

5 Inventory

5.1 Introduction, Purpose, and Scope

The inventory of the Entat subbasin summarizes the fish and wildlife protection, restoration, and artificial production projects and programs. The Inventory also identifies management programs and projects that target fish and wildlife or otherwise provide substantial benefit to fish and wildlife. The inventory includes programs and projects extant or the past five years and where possible, activities that are scheduled to be implemented within the very near future.

The inventory of programs and projects helps demonstrate current management directions, existing and imminent protections, and current strategies. However, the Council's "Technical Guide for Subbasin Planners" (2002), states that the inventory will have its greatest value when it is reviewed in conjunction with the limiting factors resulting from the assessment. This analysis helps to identify gaps between ongoing management efforts and those efforts needed to realize the vision of the subbasin plan.

A comparison of past actions with limiting factors should help assess the efficacy of current actions, indicate the areas of project gaps and guide management decisions. Please refer to the electronic reference library (NPCC ftp site) for an inventory of programmatic activities within this subbasin.

5.2 Inventory of Watershed Restoration and Habitat Improvement

This inventory summarizes some of the watershed restoration and habitat improvement projects and initiatives conducted on both public and private lands in the Entiat and Mad River watersheds over the last several years. It was created using an unpublished list of projects completed on National Forest System Lands between 1992 and 2003, a list of BPA projects from the Columbia Basin Fish and Wildlife Authority's website, a draft programmatic inventory of the Columbia Cascades Province completed by Golder Associates, and information regarding any additional restoration / protection efforts that have occurred on private/non-Forest System lands within the subbasin. This appendix will be updated in subsequent versions of this document.

Burned Area Emergency Rehabilitation

A significant amount of rehabilitation work has occurred in the subbasin in association with large scale fires. The following reports contain details of the Burned Area Emergency Rehabilitation measures implemented following the Dinkelman and Tye disturbance events:

- Burned Area Emergency Rehabilitation - Final Accomplishment Report for the 1988 Dinkelman Canyon Fire, 1989
- Burned Area Emergency Rehabilitation - Final Accomplishment Report for the 1994 Chelan County Fires, 1995
- Other Restoration-Related Activities, broken down by Assessment Unit

Other restoration projects and initiatives implemented since 1992 includes the following:

NOTE: Projects with a scope that extended over more than one Assessment Unit are included in this list in italic text. These projects are included in the inventory for each of the applicable Assessment Units.

Lower Entiat Assessment Unit

Mouth (RM 0) to Potato Moraine (RM 16.2)

1992

- Potato Creek Road Decommissioning: Involved decommissioning of a riparian section on the main road in upper Potato Creek (1.6 miles) that had been replaced by a new hillslope route; Treatment included ripping, drain dip installation and revegetation.
- Reconstruction of the Windy Creek Water Chance: The first of a series of projects targeted at replacing temporary waterchance structures with more natural and stable log weirs.

1993

- Mud-Potato Area Road Rehabilitation: Involved rehab work on the dense road network in upper Mud and Potato Creeks; Treatments included drainage improvements (drain dips, ditch relief culverts) and spot surfacing on open roads, as well as road closures (12 miles) and decommissioning (28 miles), with revegetation. (\$17,000)
- Lower Potato Creek Road Rehab: Involved drainage improvements on the North Fork Potato Creek Road and a newly relocated section of the main Potato Creek Road by the Forest Road Crew; Treatments included cut slope stabilization, drain dip installation and armoring and spot surfacing. (~\$25,000)
- Water Chance Reconstruction: Rehabilitated 3 sites associated with road crossings in Mud and North Fork Potato Creeks as described above for the Windy Creek site in 1992.

1994

- Mills-Roaring Creek Road Rehab: Involved road rehab work in the Mills/Dinkelman/Roaring Creeks area; Treatments included drainage improvements (drain dips, culvert improvement/installation), road reshaping, crossing improvements, road closures and revegetation; This work was completed under three separate contracts prior to the start of the Tye Fire. (\$29,000; Mills Creek, Roaring Creek and Old Camp Road contracts)
- Roaring Creek Riparian Clean-Up: A community-based improvement project targeted at improving conditions in and public awareness of Roaring Creek and its riparian area; Treatments on various ownerships included removal of four abandoned automobiles and other litter, tree planting and closure of user-built ORV trails in the riparian area.

- Mud-Potato Creek Road Rehab: This project was planned and contracted prior to the Tyee Fire. Some of the planned work was either completed or modified by Tyee Fire Emergency Burned Area road rehab work. The project was redesigned and completed in 1995 and included fill slope stabilization, drain dip and culvert installation, spot surfacing and revegetation. (\$65,000)

1995

- Potato-Stormy "Early" Road Rehab: Involved drainage improvement (drain dip/culvert installation), stream crossing/fill slope stabilization, temporary road relocation, spot surfacing and revegetation on roads in the lower Potato Creek drainage, in response to damage from spring runoff. (\$30,000)
- Bear-Potato Early Road Rehab: Involved continuation of Emergency Burned Area Treatments on road in the Mud and Potato Creek drainages; Treatments included drainage improvement (drain dips, culvert installation), spot surfacing, fill slope stabilization and revegetation. (\$49,000)
- Tyee Fire Culvert Replacement: Involved the installation of four large, concrete box culverts at four stream crossings in lower Mud and Potato Creeks by the Forest Road Crew. (\$72,000)
- Tyee Fire Late Road Rehab: Involved drainage improvement, surfacing and revegetation on priority, problem road segments within the fire area that were not treated in any previous contracts; Treatments included drainage improvement (dips, culvert improvement), prism reshaping, spot surfacing, slash filter windrow placement, road decommissioning (riparian road sections in N Fk Mud and Potato Creeks) and revegetation. (\$36,000)
- North Fork Drainage Improvement: Involved installation of three new culverts on 5380/5390 roads in upper North Fork Potato Creek by the Forest Road Crew. (\$4,000)

1996

- Early Entiat Road Rehab: Involved the installation of drain dips, spot surfacing and fill slope stabilization on lower Mud and Potato Creeks in response to spring runoff within the Tyee Fire Area. (\$35,000)
- Mud-Potato Creek Culverts: Involved installation of several stream crossing structures on road sections in lower Mud and Potato Creeks. Treatments included spot surfacing and armoring of fill slopes. (\$44,000)

1997

- Mills Canyon/Old Camp Road Rehab: Involved drainage improvement work (primarily drain dip installation/reconstruction and prism reshaping) on the Mills Canyon and Old Camp Roads. (\$49,000)
- Entiat Channel Restoration Project: Involved a variety of in-channel and bank treatments in association with riparian corridor roads and stream crossings in the

Stormy, Potato, Mud and Indian Creek drainages; Treatments included maintenance of burned area rehab check dams in Stormy and Potato Creeks, installation of low-profile, upstream pointing rock weirs, and large woody debris placement in channel sections adjacent to corridor roads and at stream crossings. (\$45,000)

- Entiat Area Road Rehabilitation: Involved drainage improvement and stabilization work on lower Shady Pass and in the Silver-Pope, Mud, Tillicum and Indian Creek drainages; Treatments included drain dip construction/reconstruction, ditch relief culvert installation/rehab, prism reshaping, spot surfacing, armoring of stream crossings and weir placement. Completion of restoration work on the Tillicum fan site included removal of litter/metal debris and an unsafe wooden structure, removal of old concrete structures, bridge abutment and toe slope stabilization, installation of vehicle barriers, spot surfacing, noxious weed removal, native grass seeding and shrub planting. (\$99,000)
- Upper Mud-Potato Area Road Closures: Involved road closures and spot drainage improvements on some open road segments in the road system in upper Mud and Potato Creeks; Treated roads were those used during salvage and post-fire reforestation work, that were no longer needed for access; Treatments included drain dip installation, decompaction by sub-soiling (self-drafting) and revegetation (grass). (\$30,000)
- Potato Creek Flood Repair: Involved repair of runoff damage to sections of the lower Potato Creek road and the North Fork Potato Creek road, resulting from a severe thunderstorm on 8/26/97. Treatments included slough removal, prism reshaping, culvert repair, crossing stabilization and revegetation.
- Mud Creek Meadows Soil Rehab: Involved sub-soiling (self-drafting) and grass seeding of several old log landings in the Mud Meadows area above the 5300-217 road. This work was conducted as part of a demonstration training on the use of the self-drafting, winged sub-soiler. (\$4,000)
- McKenzie Ditch Irrigation Diversion Fish Screening Project: Fish screens at the McKenzie Ditch Irrigation Diversion were replaced. This project was completed by the WDFW Yakima Screen Shop with funding from BPA. (\$40,000)

1998

- Hanan-Detwiler Irrigation Diversion Fish Screening Project: Fish screens at the Hanan-Detwiler Irrigation Diversion were replaced. This project was completed by the WDFW Yakima Screen shop with funding from BPA (\$80,000)
- Martin Sanders Irrigation Diversion Fish Screening Project: Fish screens at the Martin Sanders Irrigation Diversion were replaced. This project was completed by the WDFW Yakima Screen shop with funding from BPA. (\$7,000)

2000

- South Fork Mud Creek Relocation: Riparian road relocation in South Fork Mud Creek Road (#5340). This included 1.95 miles of new road constructed, 1.10 miles of road reconstructed and 1.85 miles of road obliteration. (\$174,000)

2001

- Mud Creek Road Relocation: Approximately 3 miles of the Main Mud Creek road (#5300) relocated away from the riparian zone. This project included decommissioning 3.9 miles of road located within riparian zone. (\$241,000)
- Entiat Instream Structure Installation: The Bureau of Land Management, in cooperation with WDFW and USFS, installed two engineered log jams at river mile 10.3, and two boulder barbs with root wads at river mile 15, in the fall of 2001. These projects were installed as part of an ongoing effort to restore habitat complexity in the Entiat River below the Potato Creek Moraine.
- Entiat Instream Structure Installation: The Natural Resource Conservation Service, in cooperation with the Chelan County Conservation District, USFWS, and BLM, installed two low profile rock cross vanes just below the fire station bridge, and an additional structure above the Dinkleman Canyon Road bridge, in the fall of 2001. The structures have added juvenile rearing and adult resting/holding pool habitat in the lower Entiat River.
- Stream Gaging Installation and Operations: BPA funded the purchase, establishment and operation of eight continuous recording/telemetered stream gages in the mainstem Entiat and Mad Rivers and their tributaries. These gages were installed by the Chelan County Conservation District in conjunction with the Washington Department of Ecology's Stream Hydrology Unit. Six staff gages were also installed in tributaries to the Entiat. The operations included installation of the gages, telemetry, data recording, and associated activities. (\$198,000)

2003

- Hanan-Detwiler Passage Improvements (BPA project number 2003-020-00): BPA recommended funding of this proposal by the WDFW Yakima Screen Shop (YSS) to complete passage improvements within a side channel of the Entiat River. This side channel is associated with the Hanan-Detwiler irrigation diversion. (No funding was available for this project as of 1/20/04).

2004

- Entiat Off-Channel Rearing Habitat: This is a cooperative salmon and steelhead restoration, enhancement, and bioengineering project aimed at helping endangered spring chinook salmon, endangered summer steelhead trout and other anadromous and resident salmonids within the lower Entiat River drainage. This project is to create approximately 0.4 miles of high quality, year round off-channel salmon and steelhead rearing habitat on WDFW owned land adjacent the mainstem Entiat River at RM 6.5, just upstream of Roaring Creek. This project was started in 2000. (\$162,398)

- **Jon Small Off Channel Rearing Pond:** The Jon Small Off-Channel Rearing Pond provides additional habitat for salmonids. This is a cooperative salmon and steelhead restoration, enhancement, and bioengineering project aimed at helping endangered spring chinook salmon, endangered summer steelhead trout and other anadromous and resident salmonids within the lower Entiat River drainage. Objectives are to create a 0.2 acre off-channel rearing pond, create a meandering 1000 ft. off channel rearing channel exiting the pond and connecting to the Entiat River, and restore a 1000 ft of previously channelized and degraded in-channel rearing habitat and eroding banks through bioengineering and placement of instream rock and fish habitat structures. This project was started in 2000. (\$196,261)
- **Stormy Creek Culvert Replacement:** Chelan County Public Works received SRFB funding in 2000 and BLM money to replace a fish passage barrier under the County river road. This project will provide salmonid access to tributary habitat in Stormy Creek. In-kind assistance has been provided by the USFWS, WDFW USFS, and CCCD. Additional funding is being currently being sought from the USFS and the USFWS in order to complete the project in 2004 or 2005. (\$185,000)

Mad River Assessment Unit, Entire Mad River Drainage

1992

- **Cougar Creek Area Stream Crossing Rehab:** Drainage improvement, site hardening and revegetation at 15 perennial stream crossings on the Tye Ridge Road (5700) in the Billy and Cougar Creek watersheds. Treatments included installation of drain dips, armoring of culvert inlets, outlets and fill slopes, pit-run surfacing at stream crossings, installation of slash filter windrows, revegetation, along with rehabilitation of adjacent non-system roads and disturbed areas. (\$62,000)

1995

- **Indian Creek Flood Repair:** Involved repair of spring runoff damage on the Indian Creek crossing on the Tillicum Road; Treatments included trash rack removal, road surface repair, ditch and culvert cleaning, and fill slope reconstruction. (\$5,000)
- **Tye-Sugarloaf Road Rehab:** Involved spot treatment of problem road sections in the Mad River watershed; Treatments included drainage improvements (2 culverts in Windy Creek; 3 in tillicum/Indian Creeks; drain dips), prism reshaping, spot surfacing, fill slope stabilization and revegetation. (\$45,000)
- **Horan Irrigation Diversion Fish Screening Project:** Fish screens at the Horan Irrigation Diversion were replaced. This project was completed by the WDFW and the Yakama Screen Shop with funding from BPA. (\$20,000)

1996

- **Tillicum-Miners Road Rehab:** Involved road drainage improvement (drain dips, culverts) cut slope stabilization, surfacing and revegetation on the lower Indian Creek Road. (\$38,000)

- Indian Creek Culvert Replacements: Involved the replacement of two existing, round corrugated metal culverts that were fish passage barriers with open bottom arch culverts. (\$54,000)
- Tyee-Berg Road Rehab: Involved drainage improvement (dip improvement/installation), pit-run surfacing and revegetation on the upper Tyee Ridge Road (5700). (\$86,000)
- Tillicum Fan Restoration: Involved revegetation work on the alluvial fan at the mouth of Tillicum Creek; Treatments included soil decompaction (moldboard plow, disc, harrow), grass seeding, alfalfa cultivation, tree planting and noxious weed removal (hand pulling). This project was completed in 1997 as part of the Entiat Area Road Rehab project. (\$10,000)

1997

- Entiat Channel Restoration Project: Involved a variety of in-channel and bank treatments in association with riparian corridor roads and stream crossings in the Stormy, Potato, Mud and Indian Creek drainages; Treatments included maintenance of burned area rehab check dams in Stormy and Potato Creeks, installation of low-profile, upstream pointing rock weirs, and large woody debris placement in channel sections adjacent to corridor roads and at stream crossings. (\$45,000)
- Entiat Area Road Rehabilitation: Involved drainage improvement and stabilization work on lower Shady Pass and in the Silver-Pope, Mud, Tillicum and Indian Creek drainages; Treatments included drain dip construction/reconstruction, ditch relief culvert installation/rehab, prism reshaping, spot surfacing, armoring of stream crossings and weir placement. Completion of restoration work on the Tillicum fan site included removal of litter/metal debris and an unsafe wooden structure, removal of old concrete structures, bridge abutment and toe slope stabilization, installation of vehicle barriers, spot surfacing, noxious weed removal, native grass seeding and shrub planting. (\$99,000)
- Upper Indian Road Rehab: Involved repair of spring runoff and storm damage in Upper Indian Creek and Hornet Creek; Treatments included culvert improvement, drain dip installation and fill slope stabilization. (\$5,000)

1998

- Tillicum-Moe Road Rehab: Road improvements on Road # 5810 Moe Ridge and Road # 5800 Tillicum Creek Road. This work included construction and reconstruction of drain dips, road drainage improvements, spot surfacing, ditch pulling of 3.21 miles of road #5810. This project also included insloping of existing road prism for drainage improvement, spot surfacing, ditch cleaning, and general blading and shaping of 5.16 miles of road #5800. Total project cost was \$71,000 and the contract completed 10/26/98.

1999

- Indian Creek Dispersed Site Rehab: Decompaction, traffic control and revegetation of dispersed campsite/sheep bedding area at the mouth of Indian Creek, including rework of outlet rock on lower arch. (\$1,000 10/99)

2002

- Stream Gaging Installation and Operations: BPA funded the purchase, establishment and operation of stream gages in eight critical reaches of the Entiat and Mad Rivers. These gages were installed by the Chelan County Natural Resource Program and the Chelan County Conservation District in conjunction with the Washington Department of Ecology's Stream Hydrology Unit. The operations included installation of the gages, telemetry, data recording, and associated activities. (\$198,000) Cut and paste from previously corrected gaging paragraph...

Middle Entiat Assessment Unit

Potato Moraine (RM 16.2) to Entiat Falls (RM 34)

1993

- Tyee-Shamel Creek Area Road Rehabilitation: Involved road rehab work on the dense road network in the Shamel Face area; Treatments included drainage improvements (drain dips, ditch relief culverts) and spot surfacing on open roads, as well as road closures (14 miles) and decommissioning (11 miles), with revegetation. (\$35,000)
- Silver-Pope Area Road Rehabilitation: Stabilization of four major stream crossings and drainage improvement on adjacent road sections on the 5901/5902 roads. Treatments included rip-rap armoring of crossings, gravel surfacing, installation of 2 sub-surface drains, drain dips, and revegetation (alder planting, grass seeding and fertilization). (\$34,000)
- Tommy-Silver-Pope Alder Planting: Involved the planting of surplus alder starts (from Entiat FSL) on a number of cut slopes in the Silver-Pope area (approx. 5 acres) and on two debris avalanche tracks in Tommy Creek (approx. 7 acres)

1994

- Lake Creek Road Rehabilitation: Involved road rehab work in the Lake Creek basin on the 5904 road and spurs; Treatments included armoring of crossings, spot surfacing, installation of 2 sub-surface drains, drain dips, culvert improvement/installation, cut/fill slope reshaping/armoring (rock, logs) and revegetation; This project was contracted in 1994 and was completed in two parts. Lake "Early" was completed in 1994 (\$27,000). Lake "Late" was completed in 1995 (\$80,000)
- Lower Tyee Road Prep: Involved preparation of the lower Tyee Road for paving/re-paving; Treatment included cut slope reshaping, ditchline refinement, ditch relief culvert installation and prism reshaping in unpaved sections of this road; This project was partially completed in 1994, shut down during the Tyee Fire and completed in the 1995 field season. (\$86,000)

- Tye Fire Emergency Burned Area Rehabilitation: A massive amount of burned area rehabilitation work was accomplished in the fall of 1994 on roads within the fire area (see Final Accomplishment Report for 1994 Chelan Fires)
- Tommy Creek Road Rehab: Involved road rehab work on the Tommy Creek Road system; treatments included stream crossing stabilization, drain dip installation, surfacing to the new trailhead, and road closures, with revegetation. The project was contracted in 1994 and completed in 1995 under two separate contracts. (\$12,000)

1995

- Many of the road rehab projects contracted in 1994 were completed during the 1995 field season, as noted above.
- Tye Fire Emergency Burned Area Rehabilitation work was continued during the 1995 field season, including the following road-related projects.
- Stormy Creek Check Dam Maintenance: Involved rework of ten loose rock check dams in lower Stormy Creek to better define the main channel, protect vulnerable banks and begin restoration of fish passage. (\$2,300)
- Potato-Stormy "Early" Road Rehab: Involved drainage improvement (drain dip/culvert installation), stream crossing/fill slope stabilization, temporary road relocation, spot surfacing and revegetation on roads in the lower Stormy Creek drainage, in response to damage from spring runoff. (\$30,000)
- Pope Creek Flood Repair: Involved restoration of the Pope Creek crossing on the Entiat Valley Road following passage of a debris torrent initiated by spring runoff. (\$8,000)

1996

- Shamel Creek Road Rehab: Involved repair of one culvert crossing that had been damaged during spring runoff. (\$4,000)
- Lake Creek Area Road Rehab: Involved completion of drainage improvement and slope stabilization work on the Lake Basin Road (5904) that was started in 1994. Also involved drain dip installation on a portion of the Shady Pass road, culvert improvement at a crossing on the Tommy Creek road and reshaping/resurfacing of a portion of the Tillicum Creek Road (above Tillicum Creek crossing). (\$81,000)

1997

- Entiat Channel Restoration Project: Involved a variety of in-channel and bank treatments in association with riparian corridor roads and stream crossings in the Stormy, Potato, Mud and Indian Creek drainages; Treatments included maintenance of burned area rehab check dams in Stormy and Potato Creeks, installation of low-profile, upstream pointing rock weirs, and large woody debris placement in channel sections adjacent to corridor roads and at stream crossings. (\$45,000)

- Shamel/Byers Road Repair: Involved repair of spring runoff damage to a culvert crossing on Shamel Face and a section of road in Byer's Canyon needed for reforestation access; Treatments included culvert improvement, running surface repair, drain dip installation and revegetation. (\$6,000)
- Entiat Area Road Rehabilitation: Involved drainage improvement and stabilization work on lower Shady Pass and in the Silver-Pope, Mud, Tillicum and Indian Creek drainages; Treatments included drain dip construction/reconstruction, ditch relief culvert installation/rehab, prism reshaping, spot surfacing, armoring of stream crossings and weir placement. Completion of restoration work on the Tillicum fan site included removal of litter/metal debris and an unsafe wooden structure, removal of old concrete structures, bridge abutment and toe slope stabilization, installation of vehicle barriers, spot surfacing, noxious weed removal, native grass seeding and shrub planting. (\$99,000)
- Entiat River Bank Stabilization and Fish Habitat Restoration Project: Involved more than 1300 feet of bank treatments called "rootwad revetments" followed by riparian shrub plantings during September 1997. Treatments included placement of more than 100 conifer logs with rootwads, erosion control seeding, and planting more than 10,000 native shrubs on private lands in the "Stillwaters" reach of the Entiat River. The project was accomplished by 10 partners. (\$153,000)

1998

- Tye Lookout Road Drainage Improvement: Installation of 46 drain dips and road drainage improvements on 3.85 miles of # 5713 Tye Lookout road. (8/98, \$2,000.00)
- Preston-Dill Road System Storm Damage Repair: Backhoe work on plugged culverts on roads # 5501, # 5502, # 5503. Removal of storm caused small slides and clearing of debris plugged ditches (8/25/98 \$3000.00)

1999

- Tommy Creek Dispersed Site Rehab: Decompaction, traffic control and revegetation of dispersed campsite roads along lower Tommy Creek Road. (\$4,000 10/99)
- Stormy Creek Check Dam modification: Third and last modification of the loose rock check dams installed in lower Stormy Creek during the 1994 Tye BAER. (\$5,000 10/99)
- Upper Entiat Spawning Channel Restoration: Approximately a quarter mile of previously constructed spawning channel was repaired. Since repair, spring chinook, steelhead and occasionally bull trout have been observed spawning in the channel. (8/04)

2000

Property Acquisitions: The Chelan-Douglas Land Trust received grant monies from the State Salmon Recovery Funding Board to purchase property along the mainstem Entiat River for the protection of properly functioning riparian/fish/wildlife habitat.

2001

- Property Acquisitions: The Chelan-Douglas Land Trust received grant monies from the State Salmon Recovery Funding Board to purchase property along the mainstem Entiat River for the protection of properly functioning riparian/fish/wildlife habitat.

2002

- Tommy Fire BAER: 220 acres of uplands were aerially seeded and the drainage on 3 miles of trail was improved following the Tommy Fire. (\$12,400)
- Entiat River Road Resurfacing: gravel surfacing was added to approximately one mile of road (\$40,000).
- Stream Gaging Installation and Operations: BPA funded the purchase, establishment and operation of stream gages in eight critical reaches of the Entiat and Mad Rivers. These gages were installed by the Chelan County Natural Resource Program and the Chelan County Conservation District in conjunction with the Washington Department of Ecology's Stream Hydrology Unit. The operations included installation of the gages, telemetry, data recording, and associated activities. (\$198,000) Use previously edited gaging paragraph...

2003

- Riparian Road Relocation: Spot seeding and mulching was applied to a two mile section of the Mud Creek Road that was decommissioned in 2001. (\$3800)

2004

- Entiat River Road Barrier Removal: This project is to replace an existing fish block culvert on Chelan County Road # 94470 (Entiat River Road) with a bottomless arch thereby allowing steelhead and juvenile spring chinook salmon immediate access to one half mile of properly functioning rearing habitat in lower Stormy Creek, a significant, perennial tributary in the mid-Entiat River.

Upper Entiat Assessment Unit

Entiat Falls (RM 34) to top of Drainage

1998

- Steliko Stream Rehab: This project entailed fixing a leak in the channel retaining wall and excavation and replacement of water pipe behind the barn. \$4,004.00; project completed 9/9/98.

1999

- Upper Entiat River Road Rehab: Spot surfacing and drainage improvements on approximately 2 miles of the Upper Entiat River Road; included surfacing Three Creek and Spruce Creek CG access roads. (\$20,000 10/99)

2003

- Spruce Grove Campground Restoration: A buck and pole fence was erected to reduce recreation impacts on the riparian area. (\$3000)

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Basin Wide Projects

2003

- Comprehensive Inventory and Prioritization of Fish Passage and Screening Problems in the Entiat and Entiat Subbasins: BPA recommended funding of this proposal by the WDFW Yakima Screen Shop (YSS) to locate and evaluate all culverts, dams, fishways, water diversions, and other human-made features in the Entiat and Entiat subbasins; conduct fish habitat assessments; and prioritize all barriers and unscreened or inadequately screened water diversions. (No funding was available for this project as of 1/20/04).
- Columbia Cascade Province Pump Screening: BPA recommended funding of this proposal by the WDFW YSS to perform a comprehensive re-assessment, re-inventory, and mitigation of previously inventoried pumps screen sites in the Entiat, Entiat, and Methow subbasins. (Don't know about \$\$ -- assume same as above?)

6 Synthesis and Interpretation

6.1 Introduction

In general, many fish and wildlife habitat attributes in the Entiat Subbasin are in good condition, especially in the upper portions of the subbasin. Attributes in the lower Entiat and Mad rivers have changed the most from the historic reference condition through agricultural and rural developments. Because of flood control measures and agricultural practices, the lower Entiat River has seen significant channel and riparian simplification and lost floodplain function which is the primary factor limiting anadromous salmonid production in the subbasin.

Low stream channel complexity is the primary limitation to productivity of salmonids on the lower 20-km of the mainstem Entiat River (downstream of the terminal moraine). Stream sinuosity is low, with very few point bars for gravel accumulation. Instream habitat diversity is also low, with few pools, glides, pocket waters or large woody debris accumulations. As a result, there are very few resting areas for both adult and juvenile salmon through this important migration corridor. Additionally, changes in channel shape have substantially increased the stream width to depth ration, exacerbating low flow and extreme water temperature conditions. Efforts to improve stream sinuosity and channel forming processes in the lower reach should be considered.

Overall, chinook and steelhead production in the Entiat River could increase if habitat problems within the lower subbasin were rectified. Increasing off channel habitat, increasing habitat diversity and structural complexity, moderating extreme water temperatures and restoring riparian areas and function in the lower Entiat River would increase adult holding and juvenile rearing habitat and to a lesser degree could increase spawning habitat as well. Creating or restoring more habitat may not increase overall production by a large degree, but it will increase the spatial and potential genetic diversity of these species in the Entiat River.

Bull trout and Westslope cutthroat trout populations are considered to be relatively healthy and may be on an improving trend within the Entiat subbasin. However, the status of bull trout is not well understood in the upper Entiat River watersheds above Entiat Falls. Reduction of sport harvest on bull trout is likely the primary reason for this trend, while harvest on cutthroat is not well documented. Habitat conditions in spawning and rearing areas is in good and stable condition. Brook trout do inhabit and compete with cutthroat and bull trout and are likely one of the key factors limiting production of these native species. Habitat improvements in the lower Entiat would likely benefit adult bull trout migration and holding.

6.2 Key Habitat – Population Relationships

Spring chinook

Adult migration and holding: Spring chinook enter the Entiat River from May through June and hold (stage) until spawning begins in August in larger pools of the Entiat and Mad rivers. Loss of riparian area (and associated large wood that is used as cover) and loss of natural geo-fluvial processes have reduced the abundance of pools. Mortality, stress or displacement to adults is likely greatest in the lower Entiat Assessment Unit, but occurs in lower Mad and Middle Entiat as well.

Spawning and egg incubation: Spawning and egg incubation areas within the Entiat subbasin has been substantially altered. Spawning substrates are embedded in some areas, and natural geo-fluvial processes have been compromised, so gravel recruitment is low, and sedimentation is high. Losses of riparian areas, channel stability, and habitat diversity have all impacted spring chinook spawning. Changes in channel morphology and lost habitat diversity likely leave some redds more susceptible to disturbance or destruction due to high flow events and bedload movement.

Rearing: Rearing habitat for fry and parr has been compromised by channel simplification, loss of riparian area and large wood in the stream channel. In the Lower Entiat AU, off channel habitat, channel stability, and habitat diversity are substantially lacking. Winter rearing habitat may be limiting to spring chinook juveniles because of natural temperature regimes especially in the lower Entiat River.

Conclusion: Spring chinook production in the Entiat River could increase if habitat problems within the lower basin were rectified. Preservation of quality spawning and rearing habitat in the Middle Entiat AU is important to maintain naturally reproducing populations. Increases of off channel habitat and riparian areas in the lower Entiat River would increase potential rearing habitat and life history diversity. Creating or restoring habitat will increase spring chinook productivity by a modest degree, and increase the spatial and potential life history diversity within the Entiat River.

Late-run chinook

Late-run chinook enter the Entiat River from June through October and hold until spawning begins in October in larger pools of the mainstem Entiat. Similar to Spring chinook, loss of riparian area (and associated large wood that is used as cover) and loss of natural geo-fluvial processes have reduced the abundance of pools. Mortality, stress or displacement to adults is likely greatest in the lower Entiat Assessment Unit and to a lesser degree in the Middle Entiat.

Spawning and egg incubation: Summer/fall chinook of the Entiat Basin spawn in the mainstem Entiat River in both Lower and Middle Assessment Units. Impacts to late-run chinook are similar to those mentioned for spring chinook.

Rearing: Impacts to rearing late-run chinook are similar as those effecting spring chinook.

Conclusion: Summer/fall chinook production in the Entiat River could increase if habitat problems within the lower river were corrected. Increases of off channel habitat and riparian areas in the lower Entiat River would increase productivity by increasing potential rearing, adult holding habitat, and genetic, spatial, and life history diversity.

Coho

Adult migration and holding

Reintroduced coho salmon will likely enter the Entiat River in early September through late November. Coho entering in September and October will hold in larger pools prior to spawning, later entering fish may migrate quickly upstream to suitable spawning locations. As observed in the Wenatchee River, during years with extreme low flow, coho entrance into the Entiat River or migration to spawning grounds may be delayed. Loss of riparian area (and associated large wood that is used as cover) and loss of natural geo-fluvial processes have reduced the abundance of pools. As described for spring chinook, mortality, stress or displacement to adults will likely be greatest in the lower Entiat Assessment Unit, but occurs in lower Mad and Middle Entiat as well.

Spawning and egg incubation

Spawning areas for coho salmon in the Entiat River have been substantially altered. Spawning substrates are embedded in some areas, and natural geo-fluvial processes have been compromised, so gravel recruitment is low, and sedimentation is high. Losses of riparian areas, channel stability, and habitat diversity have all impacted coho spawning habitat. Changes in channel morphology and lost habitat diversity likely leave some redds more susceptible to disturbance or destruction due to high flow events and bedload movement.

Rearing

Rearing habitat for fry and parr has been compromised by channel simplification, loss of riparian area and large wood in the stream channel. In the Lower Entiat AU, off channel habitat, channel stability, and habitat diversity are substantially lacking.

Conclusion

Coho are in need of reintroduction to the Entiat River. As coho are reintroduced productivity could be increased if habitat problems were improved. Preservation of quality habitat in the middle Entiat AU is important to developing a naturally reproducing coho population. Increases in off channel habitat and riparian areas in the lower Entiat River would increase potential rearing habitat, over-winter survival and life history diversity. Creating or restoring habitat will increase the success of reintroduction efforts within the Entiat River.

Steelhead

Adult migration and holding: Steelhead enter the Entiat River from August through May of the following year and hold in larger pools or deeper glides until spawning begins in February. Steelhead hold primarily in the mainstem Entiat as well as the spawning tributaries. As mentioned with Chinook salmon above, lost pool habitat and habitat

diversity likely displaces steelhead from holding in many areas within the lower and middle assessment units, and to a lesser degree in the Mad River.

Spawning and egg incubation: Steelhead primarily spawn in habitats that have been altered by land use activities and natural processes. Spawning gravel is embedded in the mainstem and tributary streams. Natural geo-fluvial processes have been compromised, so gravel recruitment is low, and sedimentation is high. Steelhead egg incubation survival is likely reduced for the same reasons as described for chinook salmon above.

Rearing: See spring chinook rearing above.

Conclusion: Steelhead production in the Entiat River could increase if habitat problems within the lower basin were rectified. Preservation of quality spawning and rearing habitat in the Mad and Middle Entiat AU is important to maintain naturally reproducing populations. Increases of off channel habitat and riparian areas in the lower Entiat River would increase potential rearing habitat and life history diversity. Creating or restoring habitat will increase steelhead productivity by a modest degree, and increase the spatial and potential life history diversity within the Entiat River.

Bull trout

Adult migration and holding: Bull trout of the Entiat River may live their entire lives within it, or may migrate between the Mad, Entiat, and mainstem Columbia R Bull trout of the Entiat Basin primarily spawn primarily in the upper Mad River in habitat that has either been preserved or is in relatively good condition. Bull trout are also known to spawn in the mainstem Entiat but it is uncertain to what degree.

Bull trout of the Entiat Basin primarily spawn primarily in the upper Mad River in habitat that has either been preserved or is in relatively good condition. Bull trout are also known to spawn in the mainstem Entiat but it is uncertain to what degree.

Rearing: Rearing habitat for fry and parr is in generally good condition, however winter rearing has been compromised by loss of riparian area, off channel habitat, channel stability, and habitat diversity.

Conclusion: Bull trout production in the Entiat River Basin could increase if habitat problems were rectified. Potentially increases of off channel habitat and riparian areas in the lower Entiat River, would increase potential rearing and adult holding habitat and life history diversity. While creating or restoring habitat may not increase overall bull trout production by a significant degree, it does increase the spatial and potential genetic diversity of bull trout in the Entiat River.

Bull trout are more sensitive than other species to habitat degradation. Water quality requirements for bull trout require the preservation and restoration of high functioning habitat. Processes that affect temperature, sediment load and connectivity from lower quality (feeding areas) to higher quality (spawning and initial rearing areas) should all be considered when trying to increase overall production of bull trout.

Westslope Cutthroat Trout

Life History

Westslope cutthroat trout (WSCT) generally exhibit three main life histories forms; fluvial, which migrate between smaller spawning stream and larger rearing streams; adfluvial, which migrate between spawning streams and a lake, and non-migratory, which generally spend their entire lives in the stream they were born in. Much of the life history of WSCT in the Entiat Subbasin is unknown.

Adult migration and holding

WSCT may live their entire lives in the tributaries to the Entiat and Mad rivers or they may migrate to the mainstem and possibly to the Columbia River. When adults are migrating upstream to spawning areas, they associate with cover; debris, deep pools and undercut banks. The availability of and number of deep pools and cover is important to offset potential prespawning mortality. Adult cutthroat trout need deep, slow moving pools that do not fill with anchor ice in order to survive the winter. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Spawning and egg incubation

WSCT spawn between March and July, when water temperatures begin to warm. Spawning and rearing streams tend to be cold and nutrient poor. Stream conditions (e.g. frequency of flooding, extreme low temperatures) may affect egg survival. Flood can scour eggs from the gravel by increasing sediment deposition that reduces oxygen and percolation through the redd.

In the Entiat Subbasin, fall flooding has a high frequency of occurrence. This may negatively affect incubation and emergence success, especially in years of extreme flows. Fire and other disturbances in the upper watershed may increase siltation. Maintaining a high degree of habitat complexity in these areas is important to maintaining and enhancing these populations.

Rearing

After emergence, fry are usually found in shallow, slow backwater side channels or eddies, in association with fine woody debris. Juvenile cutthroat trout overwinter in the interstitial spaces of large stream substrate. Rearing habitat in Mad, and upper Entiat rivers is currently in good condition.

Conclusion

Westslope Cutthroat Trout production in the Entiat Subbasin is likely to remain healthy given existing environmental conditions persist. Preservation of quality habitat in upper tributaries and small streams within the watershed would ensure remaining high quality habitat areas remain in tact. Production of cutthroat trout could increase if brook trout control programs were implemented successfully.

Pacific lamprey

Currently there is not enough information concerning this species in the Entiat subbasin to draw conclusions.

6.3 Determination of Restoration Priorities

The Entiat River has been affected by upland management activities throughout the subbasin and construction of flood control dikes in the lower mainstem. To encourage properly functioning and stable habitats in the subbasin, four actions should be approached simultaneously:

- Protect core subwatersheds in the upper subbasin and upper Mad River
- Continue restoration of highly erosive upland areas in Fox, McCree, Brenegan, Preston, and Mud creeks, Crum Canyon, and the mainstem Entiat between Fox and Stormy creeks
- Restore habitat diversity and channel function in the lower Entiat River
- Increase late summer instream flows in the lower Entiat and lower Mad rivers

Upland erosion is a severe chronic problem in the Entiat Watershed, yet substantial restoration efforts are underway in the Entiat National Forest to address this problem. Erosion on private lands contributes little to the overall problem of sediment delivery to the stream.

Low stream channel complexity is the primary limitation to productivity of salmonids on the lower 20-km of the mainstem Entiat River (downstream of the terminal moraine: Category 2). Stream sinuosity is low, with very few point bars for gravel accumulation. Instream habitat diversity is also low, with few pools, glides, pocket waters or LWD accumulations. As a result, there are very few resting areas for both adult and juvenile salmon through this important migration corridor. Efforts to improve stream sinuosity and channel forming processes in the lower reach should be implemented.

Based on the work of NRCS, we believe the most feasible means to restore habitat in the lower Entiat River is primarily in structure placement as an immediate improvement, and floodplain restoration as the long-term solution. This short term/long term approach is the most pragmatic restoration practice available for the lower Entiat River. Initially, managers should actively restore the lower Entiat River to increase stream habitat complexity, encourage thalweg development, and deposition of spawning gravels. The long-term approach should be to restore riparian and floodplain habitat in the lower Entiat River. Such measures would also be feasible in the lower Mad River.

A multi disciplinary team of fishery biologists, hydrologists, and fluvial geomorphologists can provide specific recommendations on the types of structures that would work best, based upon channel configuration. Active restoration projects will be reviewed on a case-by-case basis. We caution that these approaches to increase productivity are short-term, and may require maintenance. The lower Entiat River is one of the few watersheds in the Upper Columbia Region where active manipulation of the stream channel is appropriate.

The most pressing needs on the lower Entiat River are the lack of instream complexity and riparian cover, yet there are other factors that adversely affect salmonids. Instream flows limit salmonid production in the lower Entiat River, but not to the chronic and

severe extent seen in other subbasins of the Upper Columbia Region. This is partly a result of the natural characteristics of the watershed, upland slope condition, irrigation water withdrawals, and stream channel modifications in lower Entiat River. Projects that increase late summer flows in the lower Entiat River should be an important component in salmonid recovery.

Priorities in Species Distribution

Threatened, endangered and unlisted salmonids are found in most, but not all watersheds in the Upper Columbia Region. In order to help guide protection and restoration programs, the Regional Technical Team (RTT) adapted the work of MacDonald et al. (1996) who identified Significant Subwatersheds (HUC-6 level) for spring chinook salmon, summer chinook salmon, sockeye salmon, summer steelhead, bull trout, and westslope cutthroat trout. Based on the framework established by MacDonald et al. (1996), the RTT considered a subwatershed to be significant if any one of the following criteria was met:

The subwatershed was identified as a stronghold for the species in the Interior Columbia Basin Assessment (ICBEMP 1997).

The subwatershed provides the primary spawning and/or rearing habitat within the watershed.

The subwatershed represents the only known occupied habitat within a watershed and is fairly isolated from populations in other watersheds, and thus is significant from a distribution standpoint.

The subwatershed contributes toward the genetic integrity of a species. One of the problems facing many native fish populations is genetic introgression. Relatively pure populations, which may be very important to the evolutionary legacy of a species, may be limited. Recently genetic information has become available for some populations in the Upper Columbia Region. Populations judged to be “pure,” “essentially pure,” or “good” based upon genetic analysis were considered to be significant.

The subwatershed is known or strongly suspected to support a stable, strong population of a species.

Appendix C contains maps of RTT identified Significant Subwatersheds for sockeye salmon, spring chinook salmon, summer chinook salmon, steelhead, and bull trout. The designation of Significant Subwatershed does not necessarily depict the total distribution or life history stages of salmonids in the Upper Columbia region. The status of some salmonid species is not fully known.

Priorities Across Varied Landscapes

The consensus of the RTT is that protection and restoration should focus first on maintaining the best remaining examples of biological integrity, connectivity, and diversity. This strategy will allow the populations to stabilize in abundance and productivity over the long term. It may be likely however, that current core populations have inadequate diversity and spatial distribution to ensure population resiliency.

To provide a framework to set priorities consistent with this strategy, the RTT classified each watershed (HUC-5 level) in the Entiat subbasin into four categories, based on the functionality of the aquatic ecosystems in those watersheds, and the capability of the ecosystem to protect against ecological catastrophe for endemic populations. The RTT adapted the classification system used by Quigley and Arbelbide (1997) for this report. In general, Category 1 watersheds should receive priority allocation of financial and/or management resources. Subsequent allocation of resources should be given to Categories 2 and 3, in that order, once refuge habitats (Category 1) for the target species are protected and secure. This does not mean however, that specific actions should not occur in Category 2 and 3 watersheds until all activities in Category 1 watersheds are completed. Any project within those watersheds that increase the range, life history diversity, or age cohorts of one or more species would contribute to the overall strategy of making them more robust to disturbances within and outside the region. As salmon recovery progresses, founder populations from core areas would colonize many watersheds that are suitable, yet unoccupied. Restoration of Category 4 watersheds should be considered in the regional recovery planning process, but immediate actions there would not be a priority.

Category 1

These watersheds represent systems that most closely resemble natural, fully functional aquatic ecosystems (Table 22). In general, they comprise large, often continuous blocks of high-quality habitat and subwatersheds supporting multiple populations. Connectivity among subwatersheds and through the mainstem river corridor is good, and more than two species of federally listed fish are known to occur. Exotic species may be present but are not dominant. Protecting the functioning ecosystems in these watersheds is a priority.

Category 2

These watersheds support important aquatic resources, often with subwatersheds classified as strongholds for one or more populations throughout. The most important difference between Category 1 and Category 2 is an increased level of fragmentation that has resulted from habitat disturbance or loss. These watersheds have a substantial number of subwatersheds where native populations have been lost or are at risk for a variety of reasons. At least one federally listed fish species can be found within the watershed. Connectivity among subwatersheds may still exist or could be restored within the watershed so that it is possible to maintain or rehabilitate life history patterns and dispersal. Restoring ecosystem functions and connectivity within these watersheds are priorities.

Category 3

These watersheds may still contain subwatersheds that support salmonids. In general, however, these watersheds have experienced substantial degradation and are strongly fragmented by extensive habitat loss, most notably through loss of connectivity with the mainstem corridor. At this time, there are limited opportunities for restoring full expression of life histories for multiple populations found within the watershed. The priority for funding in these watersheds should be to rectify the primary factor that is causing the habitat degradation.

Category 4:Table 1

These watersheds contain both functional and non-functional habitats that historically supported populations of one or more federally listed species (Table 1). Exotic species may now be dominant in one or more subwatersheds; native species are typically not present in sustainable numbers.

Table 22. Comparison of key indicators for watershed categories used to identify priority actions for protection and restoration of salmonid habitat the upper Columbia region.

Category	Significant Subwatersheds	Principle Actions	Habitat Fragmentation	Exotic Species	Listed Species
1	Yes	Protection	Low	Low	Two or more
2	Yes	Protection / Restoration	Medium	Medium	One or more
3	Possible	Restoration	High	High	Possible
4	No	Restoration	High	High	Possible

Priorities in Habitat Activities

Habitat Protection

The highest priority for protecting biological productivity should be to allow unrestricted stream channel migration, complexity, and flood plain function. The principal means to meet this objective is to protect riparian habitat in Category 1 and 2 subwatersheds. Predetermined riparian protection measures (i.e., buffer strip widths) for each site may not be biologically effective. Riparian function depends on site-specific considerations including channel type, floodplain character, presence of wetlands or off-channel features, and the potential for channel migration. Obviously, some areas have more acute needs, because they may be within significant population areas, or may be at risk to habitat degradation, and should be given greater emphasis. These efforts will likely occur throughout the subbasins where properly functioning habitat remains.

Protection of existing stream flows in virtually all watersheds in the Entiat Subbasin is important to maintaining biological productivity. Currently, the primary means to protect existing flows are regulatory in nature. Additionally, some streams may need increased flows to address chronic sources of mortality to salmonids; inadequate flows may be natural or human-caused. Diversion of water for out-of-stream uses (principally for irrigation and municipalities) is the most tangible impact to instream flow needs for fish. In addition, degradation of floodplain (and some upland) habitats exacerbates the peak and nadir of seasonal flows in all Upper Columbia subbasins; this strongly reduces the productivity and expression of diverse life histories in the region. The full effects of upland habitat degradation on peak flows in the Entiat Subbasin are not understood and should be assessed. The means to increase flows are discussed in the section on habitat restoration.

Habitat Restoration

The highest priority for increasing biological productivity is to restore the complexity of the stream channel and floodplain. The RTT recommends a range of strategies for habitat restoration in the Upper Columbia Region, based on a fundamental emphasis of promoting habitat diversity, instream flows, and water quality throughout the watershed. Most of these efforts will likely be on the lower stream reaches and aggradation zones (typically areas of low stream gradient where deposition of substrate materials occurs). Restoration in these areas would benefit a broad range of species and populations.

The RTT Biologic Strategy (2003) strongly recommends that structural manipulation of the stream channel (such as boulder or log placements) not be used unless (1) they are designed at the reach level or context and (2) those factors that are causing the habitat degradation cannot be corrected within a reasonable time. Remedial measures to rectify the effects of improper land use practices can have more benefits to biological productivity, may be economically more efficient, and be more permanent than measures that require active management of the stream channel. The simple alteration of physical features in the stream channel does not necessarily restore biological productivity when improper riparian or upland management practices continue to exert their effects on the aquatic ecosystem. Attempts to restore habitat are likely to fail if structures are placed in the stream channel without addressing those activities that are causing habitat degradation. For example, some short-term habitat benefits might be achieved by adding large woody debris to streams, but the benefits can only be temporary from an ecological perspective unless riparian management practices ensure the long-term recruitment of LWD from the riparian zone.

In some isolated situations, restoration projects may be accomplished with both short-term and long-term objectives. For example, LWD may be secured to stabilize erosive banks, allowing interim streambank protection and salmonid habitat, while passive restoration and re-vegetation will ensure proper functioning riparian conditions for the long term. We feel these projects are biologically effective when the initiation of the short-term strategy has been integrated with the long-term strategy. Each active restoration project should be reviewed on a case-by-case basis.

Table 23. Categories of watersheds

Watershed	Category	Significant Watersheds
Upper Entiat	1	2
Middle Entiat	1	2
Lower Entiat	2	0
Mad River	1	3

Note: (HUC-5 level) and number of Significant Subwatersheds (HUC-6 level) within those watersheds in the Upper Columbia Salmon Recovery Region. Definitions of watershed categories and Significant Subwatersheds are provided in text.

6.4 Terrestrial/Wildlife

6.4.1 Key Findings

The terrestrial assessment viewed the subbasin from a perspective of key and major vegetative communities. Three community types were chosen as focal habitat for this evaluation, ponderosa pine, shrub steppe and riparian ecosystems. Within each of these focal habitats, representative species that are directly associated with these vegetative communities are identified and will be monitored.

Factors Affecting Ponderosa Pine Habitat

- Timber harvesting has reduced the amount of old growth forest and associated large diameter trees and snags.
- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.
- Fragmentation of remaining tracts has negatively impacted species with large area requirements.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.

Factors Affecting Shrubsteppe Habitat

- Degradation of habitat from intensive grazing and invasion of exotic plant species.
- Fire management, either suppression or over-use, and wildfires.
- Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrub-steppe/grassland communities.
- Human disturbance during breeding/nesting season, parasitism.

Factors Affecting Riparian Wetland Habitat

- Habitat degradation from livestock overgrazing which can widen channels, raise water temperatures, reduce understory cover, etc.

- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.

6.4.2 Aquatic/Fisheries

This synthesis and interpretation of information presented in the assessment section of this plan, focuses on key habitat features that affect the focal species. Focal species of the Entiat River are: spring and summer/fall chinook, steelhead, bull trout, and westslope cutthroat trout.

I. Key findings

Key Findings tie together the information from the subbasin assessment that discusses status of focal species and key habitat features and how the two work in concert.

Lower Entiat River Assessment Unit

Key Findings:

Temperature

- Water temperatures are believed to be elevated from historic levels.
- Conditions are exacerbated by land use practices during low flow years.
- Water temperature typically exceeds state water quality standards from July through September, although exceedences are usually of short duration and diurnal in nature.
- Very cold winter temperatures affects egg incubation survival, time of emergence, and winter rearing habitat for focal species and may also affect macro invertebrate production in some years.

Contaminants - Non-point Source Pollution

- Water quality for the Entiat River is generally in good to excellent condition.
- The use of herbicides and pesticides in lower Entiat may affect focal species health.
- Fecal coli form levels are generally below acceptable limits however, occasional exceedences of CWA standards have occurred.
- Unrestricted livestock access to streams may result in elevated fecal coli form levels.

Contaminants - Point Source Pollution

[No information to date]

Sediment

- The Lower Entiat lies within the depositional zone of the subbasin.
- Road densities, unstable banks, and natural/human caused disturbance events all contribute to fine sediment conditions.

- The 11-year trend of sediment deposition appears to be increasing.

Flow

- Mainstem and tributary flows are highly variable and very responsive to local weather.
- Peak flow timing is assumed to be at or near historic conditions, with current peak flows showing signs of recovery from past fires.
- Low flows are a natural occurrence within the subbasin.
- Irrigation water use during the low summer flow period, coupled with increased channel width-to-depth ratio in the lower Entiat River, may exacerbate poor conditions.

Riparian Conditions

- Riparian conditions near confluence with the Columbia River show vigor and contribute positively to stream channel diversity and properly functioning conditions.
- Channel straightening, clearing and diking/bank armoring have changed riparian and floodplain conditions.
- Riparian cover is reduced (in various degrees) and LWD recruitment is low. Filling and diking has eliminated floodplain connection in areas.
- In some reaches, loss of vigorous shrubs in the riparian zone has reduced instream organic input and shade, and contributed to unstable stream banks and associated erosion.
- Road densities are generally high and in close proximity to streams.
- These conditions have reduced available spawning, rearing and holding habitat for juveniles and adult focal fish species.

Habitat diversity, quantity, and channel stability

- Channel morphology has been simplified as a result of channel straightening/widening, diking, and bank armoring.
- The lower Entiat has been changed in many reaches to a Rosgen F type channel, resulting in a high width-to-depth ratio, channelization, stream down-cutting, and a substantial lack of habitat diversity.
- The amount of large woody debris is very low throughout the Assessment Unit.
- Pool habitat has been reduced by 80% (Entiat Watershed Plan) from historic conditions.
- Quality and quantity of rearing and holding habitat, off-channel winter rearing habitat, and spawning habitat have been reduced throughout most of the Lower Entiat River.

Barriers

- There are no physical structures in the lower mainstem Entiat River.

Pathogens

- Pathogens to salmonid species may have increased as a result of hatchery operations and fish species introductions.

Predation

- Bird and fish predation on salmonid juveniles is likely to have increased due to a lack of hiding cover.
- Smolt releases from the Entiat National Fish Hatchery result in increased avian predation.
- Reduced in-channel habitat diversity and development of Lake Entiat (Rocky Reach Hydro Project) have increased the abundance of non-native fish species, particularly predators such as the Northern Pikeminnow and bass.
- Mammal predation on adult salmonids is likely decreased from the historic reference condition due to displacement of these animals.

Food

- Food resources (macro invertebrate production) for juvenile salmonids have likely decreased since the historic reference condition as a result of increased water temperatures and decreased organic inputs and nutrient loads.
- Reduced salmonid carcasses, reduced riparian / leaf litter and reduced floodplain function have contributed to a lowering of the nutrient content and benthic macro invertebrate production within the lower Entiat.

Harassment

- Harassment of adult salmonids is largely a function of lack of hiding cover coupled with recreation use of the river.
- At this time there is no formal public outreach to educate people of the sensitivity of these fish to disturbance, especially during adult holding and spawning times.

Introduced Species

- Hatchery operations and past stocking may have reduced the genetic fitness of focal species and resulted in competition for habitat in the lower River.

Middle Entiat River Assessment Unit

Key Findings:

Contaminants - Non-point Source Pollution

Most water quality attributes are at or near pristine condition.

Sediment

- 11-year trend in mainstem appears to be a long term-decrease.
- 11-year trend for tributary streams is less clear, but also appears to be a long-term decrease.
- Riparian clearing and roading has resulted in bank erosion and increased sediment delivery in some areas.

Flow

- Flow conditions in the Middle Entiat Assessment Unit are at or near pristine conditions.
- Some alterations may exist due to past high intensity fires, although these conditions are considered to be within the range of natural variation.

Riparian condition

- Riparian condition and floodplain function has been reduced in many reaches with the exception of the Stillwaters area between Stormy and Preston Creeks.
- Fair conditions exist in localized areas (20-30% of AU stream area) where fire, riparian clearing / development, channel simplification (dikes to prevent channel migration) and grazing have resulted in accelerated channel migration and erosion.
- Roads are present in the riparian area near the mainstem Entiat River and some tributaries.
- Road densities in Preston and Brennegan creeks (most are contour roads that cross the creeks) are as high as 6mi/sq.mi.
- Riparian clearing and roading has resulted in a loss of side channel habitats, backwater pools and stream / riparian interface.

Habitat diversity, quantity, and channel stability

- Stream and fish habitat conditions have been reduced.
- General channel features, such as sinuosity, width/depth ratios exhibit near normal features. Localized bank erosion, and loss of habitat diversity and channel complexity is apparent due to stream channel clearing and development.
- In low-gradient areas, loss of side channel habitat has resulted to a loss of off-channel refugia during high flows.
- Where off-channel habitat does exist, it is in stable condition.
- Large woody debris recruitment and overall pool frequency in this AU has been diminished.
- Recruitment of LWD has been reduced in the 1970-fire area (Fox Creek to Box Canyon) as well as the 1994 fires due to past clearing/post-fire activities.

- Recruitment downstream of Fox Creek is limited, however increases are occurring due to blow-down of dead trees, and pool habitat below Fox Creek is recovering.
- Box Canyon also restricts the through-movement of LWD, thus limiting recruitment below this area.

Fish Passage

- Fish passage throughout the mainstem of this Assessment Unit is at the historic reference condition.
- Passage in several tributary streams is hindered or blocked, primarily for juvenile life stages.
- The amount of habitat upstream of potential problematic tributary culvert barriers is limited.

Harassment

- Reduced hiding cover and increased recreational use of the river has increased the harassment of adult salmonids.

Food

- Carcass availability and nutrient supply for macro invertebrate production has been reduced, thereby reducing the available food source for all native fish species in this area.

Upper Entiat River Assessment Unit

Key Findings:

Water Quality

- Water quality is at pristine condition.

Flow

- Flows are at or near the historic reference condition.

Riparian Conditions

- Riparian and floodplain attributes are stable and considered to be at or near the historic reference condition.
- Some localized compaction and disturbance of riparian vegetation is noted due primarily to trails/recreation, although these are minor at the watershed scale.

Habitat diversity, quantity, and channel stability

- In-channel attributes are considered to be at or near historic reference condition.
- Beaver were trapped from this area long ago and some channel modifications from historic are likely.

Fish Passage

- There are no man-made barriers to fish passage in this Assessment Unit.

Introduced Species

- Brook trout have been introduced and remain in this assessment unit.
- Exogenous rainbow trout are also established.

Mad River Assessment Unit

Key Findings

General Watershed Conditions

- Watershed attributes are considered to be in generally good condition.
- Relatively high human alterations have degraded conditions in the Tillicum watershed and lower Mad River.
- Road densities in the Tillicum Creek watershed are high and may contribute to modest alteration of flow timing and runoff patterns.
- The upper portions of the Mad River are considered to be at or near historical conditions.

Temperature

- Water temperature in the lower Mad River exceeds state water quality standards from July through September.
- The Mad River is minimally affected by direct management of riparian and valley bottom vegetation from RM 4 to the headwaters (nearly 20 miles).
- Water temperatures are believed to be at or near the historic reference condition, although there may be some elevation of this Assessment Unit during low flow years due to past wild fires in riparian areas.

Sediment

- Sediment monitoring over the last 11 years indicates that sediment loads in the lower Mad River (RM 1.3) average 16.9% composition (<1.0 mm).
- Measurements indicate that sediment rates are moderately variable but in a long-term stable and decreasing trend.

Flow

- Flow conditions for the Mad River Assessment Unit are at or near the historic reference condition.
- Past logging and roading may have increased peak flows slightly in the Tillicum Creek watershed.

Riparian Conditions

- Riparian attributes and floodplain function is generally in fair to good condition in this Assessment Unit.
- Some residential development and agricultural land use has degraded riparian vegetation along the stream, and the County road confines the stream channel in the lower 2-3 miles of the Mad River.

Habitat diversity, quantity, and channel stability

- In-channel attributes have been reduced for salmonid rearing and holding in various locations within the Assessment Unit.
- A reduction in large wood and pool habitat is noted, although the trend in LWD recruitment to the Mad River and the creation of pool habitat is increasing.
- Channel confinement in the lower Mad River as a result of the County road has accelerated erosion, degraded habitat diversity and reduced the amount of useable habitat for the focal species.
- Tillicum Creek experiences embeddedness due to sediment deposition associated with higher road densities.

Fish Passage

- Construction of recreational dams/swimming holes that have the potential to block passage of focal species are an ongoing issue of concern in the lower Mad River.
- Two potential barriers to steelhead passage exist within ¼ mile of one another in Tillicum Creek near RM 2.
- A partial barrier exists slightly upstream of the upper barrier.

Ecologic

- Many ecologic attributes remain intact from the historic reference condition.
- The confluence of Cougar Creek and Mad River is known to be a critical area for bull trout spawning and rearing.
- Headwaters of the Mad River are in natural conditions and are highly functioning habitats for cutthroat.

Food

- Reduced input from carcasses and nutrients may have decreased the food base for native fish species.

6.4.3 Hypotheses Statements

Hypothesis statements are based on the key findings and address the condition and ecological interrelationships within the subbasin.

Subbasin Level

Water Quality

Decreasing elevated summer water temperatures to a maximum of 16 °C through out the Entiat subbasin will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, and rearing.

Water Quantity

Maintaining the current flow regime throughout the Entiat Subbasin will support and maintain an increase in survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Lower And Middle Entiat

Water Quality

Reducing point source and/or non-point source pollution in the Lower and Middle reaches will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Riparian Floodplain

Increasing riparian shade will decrease instream temperatures thus increasing survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding

Contaminants

Maintaining or lowering contaminant levels within the Lower and Middle Entiat to at or below Clean Water Act standards will prevent 303d listings and increase the health and survival of all focal species using the areas.

In-channel Habitat

Increase channel complexity and diversity will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Sediment

Maintaining or reducing sediment loads will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Nutrients

Increasing nutrient loads will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding

Harassment

Reduction of harassment will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning and pre-spawn holding.

Barriers

Providing passage to native salmonids will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Lower and Middle Entiat, and Mad River

Riparian Floodplain

Improving or restoring riparian floodplain will increase floodplain function and overall health within the Lower and Middle Entiat, and the Mad River.

In-channel Habitat

Increase channel complexity and diversity will increase habitat capacity and quality for all species and life stages that inhabit this area.

Harassment

Reduction of harassment will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat, and the Mad River, for the following life stages: spawning and pre-spawn holding.

Middle And Upper Entiat

Exotic Species

Reduction in exotic species will increase survival of steelhead, bull trout and westslope cutthroat trout in the Middle and Upper Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

General Habitat

Maintaining current habitat conditions will increase the probability of success for programs initiated in other parts of the subbasin to increase productivity of focal species.

6.4.4 Reference Conditions

Reference conditions discuss in general terms the historic, current, and desired future health of focal species populations within the subbasin.

Abundance and productivity

Focal species within the Entiat Basin are believed to be at abundance levels less than they were historically. While no estimates of historic abundance are known, harvest in the lower Columbia River in the middle part of the 19th century and habitat degradation within the Entiat River (including an impassable dam constructed near its mouth), all

reduced the abundance of anadromous and other migratory (e.g., fluvial bull trout) species.

Chapman (1986) stated that large runs of chinook and sockeye, and lesser runs of coho, steelhead and chum historically returned to the Columbia River. Based on the peak commercial catch of fish in the lower Columbia River and other factors, such as habitat capacity, he estimated that approximately 588,000 spring chinook, 554,000 steelhead, 3.7 million summer chinook, (for the entire Columbia Basin) was the best estimate of pre-development run sizes. Runs of summer/fall Chinook, sockeye, coho, spring Chinook, and steelhead were relatively abundant in upper Columbia River tributary streams prior to the extensive resource exploitation in the 1860s. By the 1880s, the expanding salmon canning industry and the rapid growth of the commercial fisheries in the lower Columbia River had heavily depleted the mid and upper Columbia River spring and summer chinook runs (McDonald 1895), and eventually steelhead, sockeye and coho (Mullan 1984, 1986, 1987; Mullan et al. 1992). The full extent of depletion in upper Columbia River salmonid runs is difficult to quantify because of limited historical records, but the runs had been decimated by the 1930s (Craig and Suomela 1941). Many factors including construction of impassable mill and power dams, un-screened irrigation intakes, poor logging and mining practices, overgrazing (Fish and Hanavan 1948; Bryant and Parkhurst 1950; Chapman et al. 1982), and private development of the subbasins, in combination with intensive fishing, all contributed to the decline in abundance of Upper Columbia basin salmonids.

Spring Chinook

Spring chinook counting at Rock Island Dam began in 1935. Numbers (adults and jacks) in the period 1935-39 averaged just over 2,000 fish. Average counts fluctuated on a decadal average from the 1940s to 1990s from just over 3,200 (1940s) to over 14,400 (1980s), with recent counts (2000-2002) averaging almost 29,000. The long-term average of spring chinook passing Rock Island Dam is just over 8,900. Counts at Rock Island Dam have been heavily influenced since the 1980s by Leavenworth NFH returns.

Redd counts in the Entiat River basin have been conducted since 1962. Decadal averages are 205, 143, 89, 33, and 81 between 1962 and 2002, with a long term average over the spanning years of 110.

For the Entiat River, Ford et al. (2001) recommended an interim recovery level of 500 spawners per year. The historic redd counts suggest an escapement ranging from 2 to 845, and has averaged 215 since 1962.

Current productivity is affected by loss, or degradation of habitat in spawning and rearing areas, increased downstream mortality through the mainstem Columbia River, ocean conditions, and other abiotic factors (drought, etc.).

Mullan et al. (1992) postulated that current production may not be greatly different than historic for spring chinook. Caveats to this postulate are that native coho are extinct, production comes at a higher cost in terms of smolt survival through the mainstem corridor, and that harvest is drastically reduced (e.g., over 80% in the lower Columbia River in the late 1930s, early 1940s). However, recent estimates of natural replacement

rates for spring chinook suggest that they were not replacing themselves in most years until the broods of the late 1990s.

Steelhead

Steelhead counts began at Rock Island Dam in 1933, and annual counts averaged 2,800 between 1933 and 1939 (these numbers do not reflect large fisheries in the lower river that took place at that time, estimated by Mullan et al. (1992) as greater than 60%). Average decadal numbers changed little in the 1940s and 1950s (2,600 and 3,700, respectively). Large hatchery releases began in the 1960s, and the average counts increased to 6,700. In the 1970s, counts averaged 5,700 and 16,500 in 1980s (record count of about 32,000 in 1985). In the 1990s, counts decreased, following a similar trend as chinook, to 7,100, while, similar to chinook, they have increased substantially so far in the 2000s, with an average of over 18,000 (a high of 28,600 in 2001).

Beginning in 1997 (no survey was conducted in 1998), the USFS has been conducting limited spawning ground surveys for steelhead in the Mad River (Archibald 2003). The area covered has increased from the first 3 miles of the Mad River to up to 10 miles (currently the first 7 miles) of the Mad River. Roaring Creek has been surveyed too, but not the mainstem Entiat River. The number of “definite” redds has ranged from 0 (1999) to 38 (2003), averaging 13. Beginning in 2003, the USFWS began counting redds in the Entiat River from approximately RM 2-28. Eighty redds were found in the first year (K. Terrell, personal communication to C. Peven, May 2004).

Ford et al. (2001) recommended interim recovery levels of about 500 naturally produced spawners for the Entiat, using similar criteria that were used for spring chinook.

Current productivity is affected by loss, or degradation of habitat in spawning and rearing areas, increased downstream mortality through the mainstem Columbia River, ocean conditions, and other abiotic factors (drought, etc.).

Mullan et al. (1992) postulated that current production may not be greatly different than historic for steelhead. Caveats to this postulate are that native coho are extinct, production comes at a higher cost in terms of smolt survival through the mainstem corridor, and that harvest is drastically reduced. However, recent estimates of natural replacement rates for steelhead suggest that they are not replacing themselves in most years until the broods of the late 1990s.

Late-run chinook

Late-run chinook did not historically spawn in the Entiat River (Craig and Suomela 1941; Mullan 1987).

Decadal averages of summer/fall chinook escapements at Rock Island Dam from 1933 through 2002 show a rising trend. Harvest rates in the 1930s and 1940s were very high in the lower river fisheries, and no doubt had a large impact on the escapement at Rock Island (Mullan 1987). In 1951, when harvest rates in zones 1-6 (lower Columbia River) were reduced, numbers increased dramatically. Between the 1930s (starting in 1933) and 1960s (excluding 1968 and 1969), total (adults and jacks) decadal average numbers of summer/fall chinook rose from just over 7,000 to almost 28,000. Numbers remained high

in the 1970s until the mid-1980s, when they declined through the 1990s and have shown a sharp increase in the 2000s.

Redd counts have been conducted in the Entiat River since 1957. Counts ranged from 0-55 between 1957 and 1991 (Peven 1992). Between 1994 and 2002, Hamstreet and Carie (2003) estimated the number of summer/fall chinook redds ranging between 15-218, averaging 75.

Current productivity is affected by loss, or degradation of habitat in spawning and rearing areas, increased downstream mortality through the mainstem Columbia River, ocean conditions, and other abiotic factors (drought, etc.).

Coho

An estimated run size of 9,000-13,000 coho salmon historically spawned in the Entiat River (Mullan 1984). Currently the indigenous stock of coho salmon is extirpated from the Entiat River and in need of restoration. Successful reintroduction efforts in the Wenatchee and Methow Rivers will likely be expanded to include the Entiat River in the near future. Similar reintroduction methods will also be used. Mid-Columbia coho reintroduction (Wenatchee, Entiat, and Methow) is identified as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document (Tribal Restoration Plan) and by the four Columbia River Treaty Tribes and has been affirmed as a priority by the Northwest Power Planning Council.

The historic productivity of coho salmon within the Entiat Basin is not known, however it is reasonable to assume that it was higher than can currently be expected for reintroduced coho based on habitat degradation in spawning and rearing areas.

Bull trout

Historic productivity of bull trout within the Entiat Basin is not known. However, it is reasonable to assume that it was higher, based on habitat degradation and management practices (harvest). Current productivity appears to be improving based on redd counts and other factors.

Bull trout redd surveys have been conducted by the USFS in the Entiat River Basin since 1989, primarily in the Mad River. Since 1989, the number of redds observed has averaged 24, and has increased, primarily since 1997. Archibald and Johnson (2002) attribute the increase in bull trout redds in the Mad River to the closure of bull trout fishing in 1992 and the closure to all fishing (from the mouth to Jimmy Creek) since 1995. Bull trout are also known to spawn in the mainstem Entiat but it is uncertain to what degree.

Westslope cutthroat trout

Historic productivity of westslope cutthroat trout within the Entiat Basin is not known. However, it is reasonable to assume that it was higher, based on habitat degradation and management practices (hatchery plants). There are no known estimates of current abundance within the Entiat River Basin.

Summary

Below is a summary of the some key indicators relating to population health of the focal species, looking at presumed historic, current, potential, and future (if no action was taken) status.

Table 24. Key indicators to population health of focal species in the Entiat subbasin

	Distribution	Abundance	Productivity	Diversity
Spring chinook				
Historic	High	Moderate	Moderate	Moderate
Current	Mod-high	Low	Low-mod.	Low-mod.
Potential	High	Moderate	Moderate	Moderate
Future w/ no action	Mod-high	Low-mod.	Low-mod.	Low-mod.
Steelhead				
Historic	High	Low-moderate	Moderate	High
Current	Mod-high	Low	Low	Moderate
Potential	High	Low-moderate	Low-moderate	Mod-high
Future w/ no action	Mod-high	Low	Low	Moderate
Sum/fall chin.				
Historic	None	none	none	none
Current	Moderate	Low	low	low
Potential	Moderate	Low	low	low
Future w/ no action	Moderate	Low	Low	Low
Coho				
Historic	High	Moderate	High	High
Current	None-Low	None-Low	None-Low	Low
Potential	Moderate	Moderate	Moderate	Moderate
Future w/ no Action*	None-Low	None-Low	None-Low	Low
*No action includes no active coho reintroduction to date				
Bull trout				
Historic	High	Low-moderate	Moderate	High
Current	Mod.-high	Low	Low-moderate	Mod.-high

	Distribution	Abundance	Productivity	Diversity
Potential	High	Low-moderate	Moderate	High
Future w/ no action	Mod.-high	Low	Low-moderate	Mod.-high
Westlope cutthroat trout				
Historic	Low-moderate	Low	Moderate	High
Current	Low-moderate	Low	Low-moderate	Mod.-high
Potential	Low-moderate	Low	Moderate	High
Future w/ no action	Low-moderate	Low	Low-moderate	Mod.-high

Note: Low = < 500 spawners; Moderate= 500-1,000; High= > 1,000

6.4.5 Near Term Opportunities

Because coho salmon spawn and rear in habitats different than the other focal species, the reintroduction of coho salmon represents a tremendous opportunity to increase natural salmonid production and biodiversity in the Entiat River.

Current properly functioning habitat occurs in the mid- to upper portions of the Entiat River AU and Mad River AU. These areas hold the best spawning and rearing habitat for bull trout, spring chinook, steelhead, and westslope cutthroat trout.

Access to portions of the upper Entiat and Mad rivers are blocked by natural migration barriers (falls) (Figure 17). One postulate is that a thermal blockage may occur for migrating adult summer/fall Chinook in the lower Entiat River, but this has not been investigated yet. Some culverts within some tributaries inhibit juvenile fish from reaching rearing areas.

One of the main limiting factors for focal species in the Entiat River is the availability of off channel habitat in the lower assessment unit. Because of various land use practices, off channel habitat has been limited within this reach. Downstream migrant and potentially some adult migrants would benefit if more of this habitat was created for hydrologic refugia and increased trophic opportunities.

Near term opportunities are a list of potential restoration or enhancement projects that have been identified as having relatively high benefit to subbasin planning goals and objectives. This list is not intended to be comprehensive for salmon recovery, nor is it intended to provide the basis for prioritization. These projects can be accomplished within a 10-year time frame and would significantly contribute towards achievement of long-term objectives and desired future conditions.

These near-term opportunities were derived from and/or are consistent with the following documents:

- Entiat Water Resources Inventory Area (WRIA) Management Plan (Final Draft; January 2004)

- Federal Watershed Assessment for the Entiat (Watershed Restoration Projects, April 1996)
- Entiat Comprehensive Resource Management Plan (Entiat River Inventory and Analysis, NRSC Stream Team Report, 1/6/98)
- Entiat Ecosystem Diagnosis and Treatment Analysis (Final Report, Mobrand Biometrics, Inc. February 2003)
- Tribal Recovery Plan; Wy-Kan-Ush-Mi Wa-Kish-Wit, (Spirit of the Salmon)

The documents above are incorporated by reference into these near-term opportunities.

The priorities for development of in-channel and floodplain restoration projects on all ownerships in the subbasin will be better defined over the next year as the Entiat Planning Unit finalizes the Entiat WRIA Management Plan under the Washington State Watershed Planning Act. Over the last several years, the Planning Unit has concentrated its support to key demonstration projects (e.g., habitat diversification in the lower Entiat). Because habitat conditions are most degraded in the Lower assessment unit, and because there are a number of opportunities for habitat improvements to benefit focal species, projects in these areas will remain as high priority within the subbasin.

The priorities for restoration projects on National Forest System (NFS) lands are reflected in Table 5.1 (Management Strategy Priorities) in Version 2.0 of the Federal Watershed Assessment for the Entiat Analysis Area. On NFS lands, emphasis will be placed on the following categories of projects: (a) burned area recovery; (b) projects that move landscape toward a more resilient condition that is better able to handle perturbations or withstand wildfire and insect/disease epidemics; and (c) access management projects designed to improve surface water control, reduce accelerated erosion/sedimentation, increase wildlife security and reduce maintenance costs.

The following summarizes key projects that are anticipated to be implemented, or substantial progress towards implementation will have been accomplished within the next 10-years:

Subbasin-Wide Opportunities

- The extent of harassment and poaching on salmonids is unknown, especially as pre-spawning adults are holding and are vulnerable. Develop and implement a long-term and sustained public education campaign and increase enforcement activities to reduce harassment and poaching of salmonids.
- Complete a comprehensive evaluation of sediment delivery into streams from the road system. Prioritize management actions and implement actions to reduce or eliminate sediment delivery for all high priority roads. Complete long-term management plan which is coordinated between all parties with authority and responsibility for the road system and the public.
- Macro-invertebrate sampling within the Entiat subbasin has been infrequent and conducted without a larger-scale strategy. Complete a long-term macro-invertebrate monitoring strategy and implement all high priority components of this strategy.

- It is generally assumed that significant biologic (primary) productivity has been lost in the mainstem and tributary streams of the Entiat River due to a decrease of salmonid carcasses left after spawning. Resource managers should evaluate the best means to replenish these lost nutrients into the stream system and implement pilot projects to determine the potential benefits to salmonids and the stream ecology.
- Evaluate bio-accumulation of toxic materials within the flesh of indicator fish species to determine the extent that these materials are entering into the ecologic and human food chain.
- Evaluate existing and potential salmonid carrying capacity in all of the Assessment Units to increase our knowledge about this areas potential contribution towards salmon recovery.
- Continue to use forward looking infrared (FLIR) technology to identify areas where important differences in water temperature may signal important micro-refugia for winter and summer rearing. FLIR information is presently available for summer months. FLIR information should be collected during winter months.

Opportunities per Focal Species

Bull trout and westslope cutthroat trout:

Populations and distribution remain widely unknown throughout the subbasin. Evaluations to better understand population characteristics of these species should continue, including but not limited to genetic analysis, abundance estimates, age distribution and spatial distribution.

Spring Chinook

The current operation of the Entiat National Fish Hatchery is to separate the production of hatchery fish from the production of the naturally reproducing population within the subbasin. The fishery co-managers, within the U.S. v. Oregon jurisdictional forum and in coordination with other regional fishery programs and obligations should begin evaluating the feasibility, suitability and implications of re-directing Program objectives to integrate the hatchery production with the naturally producing population. Implementation of this change in production strategy will occur through a collaborative effort by all stakeholders.

Late-run chinook

Any projects that would increase the off channel habitat in the lower river, decrease late summer temperature would be beneficial to late-run Chinook salmon. Projects such as the proposed “bridge to bridge,” (see below) in-channel structural diversity, and other off-channel work should be implemented as soon as possible.

Steelhead

Continue on-going efforts to count redds and determine spawning distribution. Initiate a comprehensive effort to evaluate distribution and habitat use for various life history stages.

Opportunities for Other Species

Coho

The Yakama Nation is currently in the feasibility phase for re-introducing natural coho salmon in the Wenatchee and Methow subbasins. A similar effort is currently being discussed between fishery managers for other areas within the Columbia Cascade Province, including specifically the Entiat Subbasin. The fishery co-managers, within the U.S. v. Oregon jurisdictional forum and in coordination with other regional fishery programs and obligations will be evaluating the feasibility, suitability and implications of re-directing the Entiat National Fish Hatchery Program objectives (and/or other hatchery facilities) to integrate production of coho salmon into the Entiat subbasin.

Implementation of this change in production strategy will occur through a collaborative effort by all stakeholders.

Reintroduction of coho will substantially increase anadromous salmonid production in the Entiat subbasin.

Pacific Lamprey

Very little information about this species is available for the Entiat Subbasin. Evaluations should begin that identifies species presence, habitat preferences and habitat availability. Evaluations addressing artificial propagation of this species should be coordinated with a larger and similar effort throughout the Columbia Cascade Province.

Opportunities for Habitat Needs

Entiat River – Instream Habitat Diversification:

Instream structure placement (rock cross vane structures, large woody debris, etc.) throughout the lower 20 river miles of the mainstem Entiat River. Implement Alternative 4 (Entiat WRIA Management Plan) for pool development downstream of Potato Creek and for streambank protection above Potato Creek. Multiple ownerships are involved. See NRCS Stream Team Report for details (January, 1998).

Entiat River Corridor - Riparian Planting:

Establish approximately 40,000 lineal feet of riparian planting from the mouth of the river through RM 20. Primary emphasis on maintenance of existing, native riparian vegetation, with secondary emphasis placed on planting. Multiple ownerships are involved. See NRCS Stream Team Report for details (January, 1998).

Entiat River “Bridge to Bridge” Fish Habitat Restoration:

Project proposal includes components of projects noted above, but emphasizes development and restoration of side-channel habitat. Multiple ownerships are involved.

Off-Channel Habitat:

Development of a pond (with structural diversity) and outlet stream (600’ long) to create new off-channel, rearing/refuge habitat for salmonids. This project proposal also includes bio-engineered bank stabilization work along the Entiat River at this site.

Fish Screening of Diversions and Pumps:

Installation, upgrade and/or maintenance of fish screens on water withdrawal facilities in the lower subbasin. See the 1997 WDFW Inventory of Entiat River screening needs for identification on which screens need upgrades or maintenance. Inventory update and additional screen installation work have been proposed by WDFW for Bonneville Power Administration FY2003 grant funding.

Fish Passage Maintenance and Improvement:

Various projects involving the restoration of aquatic connectivity due to problems road culverts in the Subbasin. Refer to County-sponsored culvert/fish passage inventory.

Alternative Five – Ecosystem Diagnosis and Treatment Analysis:

Five alternative restoration scenarios were evaluated for the Entiat Planning Unit using the Ecosystem Diagnosis and Treatment methodology. These alternative scenarios were primarily based upon recommendations advanced by the Entiat Comprehensive Resources Management Plan (1998). The Entiat Planning Unit has adopted to employ the intent of Alternative Five as described in Appendix XXX (Entiat EDT Watershed Analysis February 2003). These recommendations are incorporate into this subbasin plan and described in Chapter 9.4 of the Entiat Watershed Resources Inventory Area Management Plan (Final Draft; January, 2004)

Irrigation System Improvements:

A variety of conveyance and conservations improvements on the major irrigation ditches in the subbasin are recommended. The combination of the Knapp-Wham and Hannan-Detweiler systems is proposed for preliminary design via Bureau of Reclamation funding. This project would involve upgrade and extension of the Knapp-Wham system, well installations and closure of the Hannan-Detweiler ditch. The NRCS is evaluating additional opportunities for irrigation delivery and application systems technology improvements.

On-Farm Resource Management Improvements:

Ongoing planning and application of conservation practices via the NRCS's Environmental Quality Incentive Program (EQIP), Wildlife Habitat Incentive Program (WHIP), and other programs that provide cost-share opportunities that make the implementation of conservation practices economically viable, will continue. Irrigation Water Management (IWM), Nutrient Management, and Pest Management may be used to address water quality and quantity concerns.

Wetlands Improvements:

Projects targeted at maintenance or enhancement of the function of wetland areas in the subbasin, especially in the lower river corridor where sites have been modified by flood control work.

Entiaqua River Park and Outdoor Learning Center:

Project involves development of a park/learning center facility in concert with restoration of the riparian area at the mouth of the Entiat. See Entiaqua River Park Briefing Paper for

details on proposed park and related riparian restoration work envisioned at this time. Chelan PUD, City of Entiat and Chelan County lands and/or rights-of-way are involved.

Livestock Access Management:

A few locations in the lower river corridor need fencing and off-stream water development to restrict stock access to riparian areas and stream banks.

Entiat Valley Road Rehabilitation Projects- Chelan County and USFS:

- Road relocation and riparian/stream bank restoration at MP 16.3 (CC ROW)
- Fill slope stabilization at MP 17.2 (upper end of Thomas property; CC ROW)
- Fill slope stabilization at site just within NF boundary (“wood duck site”)
- Possible correction of Valley Road-River overflow concerns at several other sites
- Improvements to stream crossings at Mud and Potato Creeks
- Other Valley Road sites to be identified in next version of project list

Improvement of Road Management Practices on State and Private Lands:

Cooperative effort to improve road maintenance and management practices on roads in the lower Entiat River corridor to improve surface water control, reduce sedimentation and improve/maintain fish passage. Projects include improved management of lower Mud Creek and lower Tyee roads; crossing replacements in Stormy Creek, etc.

Water Use and Instream Flows:

The Entiat Planning Unit is on course to establish instream flows in the next couple years for portions of the Entiat subbasin. Associated with establishing instream flows the Entiat Planning Unit has identified many water conservation and administrative recommendations designed to benefit human and natural resource needs. Incorporate by reference management recommendations identified in Chapter 9.3 of the Entiat Watershed Resources Inventory Area Management Plan (Final Draft; January, 2004).

Water Quality:

The Entiat Planning Unit has recently approved a suite of actions that continue to monitor and improve water quality throughout the Entiat subbasin. These recommendations are incorporate into this subbasin plan and described in Chapter 9.5 of the Entiat Watershed Resources Inventory Area Management Plan (Final Draft; January, 2004).

Ecosystem Restoration Priorities on National Forest System (NFS) Lands

The overall strategy for ecosystem restoration/maintenance on NFS lands in the Entiat Subbasin is currently being revised (update of approach in Version 2.0 of the Federal Watershed Assessment). This strategy will focus on restoring forest ecosystem pattern, composition and process within specified geographic areas within the Entiat Subbasin. Many of these projects will involve cooperative agreements with private and other non-federal land management actions. Many projects have been identified addressing vegetation management, road management, campground and dispersed recreation

improvements, and fish and wildlife habitat enhancements. These projects are summarized in Appendix XXX of this document.

Terrestrial

Focal species were grouped by the habitat type that they live in. Therefore, the habitat type and the focal species will be grouped in the interpretation and synthesis.

Key findings and hypothesis

Habitat: Ponderosa pine

Focal species: white-headed woodpecker, flammulated owl, pygmy nuthatch

Key findings

- Timber harvesting has reduced the amount of old growth forest and associated large diameter trees and snags.
- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.
- Fragmentation of remaining tracts has negatively impacted species with large area requirements.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.

Working hypothesis

1. Habitat has been lost due to timber harvest, fire reduction (and subsequent intensive wildfires), mixed forest encroachment, and development.
2. Habitat diversity and function has been lost from invasion of exotic vegetation and grazing.
3. Loss of habitat and habitat diversity/function has resulted in extirpation or reduction of ponderosa pine obligate species.

Habitat: Shrub-steppe

Focal species: Brewer's sparrow, mule deer

Key findings

- Degradation of habitat from intensive grazing and invasion of exotic plant species.
- Fire management, either suppression or over-use, and wildfires.
- Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrub-steppe/grassland communities.
- Human disturbance during breeding/nesting season, parasitism.

Working hypothesis

1. Reduction of habitat diversity/function has occurred from invasion of exotic vegetation, wildfires, and grazing.
2. Habitat loss and fragmentation, coupled with poor quality of existing habitat has resulted in the extirpation or reduction of shrub-steppe obligate species.

Habitat: Eastside (Interior) Riparian Wetlands

Focal species: beaver, red-eyed vireo, yellow-breasted chat

Key findings

- Habitat degradation from livestock overgrazing which can widen channels, raise water temperatures, reduce understory cover, etc.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.

Working hypothesis

1. Loss of habitat diversity/function has resulted from invasion of exotic vegetation and grazing.
2. Habitat loss and fragmentation, coupled with poor quality of existing habitat has resulted in the extirpation or reduction of riparian obligate species.