulch, Squaw Creek 1 and 2, Badger Gulch Gilliam and Sherman counties, Oregon	Rock Creek 5, Squaw Creek 2, Badger Gulch Lower mid-Columbia mainstem	F (locations), I

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Slow stream flow, restore water table, repair stream banks, restore riparian vegetation and reconnect floodplain. S: Use lease, easement or purchase practices to protect functioning floodplain areas and streams. S: Reintroduce beavers, plant native vegetation and reintroduce large woody debris.	Incised Stream Reaches	Rock Creek 2, 3 and 4 Washington: identify and prioritize other key areas for stragegy application in subbasin Oregon and the mainstem:: identify and prioritize key areas for stragegy application	Rock Creek 6, Quartz Creek 1, Quartz Creek 2, Box Canyon Upper Watershed Roads	F (locations), I
O: Restore ecologically functional floodplain/riparian wetland habitats. S: Inventory roads near riparian habitat and assess impacts to determine problem areas in need of resolution. S: Implement restoration activities in the subbasin.	Reduction in Floodplain Acreage.			F (locations), I
O: Protect all riparian buffers from inappropriate timber harvesting. O: Utilize timber harvesting to enhance degraded riparian buffers. S: Create/implement guidelines to retain and enhance riparian buffers to a functional status.	Upper Watershed Hydrologic Alteration			F (locations), I
O: Increase large woody debris presence in riparian buffers. S: Promote silviculture practices that retain large woody debris within riparian buffers. S: Place large woody debris.	Loss of Stream Complexity and Increased Flows	Throughout watershed, excluding Rock Creek 6, Quartz Creek 1 and 2, Box Canyon Rock Creek 2, 3 and 4 Gilliam and Sherman counties	Luna Gulch, Squaw Creek 1	F (locations)

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Restore and protect remaining riparian buffers from conversion. S: Utilize purchase easements, leases or agreements, for landowners to restore or protect riparian vegetation (e.g. Farm Program partner, etc.).	Loss of Riparian Habitat and Function Fragmentation of Habitat	Rock Creek 2, 3, 4 and 5, Luna Gulch, Squaw Creek 1 Gilliam and Sherman counties		F (locations), I
O: Restore native riparian tree and shrub habitats degraded by inappropriate grazing. S: Provide incentives through easements, leases or agreements, for landowners to manage livestock in such a way to provide for riparian vegetation restoration (e.g., farm programs).	Overall Loss of Riparian Vegetation	Rock Creek 2, 3 and 4, Squaw Creek 1 Gilliam and Sherman counties		B

8.2.2 Interior Riparian Wetlands Focal Species (Yellow Warbler, American Beaver and Lewis' Woodpecker)

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Yellow Warbler

Table 42 Objectives and strategies for Interior Riparian Wetlands—Yellow Warbler

TIER DEFINITIONS	**Project or Actions:**	**Primary—Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**		
		Secondary—Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.		
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**	
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**	
	F=From Fish Data	**Linda = Local Residential Information**	**H = Habitat Database**	
Target Objectives and Strategies	**Associated Limiting Factor**	**Tier Rankings by Geographical Areas**		**Source**
		Primary	**Secondary**	
O: Increase quality and quantity of habitat for yellow warblers. O: Restore yellow warbler population numbers to historic levels. S: Inventory existing and potential yellow warbler habitat. S: Create/retain optimal habitat (see assessment).	Reduction in Floodplain Acreage Overall Habitat Loss Fragmentation of Habitat	Washington: Identify and prioritize key areas for stragegy application in subbasin	Oregon: Identify and prioritize key areas for strategy application	I,R

O: Reduce mortality of food base (insects), needed by yellow warblers, from chemical applications. S: Use alternative control measures for undesirable species in riparian buffers, especially in areas used by yellow warbler.	Reduced Food Base	Washington: Identify and prioritize key areas for stragegy application	Oregon: Identify and prioritize key areas for strategy application	I

American Beaver

Table 43 Objectives and strategies for Interior Riparian Wetlands—American Beaver

TIER DEFINITIONS	Project or Actions:	Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	O = Objective	FO = Field Observation	RL= Research Literature
	S = Strategy	B = Best Professional Judgment	I = Information Needed
	F = From Fish Data	L = Local Residential Information	H = Habitat Database

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Provide suitable habitat for beaver where they were historically found. S: Inventory existing and potential beaver habitat. S: Create optimal habitat (see assessment).	Overall Loss of Riparian Vegetation Fragmentation of Habitat Reduction in Mean Annual Floodplain Acreage	Throughout Rock Creek watershed, in appropriate habitat Oregon: Identify and prioritize key areas for strategy application		F
O: Restore beaver populations to historical levels. S: Reintroduce beaver where/when appropriate.		Throughout Rock Creek watershed, in appropriate habitat. Oregon: Identify and prioritize key areas for strategy application		F

Lewis' Woodpecker

Table 44 Objectives and strategies for Interior Riparian Wetlands—Lewis' Woodpecker

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R= Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
		L = Local Residential Information	**H = Habitat Database**

Target Objectives and Strategies	**Associated Limiting Factor**	**Tier Rankings by Geographical Areas**		**Source**
		Primary	**Secondary**	
O: Increase quantity and quality of habitat for Lewis' woodpecker. O: Restore Lewis' woodpecker population numbers to historic levels. S: Inventory existing and potential Lewis' woodpecker habitat. S: Create optimal habitat (see assessment).	Reduction in Floodplain Acreage Fragmentation of Habitat Overall Loss of Riparian Vegetation	Washington: Identify and prioritize key areas for stragegy application	Oregon: Identify and prioritize key areas for strategy application	I,R
O: Reduce mortality of food base (insects), needed by yellow warblers, from chemical applications. S: Use alternative control measures for undesirable species in riparian buffers, especially in areas used by yellow warbler.	Reduced Food Base	Washington: Identify and prioritize key areas for stragegy application	Oregon: Identify and prioritize key areas for strategy application	I

8.2.3 Shrub Steppe/Interior Grasslands Habitat Objectives and Strategies

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Table 45 Wildlife objectives and strategies for Shrub Steppe/Interior Grasslands Habitat

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**RL= Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
		L = Local Residential Information	**H = Habitat Database**

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	**Secondary**	
O: Protect remaining deep-soil shrub steppe sites S: Use lease, easement or purchase practices to protect high quality areas from land-use conversion	Loss of Shrub Steppe /Grassland Habitat	Areas throughout southern half of Rock Creek watershed Gilliam and Sherman counties		B
O: Restore habitats that provide the function attributes of shrub steppe and grasslands. S: Augment or support conservation oriented farm programs (e.g., CRP; BiOp RMS in Oregon).	Loss of Shrub Steppe /Grassland Habitat	Areas throughout southern half of Rock Creek watershed. Gilliam and Sherman counties		B

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Limit expansion of invasive non-native plants and reduce occurrence. O: Restore native plant communities. S: Reduce sources of introduction of non-native seed. S: Continue and enhance shrub steppe/grassland weed control programs, for early identification and to remedy localized heavy infestations.	Displacement of Native Vegetation with Non-Native Vegetation	Washington and Oregon: Identify and prioritize key areas for strategy application in subbasin		I
O: Restore more natural fire cycles to increase mean age class of shrub steppe and restore areas of complete shrub loss where it has been altered by fire. S: Suppress fire by fighting wildfires. S: Reduce amounts of cheatgrass.	Reduction in Age Class, or Complete Loss, of Shrub Steppe Vegetation	Washington and Oregon: Identify and prioritize key areas for strategy application in subbasin		I
O: In areas of inappropriate grazing, improve vegetation and microbiotic crusts. S: Encourage and support Coordinated Resource management Programs (e.g., CRP; BiOp RMS). S: Avoid inappropriate grazing of livestock through rotational grazing regimes. S: Use proper grazing to reduce sagebrush cover to natural cover %ages where excessive.	Loss of Habitat Quality	Squaw Creek 1, Luna Gulch, other unidentified areas in Washington Gilliam and Sherman counties		L, I
O: Maintain current ephemeral wetlands in natural condition and where possible restore disturbed areas to natural function. S: Create inventory of historical and current locations of ephemeral wetlands. S: Augment or support conservation oriented	Loss of Ephemeral Wetlands	Washington: Identify and prioritize key areas for strategy application in the subbasin	Oregon: Identify and prioritize key areas for strategy application in the subbasin	I

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
farm programs (e.g., CRP).				
O: Reduce off road vehicle damage in high trespass areas. S: Remove access of off road vehicles to sensitive areas and enforce closures. S: Create public education programs.	Vegetation and Soil Damage	Upper Luna Gulch, Quartz Creek 1 and 2.		L

8.2.4 Shrub Steppe/Interior Grasslands Focal Species (Mule Deer, Grasshopper Sparrow, and Brewer's Sparrow

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Mule/Black-Tailed Deer

Table 46 Objectives and strategies for Shrub Steppe/Interior Grasslands Habitat -- Mule/Black-Tailed Deer

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
	F=From Fish Data	**L = Local Residential Information**	**H = Habitat Database**

Target Objectives and Strategies	**Associated Limiting Factor**	**Tier Rankings by Geographical Areas**		**Source**
		Primary	**Secondary**	
O: Provide quality habitat for deer. S: Augment or support conservation oriented farm programs (e.g., CRP). S: Fire suppression by fighting wildfires. S: Reduce amounts of cheatgrass. S: Use fire, along with understory thinning, to enhance forage in woodland/grassland transition zones.	Loss of Shrub Steppe Habitat Within Winter Range Reduction in Age Class, or Complete Loss, of Shrub Steppe Vegetation	Washington and Oregon: Identify and prioritize key areas for strategy application in the subbasin	Oregon: Identify and prioritize areas for strategy application	I
O: Limit inappropriate mortality from hunting. S: Continue responsible hunting management practices in subbasin.	Hunting Mortality	Throughout Rock Creek		R

Grasshopper Sparrow

Table 47 Objectives and strategies for Shrub Steppe/Interior Grasslands Habitat -- Grasshopper Sparrow

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**F = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
	F = From Fish Data	**L = Local Residential Information**	**H = Habitat Database**

Target Objectives and Strategies	**Associated Limiting Factor**	**Tier Rankings by Geographical Areas**		**Source**
		Primary	**Secondary**	
O: Increase quantity of habitat for grasshopper sparrow. S: Inventory existing and potential grasshopper sparrow habitat. S: Augment or support conservation oriented farm programs (e.g., CRP).	Loss of Grassland Habitat within Breeding Range	Washington: Identify and prioritize important areas for strategy application Oregon: Identify and prioritize key areas for strategy application in the subbasin		I
O: Increase quality habitat for grasshopper sparrow. O: Create habitats that provide the functional	Loss of Grassland Habitat Quality Displacement of Native	Washington: Identify and prioritize important areas for strategy application		I,R

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
attributes of grasslands. S: Create / retain optimal habitat for the species (see assessment). S: Use proper grazing to reduce sagebrush cover to natural cover percentages where excessive. S: Augment or support shrub steppe / grassland weed control programs.	Vegetation with Non-Native Vegetation	Oregon: Identify and prioritize key areas for strategy application in the subbasin		

Brewer's Sparrow

Table 48 Objectives and strategies for Shrub Steppe/Interior Grasslands Habitat -- Brewer's Sparrow

TIER DEFINITIONS	Project or Actions:	Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	O = Objective	FO = Field Observation	R = Research Literature
	S = Strategy	B = Best Professional Judgment	I = Information Needed
	F = From Fish Data	L = Local Residential Information	H = Habitat Database

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Increase quantity of habitat for Brewer's sparrow. O: Restore Brewer's sparrow population numbers to historic levels. S: Inventory existing and potential Brewer's sparrow habitat. S: Augment or support conservation oriented farm programs (e.g., CRP). S: Use lease, easement or purchase practices to protect high quality areas from land-use conversion.	Loss of Shrub Steppe Habitat within Breeding Habitat	Washington: Identify and prioritize key areas for strategy application in the subbasin	Oregon: Identify and prioritize key areas for strategy application in the subbasin	I
O: Increase quality of habitat for Brewer's sparrow. O: Lengthen fire cycles and reduce loss of Brewer's sparrow habitat by catastrophic fire. S: Avoid inappropriate grazing of livestock through rotational grazing regimes. S: Augment or support shrub steppe/grassland weed control programs. S: Fire suppression by fighting wildfires. S: Reduce amounts of cheatgrass.	Loss of Shrub Steppe Habitat Quality Displacement of Native Vegetation with Non-Native Vegetation	Washington: Identify and prioritize key areas for strategy application in the subbasin	Oregon: Identify and prioritize key areas for strategy application in the subbasin	I,R

8.2.5 Ponderosa Pine/Oregon White Oak Habitat Objectives and Strategies

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Table 49 Wildlife objectives and strategies for Ponderosa Pine/Oregon White Oak Habitat

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
	F = From Fish Data	**L = Local Residential Information**	**H = Habitat Database**

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Increase average dbh and decrease understory density. S: Encourage silviculture practices that retain large diameter trees and reduce understory density.	Reduction of Large Diameter Trees and Snags	Throughout upper Rock Creek watershed, data gaps		I
O: Retain late seral stands and large decadent trees. S: Create/implement guidelines to retain specified number of large diameter, decadent live trees.	Reduction of Large Diameter Trees and Snags	Throughout upper Rock Creek watershed, data gaps		I

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Decrease stand density of ponderosa pine. O: Decrease stem density of ponderosa pine. S: Reduce fuel loads through forestry practices. S: Reintroduce low intensity, controlled, site-specific fires. S: Manage grazing and forest practices that mimic fire, when necessary.	Increased Stand Density and Decreased Average Tree Diameter	Upper Rock Creek watershed, data gaps		I
O: Retain existing tracts of late seral forests and reduce future fragmentation. S: Continuation of conservation oriented programs on small private land holdings. S: Use lease, easement or purchase practices to conserve remaining intact pine/oak forests.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Upper Rock Creek watershed, data gaps.		I
O: Reduce non-native species presence and reestablish native plant communities. S: Site-specific grazing management plans for habitat improvement, including reduction of non-native species and reestablishment of native species.	Loss of Native Understory Vegetation and Composition	Washington: Identify and prioritize key areas for strategy application in the subbasin		I

8.2.6 Ponderosa Pine/Oregon White Oak Focal Species (Western Gray Squirrel and White-Headed Woodpecker)

Biological Objectives and Strategies and Tier Rankings by Geographical Areas

Western Gray Squirrel

Table 50 Objectives and strategies for Ponderosa Pine/Oregon White Oak Habitat -- Western Gray Squirrel

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
	F=From Fish Data	**L = Local Residential Information**	**H = Habitat Database**

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
O: Increase quantity of western gray squirrel habitat. S: Increase compliance with forest guidelines for western gray squirrels. S: Retain remaining large, unfragmented tracts of western gray squirrel habitat.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Washington: Identify and prioritize key areas for strategy application in the subbasin		I
O: Increase quality of western gray squirrel habitat. S: Use site-specific fire prescriptions to enhance potential and used western gray	Increased Stand Density and Decreased Average Tree Diameter Loss of Native Understory	Washington: Identify and prioritize key areas for strategy application in the subbasin		I,R

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
squirrel habitat. S: Create site-specific grazing management plans for habitat improvement, including reduction of non-native species and reestablishment of native species. S: Create/retain optimal habitat (see assessment).	Vegetation and Composition			
O: Retain decadent and other important wildlife trees. S: Encourage woodcutting to be used as a tool for thinning overstocked areas. S: Create public education programs.	Loss of Individual, Late Seral Trees (From Woodcutting)	Washington: Identify and prioritize key areas for strategy application in the subbasin		I
O: Reduce pressure to western gray squirrels from California ground squirrels. S: Create programs to control non-native wildlife and other non-historical species. S: Create public education programs.	Increased Competition with Western Gray Squirrels	Washington: Identify and prioritize key areas for strategy application in the subbasin		I,R

White-Headed Woodpecker

Table 51 Objectives and strategies for Ponderosa Pine/Oregon White Oak Habitat -- White-Headed Woodpecker

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective.**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.	
CODES:	**O = Objective**	**FO = Field Observation**	**R = Research Literature**
	S = Strategy	**B = Best Professional Judgment**	**I = Information Needed**
		L = Local Residential Information	**H = Habitat Database**

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	**Secondary**	
O: Increase quantity of white-headed woodpecker habitat. S: Retain remaining large, unfragmented tracts of white-headed woodpecker habitat.	Loss of Large Tracts of Old Growth, or Late Seral Forests	Throughout upper Rock Creek watershed, data gaps		I
O: Increase quality of white-headed woodpecker habitat. S: Increase number of snags and snag recruitment in white-headed woodpecker habitat (review assessment for guidelines on optimal number and diameter of snags needed). S: Use site-specific fire prescriptions to enhance potential and used white-headed woodpecker habitat. S: Create/retain optimal habitat (see	Reduction of Large Diameter Trees and Snags Increased Stand Density and Decreased Average Tree Diameter	Throughout upper Rock Creek watershed, data gaps		I,R

Target Objectives and Strategies	Associated Limiting Factor	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
assessment).				
O: Retain decadent and other important wildlife trees. S: Encourage woodcutting to be used as a tool for thinning overstocked areas. S: Create public education programs.	Loss of Individual, Late Seral Trees (From Woodcutting)	Washington: Identify and prioritize key areas for strategy application in the subbasin		I

8.3 Fish

8.3.1 Mainstem Objectives and Strategies: Steelhead, Coho, Fall Chinook

Table 52 Mainstem Objectives, Strategies and Associated Findings by Tier Rankings: Steelhead, Coho, Fall Chinook

Target Objective and Strategy	Associated Key Finding	Tier Rankings* by Geographical Areas	
		Primary	Secondary
Rebuild and maintain healthy steelhead populations. Rebuild ESA-listed upriver steelhead stocks to levels that support increased fishing opportunities.	Steelhead use the subbasin primarily as a migration corridor from upstream spawning areas to the ocean. Upriver steelhead are a mix of hatchery and wild stocks. Naturally spawning steelhead are returning below escapement objectives.		Subbasin mainstem
Restore coho populations.	Coho use the subbasin primarily as a migration corridor from upstream spawning areas to the ocean. Although indigenous to upstream tributary areas, most of the coho currently migrating through the subbasin are the product of hatchery outplantings. Coho remain historic levels in the upper basin.		Subbasin mainstem
Rebuild and maintain healthy fall chinook populations. Rebuild ESA-listed Snake River fall chinook to levels that support increased fishing opportunities	Fall chinook use the subbasin mainstem primarily as a migration corridor from upstream spawning areas; Hanford Reach and the Snake River are the two main spawning areas. Hanford population consistently exceeds escapement objectives. Snake River escapement underdevelopment, but population remains below desired levels.		Subbasin mainstem
Make continued progress toward tribal goals to halt declining trends in salmon populations, including steelhead, coho, and fall chinook, to naturally sustainable levels that also support tribal harvest opportunities. Make progress toward protecting and rebuilding ESA-listed steelhead and fall chinook.	The subbasin's mainstem area is an important part of four tribes' treaty-guaranteed traditional fishing areas. Rights to the fish passing here have been repeated upheld in *U.S. v. Oregon*. Upriver steelhead stocks and Snake River fall chinook populations using this mainstem subbasin are listed for protection under the Endangered Species Act.		Subbasin mainstem

Target Objective and Strategy	Associated Key Finding	Tier Rankings* by Geographical Areas	
		Primary	Secondary
Improve juvenile passage conditions at The Dalles, John Day and McNary dams though water management actions, including extending summer spill	The construction of the hydropower system turned the river into a series of reservoirs, which has greatly extended the juvenile migration period. Juvenile steelhead migrate through the area throughout the spring and early summer; juvenile coho in the spring; and fall chinook in late spring and late summer.	All three dams and reservoirs	
Restore normative hydrograph will improve migration conditions.	Reduced travel time will improve survival and subsequent adult returns. Flow augmentation can increase water velocities. Alternative flood control strategies can helpful recapture the historical timing of flow. Increased spill diverts fish from the turbines and increases survival.	All three dams and reservoirs	
Investigate the efficacy of the planned installation of removable spillway weirs to aid in directing migrants to safer passage routes.	The technology is new and has being tested only at Lower Granite Dam. Not all dams and reservoirs have the same passage conditions.		At dams with weirs and those where proposed
Improve adult passage conditions by restoring features of the normative hydrographs to improve migration conditions.	Altered hydrologic conditions affect adult migrating salmon survival. Enhanced migration survival should contribute to increased adult returns. Adult steelhead actively migrate through the subbasin from March to October; adult coho migrate in September and October; adult fall chinook from August to October.	McNary Dam	The Dalles and John Day dams
Develop a temperature TMDL for the subbasin and implement specific actions to reduce exposure to elevated water temperatures	Prolonged exposure to elevated water temperatures is stressful for upstream migrants. Steelhead are thought to seek cold water refuges, including tributary mouths.		Subbasin mainstem
Monitor fishways regularly at the dams for compliance with adult fish passage criteria	When monitored, adult fish passage perfomance criteria are often not in compliance.	The Dalles, John Day, and McNary dams	
Identify and correct adult steelhead fallback conditions at dams.	Adult steelhead fallback at dams.	McNary Dam	The Dalles, John Day dams
Continue research on kelt reconditioning to identify conditions that improve survival	Steelhead kelts migrate back to the ocean after spawning. Collecting and reconditioning the kelts improves the chances of repeat spawning.	McNary Dam	

Target Objective and Strategy	Associated Key Finding	Tier Rankings* by Geographical Areas	
		Primary	Secondary
Improve water quality by reducing exposure to contaminants.	Contaminants input from upstream land-use activities are often trapped in the reservoirs behind dams. Dredging suspends contaminants accumulated in sediments. Dredging can also lead to direct mortalities of juveniles (and adults).		Subbasin mainstem
Eliminate dredging.	Same as above		Subbasin mainstem
Identify contaminants in the sediment and water and the effects of the contaminants on salmon	Same as above	Subbasin mainstem	
Develop TMDLs for contaminants, including identifying remedial actions.	Same as above		Subbasin mainstem
Minimize juvenile stranding; start by identifying areas vulnerable to stranding	Rapid changes in reservoir levels can isolate or dewater rearing areas and lead to juvenile mortalities. Reservoir levels in The Dalles Pool can change several feet in one day.		The Dalles, John Day, and McNary reservoirs
Protect rearing habitat.	Juveniles can be entrained into irrigation pumps. Irrigation withdrawals can affect water quantity and contribute to potential stranding of juveniles.		Subbasin mainstem
Determine abundance, distribution, and habitat use of rearing juveniles	The information on the mainstem subbasin's rearing habitat is incomplete.	Subbasin mainstem	
Screen all irrigation pumps	Juveniles can be entrained into irrigation pumps. Irrigation withdrawals can affect water quantity and contribute to potential stranding of rearing juveniles.	Data gap? Learn extent of current compliance	Subbasin mainstem
Enact a moratorium on additional mainstem water withdrawals and quantify the effects of irrigation withdrawals	Same as above		Subbasin mainstem

Target Objective and Strategy	Associated Key Finding	Tier Rankings* by Geographical Areas	
		Primary	Secondary
Remove lost fishing gear by identifying locations of lost gear removing it; quantify the impact of lost fishing gear	Commercial and recreational fisheries occur in the subbasin. Commercial gillnets used in The Dalles and John Day pools may break free and get lost. Under certain conditions the lost gear will continue to trap fish.		The Dalles and John Day reservoirs
Predation		Subbasin mainstem	
Less reliance on peak flows		The Dalles, John Day, and McNary dams and reservoirs	

TIER DEFINITIONS: Project or Actions: **Primary** - Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective; **Secondary** - Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.

8.3.2 Mainstem Objectives and Strategies: White Sturgeon

Table 53 Mainstem Objectives, Strategies and Associated Findings by Tier Rankings: White Sturgeon

Key Finding	Cause/Working Hypothesis	Confidence Effect Actually Occurring	Level of Confidence in Causal Relationship	Relative Contribution to Causal Relationship	Biological Objective (Reduce/Eliminate Negative Causes, Improve/Maintain Positive Causes)	Strategy to Reduce/Eliminate or Improve/Maintain
Spawning occurs in the mainstem but can be limited by hydrograph and water temperatures	Modification of the historic hydrograph due to dam operation can result in peak flows that do not coincide with optimal spawning temperatures and can result in year class failure	High	High	High	Increase spawning success of white sturgeon in the LMM Columbia River	Operate hydrosystem so that peak flows occur when water temperature is suitable for white sturgeon spawning
Impounded WS populations incur periodic year-class failures	Inadequate spawning ground water velocities, lack of multi-day uniformity in flow, turbulence, and turbidity produce year class failures	High	High	High	Increase first-year survival of naturally spawned WS in the LMM Columbia River	Operate hydrosystem for multi-day uniform peak flow (no excessive hourly or daily variation) when water temperature is suitable for white sturgeon spawning
Egg, larval stage, and YOY WS are susceptible to predation	Indigenous and introduced predators cause mortality in pre-juvenile white sturgeon	High	High	High	Reduce predation in LMM Columbia River, especially on egg and larval stage WS, but also sub-yearling WS	Develop predator control studies for the LMM Columbia River. Identify predator population densities and dynamics. Develop experimental predator removal programs. Establish predator removal M&E including predator population exploitation, WS egg, larvae, and YOY consumption rates, and pre-yearling WS survival rates.
Impounded WS populations are less productive than the unimpounded lower Columbia	Construction and operation of Mainstem hydroelectric dams has reduced WS population productivity especially in The Dalles and John Day	High	High	High	Restore LMM Columbia River population abundance and productivity	Supplement less productive impounded WS populations through capture of juvenile WS from below Bonneville Dam and transporting them into The Dalles and John Day reservoirs to compensate for year

Key Finding	Cause/Working Hypothesis	Confidence Effect Actually Occurring	Level of Confidence in Causal Relationship	Relative Contribution to Causal Relationship	Biological Objective (Reduce/Eliminate Negative Causes, Improve/Maintain Positive Causes)	Strategy to Reduce/Eliminate or Improve/Maintain
River population	pools					class failures.
The health of WS populations show up in density, condition factor, reproductive potential, age structure, and fish growth rates	Construction and operation of Mainstem hydroelectric dams has reduced or eliminated WS population productivity resulting in reduced or negated sustainable WS harvest	High	High	High	Restore LMM Columbia River population abundance and productivity to levels that can sustain reasonable harvest	Identify the need for and evaluate the success of LMM WS population recovery activities. Sustainable tribal and sport harvest is dependent upon periodic population status updates. Expand the periodic stock assessment program into McNary pool, the Hanford Reach, and into Priest Rapids Pool.
Reservoir specific intensive harvest management can influence WS abundance levels	Population over harvest has been mitigated by WDFW, ODFW, and CRITFC through many years of adapted reservoir specific harvest management involving in-season harvest monitoring linked to periodic population assessment and harvest regulation modeling	Medium	Medium	Medium	Increase LMM Columbia River WS populations to levels supporting reasonable harvest opportunities	Continue to monitor harvest levels and adjust fishing regulations as necessary between Bonneville and McNary Dams. Expand annual angler survey program to McNary pool, the Hanford Reach, and eventually to Priest Rapids Pool .
Hatchery technology has progressed and it may be possible to supplement white sturgeon populations in the LMM		Medium	Medium		Increase white sturgeon population abundance in the LMM Columbia River, especially the population in Priest Rapids Pool which is likely dying out	Continue to develop hatchery technology and methodologies and supplement the white sturgeon population in Priest Rapids Pool with hatchery fish. Consider using hatchery fish to supplement The Dalles and John Day WS populations.
White sturgeon populations are fragmented,	Construction of Mainstem hydroelectric dams has caused fragmentation of	High	High	High	Reduce fragmentation of white sturgeon population	Improve upstream passage. Improve spawning success in upstream reservoirs.

Key Finding	Cause/Working Hypothesis	Confidence Effect Actually Occurring	Level of Confidence in Causal Relationship	Relative Contribution to Causal Relationship	Biological Objective (Reduce/Eliminate Negative Causes, Improve/Maintain Positive Causes)	Strategy to Reduce/Eliminate or Improve/Maintain
there is little passage upstream but some downstream passage	sturgeon population					Capture and transport sturgeon from downstream to upstream reservoirs.
There is thought to be a net downstream displacement of sturgeon from upstream reservoirs	There is little upstream passage through fish ladders at mainstem projects.	Medium	Medium		Increase white sturgeon population abundance in the LMM Columbia River	Research possible improvements to fish ladders to allow upstream passage of juveniles.

8.3.3 Mainstem Objectives and Strategies: Pacific Lamprey

Table 54 Mainstem Objectives, Strategies and Associated Findings by Tier Rankings: Pacific Lamprey

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas	
		Primary	Secondary
Restore Pacific lamprey populations. Attain self-sustaining natural production of Pacific lamprey that provides for fishing opportunities at traditional locations.	Recent counts of Pacific lamprey at The Dalles, John Day and McNary dams indicate a serious decline in abundance. Pacific lamprey serve an important role in the ecological function of the area by contributing to nutrient budgets and transporting marine nutrients to freshwater systems. Pacific lamprey are important part of the natural food web. Pacific lamprey are an important tribal cultural food source. Low abundances preclude fishing opportunities in upstream tributaries.		Subbasin mainstem
Make continued progress toward tribal goals to halt declining trends in Pacific lamprey; increase to naturally sustainable levels that also support tribal harvest opportunities.	The subbasin's mainstem area is an important part of four tribes' treaty-guaranteed traditional fishing areas. Rights to the fish passing here have been repeated upheld in *U.S. v. Oregon*. Pacific lamprey have been petitioned for designation under the Endangered Species Act.		
Improve adult passage at dams.	Adult fishways are difficult for lamprey to negotiate. Research indicates that rounding corners and alternative substrates improves passage efficiency.	The Dalles, John Day, and McNary dams	
Investigate auxiliary passage systems, similar to those being researched at Bonneville Dam.	Same as above and alternative passage routes may be more effective.		The Dalles, John Day, and McNary dams
Identify areas and make improvements in juvenile passage that do not conflict with salmonid passage needs.	Juvenile lamprey suffer from high impingement rates on bypass screens because they are relatively poor swimmers. John Day Dam, in particular, impinges large numbers of lamprey.		The Dalles, John Day, and McNary dams
Identify contaminants and the effects on lamprey	Contaminants input from upstream land-use activities are often trapped in the reservoirs behind dams. Dredging suspends contaminants accumulated in sediments. Dredging can also lead to direct mortalities. Dredging should be minimized and limited to periods outside of the active migration period.		The Dalles, John Day, and McNary dams and reservoirs
Reduce exposure to contaminants	Same as above		The Dalles, John Day, and McNary dams and reservoirs

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas	
		Primary	Secondary
Minimize stranding.	Rapid changes in reservoir levels can isolate or dewater rearing areas and lead to mortalities of juveniles. Reservoir levels in The Dalles Pool can change several feet in one day.		The Dalles, John Day, and McNary reservoirs
Identify areas vulnerable to stranding.	Data gap. Important to know where stranding occurs.		The Dalles, John Day, and McNary reservoirs
Determine abundance, distribution, and habitat use of rearing juveniles	Data gap. Essential for efforts to restore Pacific lamprey.	The Dalles, John Day, and McNary reservoirs	

TIER DEFINITIONS: Project or Actions: **Primary** - Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective; **Secondary** - Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.

8.3.4 Rock Creek Objectives and Strategies

Table 55 Rock Creek Objectives, Strategies and Associated Findings by Tier Rankings

TIER DEFINITIONS	**Project or Actions:**	**Primary-- Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective**	
		Secondary-- Not able to be implemented in next 5 years and/or less certainty of achieving biological objective	
	Assessments (Data Gaps, M&E):	**Primary-- Able to be implemented within next 5 years and addresses critical uncertainties and/or assumptions**	
		Secondary-- Not able to be implemented in the next 5 years and/or addresses less immediately critical uncertainties and/or assumptions	
SOURCE CODES:	**S= Subbasin Summary**	**FO= Field Observation**	**B= Best Professional Judgement**
	RL= Research Literature	**O= Orthophoto Interpretation**	

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
Evaluate genetics of Rock Creek steelhead	Hatchery Fish compete with Natural Origin fish for space and food resources; clipped fish morts have been observed in lower river in very low numbers; competition with natural origin fish	Throughout Watershed		RL
Support Corps studies of fish passage at mainstem Columbia dams. Evaluate habitat conditions for survival in the mainstem Columbia habitat.	Survival of steelhead kelts (mature spawned out fish with the potential to spawn again) migrating out of the Rock Creek watershed and through the mainstem Columbia to the ocean is believed to be at or near zero.		Out of basin effect	RL

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
Increase kelt survival and repeat spawner success. Increase steelhead productivity.	Capture, rehabilitation, and release of these fish in the Rock Creek watershed increases survival and could act as a source of broodstock/genetic material for reintroduction efforts	Rock Creek 2		RL
Fund Kelt reconditioning in Rock Creek. Determine breeding success of Kelts.	Same as above	Rock Creek 2 for faciliities.		RL
Restore/supplement fish populations such that escapement is sufficient in number to provide adequate carcasses.	Food availability decreased by lack of nutrient transport/carcasses; Carcasses of anadromous fish were critical components of the inland food web, supplying ocean-derived food and energy to the watershed, greatly increasing aquatic, riparian, and upland ecosystem productivity.	Throughout Watershed, excluding lower miles of Rock Creek 2		RL
Fertilize streams with artificial carcasses	Same as above		Throughout watershed, excluding Rock Creek 2	RL
Increase floodplain and channel roughness	Road, timber, and grazing management activities have lead to increased sediment supply from incoming tributaries	Throughout watershed excluding Secondary tier reaches	Rock Creek 6, Quartz Creek 1, Quartz Creek 2, Box Canyon	F, S, RL
	Summer/Early Fall Habitat availability lower in comparison with pre-settlement environment			S, B,
	Hydrologic routing in watershed has been modified; Land use management activities have modified flow timing and discharge			S, B, RL
	Rock Creek Road and other infrastructure in watershed have altered floodplain , confined river and tributaries			S, B, F, O
Reconnect side channels	Same as above	Rock Creek 2, Rock Creek 3		S, F ,B, O

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
Improve floodplain connectivity	Same as above	Rock Creek 2, Rock Creek 3, Rock Creek 4,Rock Creek 5, Luna Gulch, Squaw Creek 1		S, F, B, O
Relocate floodplain infrastructure, roads; improve maintenance, rehabilitate, decommission as approriate	Same as above	Rock Creek 2, Rock Creek 3, Rock Creek 4	Upper Watershed Roads	F, B, O
Re-establish and/or enhance native vegetation on floodplain	Same as above	Rock Creek 2, Rock Creek 3, Rock Creek 4,, Luna Gulch, Squaw Creek 1, Squaw Creek 2, Badger Gulch,	Rock Creek 5, Squaw Creek 2, Badger Gulch,	S, F, B, O
Implement appropriate practices which leave sources of Large Woody Debris to naturally enter and remain in the system		Throughout watershed, excluding Rock Creek 6, Quartz Creek 1 and 2, Box Canyon		S, F, B, O
Artificially introduce Large Woody Debris		Rock Creek 2, Rock Creek 3, Rock Creek 4	Luna Gulch, Squaw Creek 1,	F, B, O
Inventory existing and potential beaver habitat, include reintroduction of beaver into restoration actions.	Reduction of habitat, conflict with water infrastructure results in removal of dams and beavers, current trapping and historic population reduction and fragmentation. Other effects: Loss of fine sediment storage capacity, beaver dams also created grade control structures which resulted in off channel habitat and increased channel stability and maintained channel planform	Throughout watershed		S Rl, B, F
Encourage beaver colonization	Same as above.	Throughout watershed		S, F, B

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
Study presence of pathogens in juveniles and adults during high temperatures.	High Temperatures have resulted in increased susceptibility of native salmonids to pathogens.		Rock Creek 2, Rock Creek 3, Rock Creek 4, Rock Creek 5, Luna Gulch, Squaw Creek 1 and 2, Badger Gulch	RL, F, B
Explicitly include desired carcass numbers within escapement goals to benefit ecosystem processes in population/harvest management decisions.	Carcasses of anadromous fish were critical components of the inland food web, supplying ocean-derived food and energy to the watershed, greatly increasing aquatic, riparian, and upland ecosystem productivity.	Primary Policy Consideration		RIL, B
Study/Characterize productivity in relation to water quality parameters.	Fluctuations in water quality parameters have reduced native aquatic vegetation and faunal (insect, zooplankton, vertebrates) communities and productivity	Throughout watershed		S, RL, F, B
Study and assess sources/attribute relative contributions of fine sediment.	Same as above.	Luna Gulch, Squaw Creek, Badger Gulch, Quartz Creek, Box Canyon, Rock Creek 6, Rock Creek 2		S, F, B,
Implement off road vehicle management actions that reduce fine sediment inputs.	Same as above.		Upper Quartz, Box Canyon	F, B
Implement road management actions that reduce fine sediment inputs.	Same as above.	Throughout watershed		S, RL, F, B
Implement upland management practices that mimic natural runoff and sediment production.	Same as above.	Throughout watershed		RI, S
Assess significance of predation by native birds	Loss of abundance of native salmonids has resulted in a greater proportional impact from native predation	Common need throughout Assessment Unit		RI, B

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas		Source
		Primary	Secondary	
Study specific habitat relationships for Pacific lamprey.	Poor passage for anadromous forms through the mainstem Columbia River (and possibly in the Subbasin) have severed life history pathways and reduced population abundance, productivity and spatial diversity.	Rock Creek 2, Rock Creek 3, Rock Creek 4, Squaw Creek 1, Luna Gulch		RL, B
	Changes in habitat conditions and reduction in salmon populations within the subbasin have reduced habitat suitability and reduced abundance, productivity and life history diversity. Improvement in habitat conditions for salmonids will improve lamprey populations as well.			
Implement habitat restoration actions for pacific lamprey.	Same as above.		Lower Watershed	RI, B

8.3.5 Fulton Canyon and Spanish Hollow Objectives and Strategies

Table 56 Fulton Canyon and Spanish Hollow Objectives, Strategies and Associated Findings by Tier Rankings

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas	
		Primary	Secondary
Implement Dry Cropland or Range and Pastureland Resource Management Systems (RMS) in Gilliam and Sherman counties in conjunction with the Natural Resources Conservation Service (NRCS) as per the April 2004 Biological Opinion. (All but the last two strategies relate to the proscribed RMS.)	Agricultural and rangeland practices have contributed to the decline in steelhead and other anadromous species in Fulton Canyon and Spanish Hollow watersheds/	Gilliam and Sherman counties	
Restore historical hydrologic regime and increase extent and distribution of perennial habitat	Groundwater withdrawals lower base flows, decreasing perennial flow area	Entire Assessment Unit (Fulton Canyon and Spanish Hollow watersheds) or e.g., Mud Hollow, lower 5 miles of Fulton Canyon, etc.	
	Historic data suggests loss of wetland structure	?	
	Increased peak runoff	?	
Study and monitor groundwater withdrawals in area	Same as above	Entire Assessment Unit	
Study and evaluate sources and attribute relative sources of fine sediment	Land and water uses caused watershed-level changes in vegetation cover, soil quality and disposition (erosion), gully development, stream channel instability, and water quality.	?	
	Fluctuations in water quality parameters have reduced native aquatic vegetation and faunal (insect, zooplankton, vertebrates) communities and productivity	?	
Study/characterize productivity in relation to water quality parameters	Same as above		

Target Strategy or Objective	Associated Key Finding	Tier Rankings by Geographical Areas	
		Primary	Secondary
Reduce temperatures to near pre-settlement conditions	Reduction in summer low flow and loss of riparian vegetation	?	
Conduct spawning surveys or?	Historical data suggests abundance is far below pre-development era	Entire Assessment Unit	
Restore steelhead population abundance, productivity and spatial distribution to sustainable levels	Steelhead populations have been dramatically reduced from pre-settlement abundance levels because of habitat degradation and alterations		Entire Assessment Unit
Support Corps studies of fish passage at mainstem Columbia dams and evaluate other habitat conditions for improved survival in mainstem Columbia habitat	Many juvenile and some adult anadromous fish are killed by migatrory conditions created dams and reservoirs		Out of basin effect
Support efforts to reduce predator population levels in mainstem Columbia	Increased habitat for native and non-native predators in Columbia mainstem leads to increased predator populations in lower tributary areas		Out of basin effect

TIER DEFINITIONS: Project or Actions: Primary - Able to be implemented within next 5 years and addresses significant limiting factors; high likelihood of achieving biological objective; Secondary - Not able to be implemented in next 5 years and/or less certainty of achieving biological objective.

8.4 Monitoring, Evaluation and Adaptive Management

Monitoring and evaluation efforts in this subbasin have been minimal to date. The following guidelines extracted from the Washington State Salmon Recovery Funding Board will be used when preparing project proposals in the future unless project proponents have a specific reason for changing the monitoring and evaluation criteria.

The Monitoring and Evaluation Strategy For Habitat Restoration documents published by the Washington Salmon Recovery Funding Board (SRFB) can be found at http://www.iac.wa.gov/srfb.

The following project types are addressed by this subbasin monitoring and evaluation plan:

- Fish passage projects
- Instream structure projects
- Riparian vegetation restoration projects
- Livestock exclusion projects
- Constrained channel projects
- Channel connectivity projects
- Spawning gravel projects
- Habitat protection projects at the parcel scale

8.4.1 Fish Passage Projects

The objective for fish passage projects is to increase access to areas blocked by human-cause impediments.

Types of Fish Passage Projects

Bridge projects, culvert improvements, small dam removals, debris removals, diversion dam passage, fishway construction, weirs, and water management projects.

Monitoring Goal

Determine whether fish passage projects are effective in restoring upstream passage to targeted fish species.

Questions to be answered:

- Have the engineered fish passage projects continued to meet design criteria post-project for at least five years?
- Have fish passage projects as an aggregate demonstrated increased abundance of target species post-project within five years?

Objectives

Before Project Objectives (year 0)

Project managers determine the proper design criteria for meeting the fish passage objectives for the project. Determine fish abundance both in the downstream control reach and impact reach upstream of the fish blockage for the sampled projects.

After Project Objectives (Years 1, 2, and 5)

Determine whether fish passage design criteria are being met at each project monitored. Determine salmon abundance both in the downstream control reach and impact reach upstream of the fish blockage for each project.

Response Indicators

- Design criteria: Project design criteria taken from construction blueprints or pre-project plan.
- Abundance: Salmon abundance can be determined using both adult spawner and redd counts and juvenile counts. Adult estimating procedures are found in SRFB Protocol 9. Juvenile estimating procedures are found in SRFB Protocols 7 and 8. The least intrusive monitoring protocol should be used whenever possible. Impact areas will be compared to the controls and to controls and impacts on other streams as well. The metrics used will be numbers per square meter for juveniles and number per kilometer or redds per kilometer for adults depending upon the target species.

8.4.2 Instream Structure Projects

Types Of Instream Structure Projects

Channel reconfiguration, installed deflectors, log and rock control weirs, roughened channels, and woody debris.

The objective for instream projects is to increase instream cover, spawning, and resting areas by constructing artificial instream structures. The basic assumption is creating more diverse pools, riffles, and hiding cover will result in an increase in local fish abundance.

Monitoring Goal

Determine if projects that place artificial instream structures (AIS) into streams are effective in improving stream morphology and increasing local fish abundance in the treated area at the stream reach level.

Questions to be answered:

- Have AIS as designed remained in the stream for up to ten years for the sampled instream structure projects?
- Has stream morphology improved significantly in the treated stream reach for the sampled instream structure projects within ten years?
- Has salmon abundance increased significantly in the impact area for the sampled instream structure projects within ten years?

Objectives

Before Project Objectives (Year 0)

Determine the Thalweg profile in the impact and control areas for each of the instream structure projects sampled. Determine the numbers of adult and juveniles of the targeted salmon species in the control and impact areas for each of the instream structure projects sampled.

After Project Objectives (Years 1, 3, 5, and 10)

Determine the number and location of AIS within the treated area for the sampled instream structure projects. Determine the Thalweg Profile in the control and impact areas for the sampled instream structure projects. Determine the numbers of adult and juvenile of the target salmon species within the control and impact areas for the sampled instream structure projects.

Response indicators

- Number of AIS remaining in sampled reach: AIS must be identified using GPS coordinates and other techniques such as tags affixed to LWD in order to track the life of AIS over time. AIS sampling methods are found in Protocol 13 (SRFB 2003).
- Thalweg profile: The Thalweg profile characterizes pool-riffle relationships, sediment deposits, wetted width substrate characteristics, and channel unit-pool forming categories. Stream morphology sampling methods are taken from EMAP (Peck et al. unpubl.), Section 7.4. Protocols summarizing EMAP Table 7-3 and 7-4 are found in Protocols 14, 15, and 16. Sampling is based upon establishing 11 regular transects within each identified stream reach. Pre-project measures of the variation of depth throughout the stream reach and the residual pool volume will be compared to detect post-project changes.
- Abundance numbers of adult and juvenile salmon in the reach: Salmon abundance can be determined using both adult counts, redd counts, and juvenile counts. Adult estimating procedures are found in Protocol 9. Juvenile estimating procedures are found in Protocols 7 and 8. The least intrusive monitoring protocol should be used whenever possible. Impact areas will be compared to the controls and to controls and impacts on other streams as well. The metrics used will be numbers per square meter for juveniles and number per mile or redds per mile for adults depending upon the target species.

8.4.3 Riparian Vegetation Restoration Projects

The goal of riparian planting projects is to restore natural streamside vegetation to the stream bank and riparian corridor. The assumption is that riparian vegetation increases shading of the stream, leading to cooler temperatures more desirable for salmon rearing. Vegetative cover also reduces sedimentation and erosion, which can impact egg survival, food organisms, and the ability of salmon to find food.

Monitoring Goal

Determine whether riparian plantings are effective in restoring riparian vegetation, stream bank stability, and reducing sedimentation.

Questions to be answered:

- Have at least 50% of the riparian plantings survived for at least 10 years?
- Have the riparian shading and riparian vegetative structure been improved by year 10?
- Has erosion and stream sedimentation been significantly reduced by year 10?

Objectives

Before Project Objectives (Year 0)

Determine the proportion of the three layers of riparian vegetation present within the project impact and control areas. Determine the proportion of shading within the project impact and control areas. Determine the proportion of actively eroding stream banks within the project impact and control areas.

After Project (Years 1, 3, 5, And 10)

Determine the overall survival of the species of riparian vegetation planted. Determine the proportion of the three layers of riparian vegetation present within the project impact and control areas. Determine the proportion of shading within the project impact and control areas. Determine the proportion of actively eroding stream banks within the project impact and control areas.

Response Indicators

- Number of trees and shrubs planted: The number of trees and shrubs planted at the time of the project. The Level 1 indicator tracks how many plantings actually survived over time as a measure of project effectiveness.
- Riparian vegetation: Using EMAP protocols (Peck et al. unpubl.), the percent shading is calculated using a densitometer and the riparian species diversity understory ground cover and canopy can be determined in a consistent manner. One would expect the percent shading and the species diversity to change over time as the plantings grow. The proportion of actively eroding streambanks is an indicator of sedimentation and erosion into the stream. If riparian plantings are effective in creating riparian cover, then bank erosion should decline.

8.4.4 Livestock Exclusion Projects

The goal of livestock exclusion fencing is to exclude cattle from the riparian area of the stream where they can cause severe damage to the stream by breaking down stream banks and increasing erosion, destroying shade producing trees and shrubs, and increasing sedimentation. By excluding cattle with fencing, these adverse impacts can be avoided and restoration of the shoreline can occur.

Monitoring Goal

Determine whether livestock exclusion projects are effective in excluding livestock, restoring riparian vegetation and restoring stream bank stability.

Questions to be answered:

- Are livestock excluded from the riparian area?

- Has riparian vegetation been restored in the impact area?
- Has bank erosion been reduced in the impact area?

Objectives

Before Project Objectives (Year 0)

Determine overall use by livestock of the riparian area to be excluded. Determine the total acreage to be fenced. Determine the total kilometers of stream protected. Determine the overall riparian vegetation cover layers and percent shading within the project area.

Determine the overall proportion of stream bank actively eroding.

Post-Project Objectives (Years 1, 3, 5, and 10)

Determine the overall use by livestock of the riparian area excluded. Determine the overall riparian vegetation cover layers and percent shading within the project area.

Determine the overall proportion of stream bank actively eroding.

Response Indicators

- Exclusion effectiveness: Using Protocol 10, the presence or absence of livestock inside the exclusion can be used as a measure of the effectiveness of the fencing design in excluding livestock from the riparian area.
- Riparian indicators: Using EMAP protocols (Peck et al. unpubl.), the percent shading (using a densiometer) is a metric that can be determined in a consistent manner. This metric was chosen because it has been shown to have one of the highest signal to noise ratios (17) of 18 different parameters measured involving riparian vegetation. Using EMAP protocols, the percent of riparian area containing all three layers of vegetation, canopy layer (.5m high), understory (0.5 to 5m high), and ground cover (0.5m high). This metric was chosen because it has been shown to have one of the highest signal to noise ratios (8) of 18 different parameters measured involving riparian vegetation. Using methods outlined in Protocol #17, the proportion of actively eroding streambanks can be determined within the sampled stream reaches.

8.4.5 Constrained Channel Projects

The goal of constrained channel projects is to restore the natural flood flow basin width so that gravel, large wood, and normal stream morphology and fish habitat can be restored. Diking, road construction, fills, and other construction work within the stream's normal flood line can constrain flow within the normal flow channel leading to scouring effects upon stream gravel, loss of hiding cover and food organisms, and unsuitable habitat for rearing juvenile salmon. Unconstrained streams dissipate flood flow energy over a broader valley floor and provide slower velocities for preserving stream channel morphology and rearing habitat for salmon.

Types of Constrained Channel Projects

Dike removal or setback, riprap removal, road removal or setback, and landfill removal.

Monitoring Goal

Determine whether projects that remove or set back dikes, riprap, roads, or landfills are effective in restoring stream morphology and eliminating channel constraints in the treated area.

Questions to be answered:

- Has removal and/or setback reduced channel constraints and increased flood flow capacity for ten years?
- Has stream morphology improved over ten years?

Objectives

Before Project Objectives (Year 0)

Determine the overall channel capacity and constraints in the impact area. Determine the overall stream morphology using Thalweg Profile in the impact area.

After Project Objectives (Years 1, 3, 5, and 10)

Determine the overall changes in channel constraints and flow capacity in the impact area. Determine the overall stream morphology using Thalweg Profile in the impact area.

Response Indicators

- Channel capacity: Channel capacity as cross-sectional area calculated from mean bankfull width (XBF_W) and height (XBF_H) measures the overall channel flow capacity. When a channel is constrained the velocity of the water increases to compensate for higher volume. Increased velocity scours stream bottom eliminating pools, large wood, and other structures associated with fish habitat.
- Thalweg profile: The Thalweg profile characterizes pool-riffle relationships, sediment deposits, wetted width substrate characteristics, and channel unit-pool forming categories. Stream morphology sampling methods are taken from EMAP (Peck et al. unpubl.), Section 7.4. Protocols summarizing EMAP Table 7-3 and 7-4 are found in Protocols 15, and 16 (SRFB, 2003). Sampling is based upon establishing 11 regular transects within each identified stream reach. Pre-project measures of the variation of depth throughout the stream reach (RP100) and the residual pool volume (AREASUM) will be compared to detect post-project changes.

8.4.6 Channel Connectivity Projects

Channel connectivity projects and off-channel habitat projects are designed to reconnect flood flow channels, oxbows, and other winter flood flow channels and winter rearing areas for fish and other aquatic organisms. Loss of channel connectivity is most often caused by manmade disturbances such as dikes, roads, fills, etc.

Types of Channel Connectivity Projects

Channel connectivity, off-channel habitat, and wetlands

The goal of channel connectivity projects is to restore lost channels and side channel rearing areas to active fish production and to dissipate the destructive effects of flood flows upon habitat.

Monitoring Goal

Determine whether projects that restore connectivity to channels that have previously been disconnected from the stream are effective in improving stream morphology and increasing fish abundance in the impacted area. This would include side channels, meander bends, old oxbows, and wetlands.

Questions to be answered:

- Has the reconnected channel remained attached to the stream as designed?
- Has off-channel stream morphology improved over time?
- Has riparian vegetation in the off-channel impact area changed from upland to wetland species?
- Has salmon abundance increased in the off-channel impact area over time?

Objectives

Before Project Objectives (Year 0)

Determine the overall size and configuration of the disconnected channel in the impact and control areas. Determine the plant community characteristics in the impact and control areas. Determine the overall stream morphology using Thalweg Profile in the impact and control areas. Determine the overall abundance of targeted fish species in the impact and control areas.

After Project Objectives (Years 1, 2, and 5)

Determine the effectiveness of the connected channel within the impacted area. Determine the plant community characteristics within the impact and control areas. Determine the overall stream morphology using Thalweg Profile in the impact and control areas. Determine the abundance of target fish species within the control and impact areas.

Response Indicators

- Connected channel. The channel connection must remain functional as designed for the project to be considered a success. The response indicator in this case is whether the channel has remained connected to the main channel of the stream thereby meeting design criteria.
- Thalweg profile. The Thalweg profile characterizes pool-riffle relationships, sediment deposits, wetted width substrate characteristics, and channel unit-pool forming categories. Stream morphology sampling methods are taken from EMAP (Peck et al. Unpubl.), Section 7.4. Protocols summarizing EMAP Table 7-3 and 7-4 are found in Protocols 14, 15, and 16 (SRFB, 2003). Sampling is based upon establishing 11 regular transects within each identified stream reach. Pre-project measures of the variation of depth throughout the stream reach and the residual pool volume will be compared to detect post-project changes.
- Riparian species diversity and percent shading: Using EMAP protocols, the percent shading (using a densiometer) and riparian species diversity are metrics that can be determined in a

consistent manner. One would expect the percent shading and the species diversity to change over time after the channel has been reconnected.

- Abundance: Salmon abundance can be determined using both adult counts and juvenile counts. Adult estimating procedures are found in Protocol 9. Juvenile estimating procedures are found in Protocols 7 and 8. The least intrusive monitoring protocol should be used whenever possible. Impact areas will be compared to the controls and to controls and impacts on other streams as well. The metrics used will be numbers per square meter for juveniles and number per mile or redds per mile for adults depending upon the target species.

8.4.7 Spawning Gravel Projects

Spawning salmon require clean gravel of the proper size in order to spawn successfully. Where the stream is subjected to high sediment loading, gravel that is normally the proper size and location may become embedded into a matrix of silt and clay sediments that do not provide aeration of the redd.

The goal of gravel placement projects is to improve spawning capabilities within the impacted area by artificially placing gravel in the stream. The assumption is that spawning areas are a limiting factor in producing juvenile salmon, and placing gravel in the stream should result in an increase in successful spawning and local juvenile and adult fish abundance.

Monitoring Goal

Determine if projects that place spawning gravel into streams are effective in improving salmon spawning, and increasing local adult fish abundance in the impacted area at the stream reach level.

Questions to be answered:

- Has gravel placed in the stream remained in the stream for up to ten years for the sampled gravel replacement projects?
- Has gravel remained usable for spawning over time or has it become embedded with fines?
- Have more adult salmon utilized the new spawning gravel?

Objectives

Before Project Objectives (Year 0)

Determine the total area of spawning gravel in the impact and control areas for each of the gravel placement projects sampled. Determine how embedded the spawning gravel is in the control and impact areas for the sampled gravel placement projects. Determine the %age of fines in the gravel in the control and impact areas for the sampled gravel placement projects. Determine the numbers of adult spawners of the targeted salmon species in the control and impact areas for each of the gravel placement projects sampled.

After Project Objectives (Years 1, 3, 5, and 10)

Determine the total area of spawning gravel in the impact areas for each of the gravel placement projects sampled. Determine how embedded the spawning gravel is in the control and impact areas for the sampled gravel placement projects. Determine the %age of fines in the gravel in the

control and impact areas for the sampled gravel placement projects. Determine the numbers of adult spawners of the targeted salmon species in the control and impact areas for each of the gravel placement projects sampled.

Response Indicators

- Area of gravel remaining in the sampled reach: Spawning gravel placed in the stream must be identified using GPS coordinates and other techniques such as streambank markers in order to track the life of the gravel placement over time.
- Gravel characteristics. Gravel characteristics can be quantified using the EMAP protocol for characterizing stream substrate (Peck et al. Unpubl.). This protocol measures size of substrate. Percent of fines is commonly used as a measure of siltation. Embeddedness is also determined (see Protocol 12, SRFB, 2003).
- Abundance: Salmon abundance can be determined using adult spawner counts. Adult estimating procedures are found in Protocol 9. The least intrusive monitoring protocol will be used whenever possible.

8.4.8 Habitat Protection Projects at the Parcel Scale

A protection project is a property acquired either in fee title or a property protected by a restrictive use agreement or easement for the purpose of:

- Protecting identified blocks of critical habitat that protect fish and wildlife from further population declines.
- Protection of property providing key linkages connecting fragmented habitats.
- Protection of property used to enhance habitat and to offset poor habitat elsewhere in the watershed.

Determine whether habitat protection parcels as a whole and individually are effective in maintaining or improving fish and wildlife habitat and invertebrate species assemblages within the parcel boundaries.

Monitoring Goal

Determine whether habitat protection parcels as a whole and individually are effective in maintaining and/or, improving fish and wildlife and invertebrate species assemblages within the parcel boundaries.

Questions to be answered:

- Have the protected properties maintained or improved the riparian habitat benefits for which they were purchased?
- Have the protected properties maintained or improved the upland habitat benefits for which they were purchased?
- Has the biological condition of the macro-invertebrate and fish and wildlife assemblages improved, declined or stayed the same within the protected properties?

Objectives

Baseline (Year 0)

Determine status of instream, riparian and upland habitat within each randomly selected parcel. Determine the biological condition of macro-invertebrate and fish and wildlife species assemblages using a multi-metric index for each randomly selected parcel.

Post-Acquisition Objectives (Years 3, 6, 9, and 12)

Determine trends in instream, riparian and upland habitat within each randomly selected parcel compared to the baseline year. Determine status of macro-invertebrate and fish and wildlife species assemblages using a multi-metric index for each randomly selected parcel.

Response Indicators

- Thalweg profile. The Thalweg profile characterizes pool-riffle relationships, sediment deposits, wetted width substrate characteristics, and channel unit-pool forming categories. Stream morphology sampling methods are taken from EMAP (Peck et al. unpubl), Section 7.4.

- Riparian plants: Riparian condition is determined by measuring the plant density and species composition within the study reach. It is also important to measure stream bank erosion. Streamside riparian habitat sampling methods are taken from EMAP (Peck et al. Unpubl.), Section 7.4.

- Upland plants: Upland plant community sampling methods are taken from the National Park Service "Fire Monitoring Handbook (FMH)", Chapter 4 Monitoring Program Design, Table 3, Table 4 and Figures 9-14; and Chapter 5 Vegetation Monitoring Protocols Tables 5-10 and Figures 15-20. SFRB Protocols summarizing FMH protocols are found in Protocol X (SRFB, 2003).

- Macro-invertebrate assemblages: Stream macro-invertebrate species composition and relative abundance of particular groups show strong correlations with water quality and watershed health factors. Changes in macro-invertebrates would indicate that water quality conditions within the parcel have changed over time. Macro-invertebrate sampling methods are taken from EMAP (Peck et al. unpubl), Section 11. Protocols summarizing EMAP Table 11-2, 11-3, and 11-4 are found in Protocols X (SRFB, 2003) and in the Department of Ecology's "Benthic Macro-Invertebrate Biological Monitoring Protocols for Rivers and Streams", Publ No. 01-03-028. Indicators considered most sensitive to regional change are compared using a multi-metric index (Karr and Chu, 1999; Wiseman, 2003).

Abundance: Salmon abundance can be determined using both adult counts and juvenile counts. Adult estimating procedures are found in Protocol 9. Juvenile estimating procedures are found in Protocols 7 and 8. The least intrusive monitoring protocol should be used whenever possible. Impact areas will be compared to the controls and to controls and impacts on other streams as well. The metrics used will be numbers per square meter for juveniles and number per mile or redds per mile for adults depending upon the target species.

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10 Acronyms and Abbreviations

BAIC	Boeing Agricultural Industrial Company
BLM	Bureau of Land Management
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
BiOP	Biological Opinion
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
Colville Tribes	Confederated Tribes of the Colville Reservation
CRITFC	Columbia River Inter-Tribal Fish Commission
CRMP	Cultural Resources Management Plan
CWA	Clean Water Act
CRP	Conservation Reserve Program
DOE	U. S. Department of Energy
DOI	U.S. Department of the Interior
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
ECP	Eco-regional Conservation Planning
EDT	Ecosystem Diagnostic & Treatment
EIS	Environmental Impact Statement
EMS	Energy Management System
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure
HGMP	Hatchery Genetic Management Plan
huc	habitat
IBIS	Interactive Biological Information System
ISRP	Independent Scientific Review Panel
JFC	Joint Fisheries Committee
LFA	Limiting Factors Analysis
LWD	large woody debris
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPPC	Northwest Power Planning Council
NPCC	Northwest Power and Conservation Council
PA	Programmatic Agreement
PUD	Public Utility District
RC&D	North Central Washington Resource Conservation & Development Council
RM	river mile
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project

SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TSS	Total Suspended Sediment
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WQI	water quality index
WDFW	Washington Department of Fish and Wildlife
Yakama Nation	Confederated Tribes and Bands of the Yakama Indian Nation
YCT	U.S. Army Yakima Training Center (YTC)
YFRM	Yakama Fisheries Resource Management

11 Appendices

Appendix A. Lower Mid-Columbia Mainstem including Rock Creek Subbasin Planners and Contributors

Appendix B. Common and Scientific Names Used in Lower Mid-Columbia Mainstem Assessment

Appendix C. Wildlife Species Occurring in the Lower Columbia Middle Subbasin

Appendix D. Rare Plants and Plant Communities of the Rock Creek Watershed Area

Appendix E. Adult Salmon Passage at the Dalles Dam on the Lower Mid-Columbia Mainstem Columbia River from 1977 – 2003

Appendix F. Figures 160 A and B showing Fulton Canyon and Spanish Hollow along with the Hood River Basin (in folder)