7 Management Plan

7.1 Vision for the Subbasin

The vision of the Wenatchee subbasin plan is to voluntarily bring people together in a collaborative setting to improve communication, reduce conflicts, address problems, reach consensus and implement actions to improve coordinated natural resource management on private and public lands in the Wenatchee subbasin. The strategy is to complete a science-based watershed management plan using watershed specific information ultimately leading towards compliance with the federal Endangered Species Act (ESA) and Clean Water Act (CWA). End products will reflect a balance between existing natural resources and human uses, and will capitalize on opportunities to improve these values.

Specific goals to advance this vision under the Watershed Planning Act (WPA) are as follows:

- Optimize quantity and quality of water to achieve a balance between natural resources and human use, both current and projected
- Provide for coexistence of people, fish and wildlife while sustaining lifestyles through planned community growth, and maintaining and/or improving habitats
- Prevent avoidable human-caused mortality of state and federal threatened, endangered and candidate species
- Develop and implement an adaptive action plan to address priority issues, emphasizing local customs, and culture and economic stability in balance with natural resources. All actions will comply with existing laws and regulations, however, changes to existing laws and regulations will be recommended as needed to attain the common vision and avoid one-size-fits-all solutions.
- Recognize the significance of the roles of limiting factors outside of the watershed and natural events within the watershed. The long term goal is to have the Wenatchee River's existing and future habitats contribute to the recovery of listed species and to eventually provide harvestable and sustainable populations of fish and other aquatic resources.
- Since 1993, landowner members of the CRMP Group/EWPU have insisted that good science be applied to the collection and interpretation of information for all resource elements of concern. Landowners hope that through the continued use of good science, the mission and goals of the group will be met and with landowner cooperation during implementation, regulating agencies may not find it necessary to apply one-size-fits-all regulations to achieve their management objectives for the Wenatchee subbasin (CCCD 2004).
- Wildlife and fisheries vision for the Wenatchee subbasin is to have natural habitats with sufficient quantity, quality, and linkages to perpetuate existing native wildlife and fish populations into the foreseeable future. Furthermore, the vision is to restore extirpated wildlife and fisheries through protection and restoration of the subbasin where sufficient habitat exists.

7.2 Purpose and Scope

The Management Plan integrates the vision for the Wenatchee subbasin with the Assessment (Section 4) and Inventory (Section 5). The vision and goals were crafted by the Wenatchee Planning Unit (WPU) and are incorporated into the Wenatchee subbasin plan. The vision and goals also drive for the selection of objectives and strategies for restoration of fish and wildlife habitat and populations, which form the bulk of the management plan.

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

The management plan describes the most effective ways that NPCC and Bonneville Power Administration (BPA) can use funding resources to meet obligations in the Wenatchee subbasin for protection and mitigation of resources that have been affected by the construction and operation of the Federal Columbia River Power System (FCRPS). As such, the management plan is non-regulatory in nature and contingent on BPA ratepayer funds to construct or improve existing infrastructure, acquire land or protective easements as a means of habitat protection, fund personnel to improve management of natural resources, monitor and research the relationships between management actions and the health of the resource, and fund other actions that protect or restore the health of natural resources that have been negatively impacted by the FCRPS.

7.2.1 Overarching Principles

The Wenatchee subbasin has a long history of citizen participation in resource management efforts. The WPU recognizes the close connection between community well-being and watershed conditions, and as a result a set of basic principles regarding the past, present and future of Subbasin became clear during this planning process. The WPU therefore acknowledges the following overarching principles:

- Continued community participation and involvement with the Wenatchee WPU is necessary to ensure its future success and achievement of the group's vision and goals
- Future projects proposed in the subbasin need to be communicated to and coordinated with the Chelan County Conservation District (CCCD) and Wenatchee WPU in order to reduce duplication of effort and assure compatibility with this strategic plan
- Monitoring and continual feedback are key to the design of future projects and tracking progress towardss the achievement of desired results
- Surface and ground water in the subbasin have a high degree of connectivity; therefore surface and ground water in the watershed should be treated as one source for all water quality, water quantity, habitat and instream flow actions

7.3 Subbasin Planning Guidelines

The natural environment including its fish and wildlife resources is society's common cultural heritage. The WPU's mission and goals is to prepare and implement a balanced plan of action that play a key role in the long term sustainability of the natural resources within the Wenatchee subbasin.

The quality of water, near natural timing, and quantity of water flow (normative hydrograph) are principle indicators of a healthy river ecosystem. These indicators must be improved and monitored to measure the progress of the subbasin plan.

The Wenatchee subbasin management plan enhances Native Americans' continued exercise of treaty reserved and aboriginal rights for religious, subsistence, commercial, and recreational use of cultural (natural) resources.

The Wenatchee subbasin management plan is based on voluntary incentives.

The processes of plan preparation, implementation, and amendment, must be open to the public and equitable to all stakeholders.

The costs of plan actions must be estimated in relation to benefits. Alternatives that achieve the highest benefit/cost ratio are preferred. Costs of habitat/species restoration should be mitigated and distributed equitably.

The science, strategies, and art of restoring ecosystems is evolving, hence programs and actions must be monitored and evaluated for effect, and may be altered as necessary.

Balanced sustainable resources management recognizes these basic precepts: a)that the physical and biological environments are functionally interdependent relative to productivity, b)that at any level of function, productivity is finite; c)without actions to restore degraded functions and to protect, avoid, and mitigate impacts to the physical and biological environment, the increasing demands of human population growth would reduce productivity to zero, with unacceptable costs to the cultures and economies of the subbasin.

7.4 Subbasin Management Plan Goals

7.4.1 Wildlife/Terrestrial Biological Goals, Objectives, and Strategies

Riparian Wetlands

Goal

- Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations

Habitat Objective 1

- Determine the necessary amount, quality, and connectivity of riparian wetlands by the year 2008

Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize riparian wetlands habitats in the Wenatchee subbasin

Habitat Objective 2

- Based on findings of Habitat Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010

Strategy: Utilize federal, state, tribal, and local government programs, to conserve riparian wetlands habitat

Strategy: Achieve permanent protection of riparian wetlands through acquisition, conservation easement, cooperative agreements, etc

Strategy: Emphasize conservation connectivity of high-quality riparian wetlands habitat

Strategy: Promote local planning and zoning to maintain or enhance riparian wetlands habitat

Habitat Objective 3

- Enhance beaver (Castor canadensis) habitat where appropriate to increase the quantity and quality of riparian wetlands for focal species by 2009

Strategy: Determine the number and location of active and inactive beaver lodges and dams in the subbasin

Strategy: Using GIS and aerial photos identify and quantify occupied, unoccupied, and potential beaver habitat

Strategy: Identify areas where beaver habitat can be enhanced, beginning with areas lower in the watershed where beaver dams can create more extensive wetlands

Strategy: Enhance beaver habitat within 100 m of riparian areas by thinning specific areas of dense conifers and by planting hardwood succors for forage (e.g. cottonwood and aspen)

Strategy: Reintroduce beaver into suitable unoccupied habitat where natural recolonization is less likely

Strategy: Work closely with landowners, orchardists, public land managers, and local and state transportation departments to reduce damages caused by beaver

Strategy: Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate

Habitat Objective 4

- Enhance beaver populations to benefit habitat for threatened/endangered fish species

Strategy: Identify positive and negative aspects of beaver on fish species

Strategy: Determine suitable sites where beaver could help increase and restore habitat for juvenile and adult populations of fish

Strategy: Reintroduce beaver into suitable unoccupied habitat where natural recolonization may not occur

Habitat Objective 5

- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture and agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands

Strategy: Implement habitat stewardship projects with private landowners

Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired riparian wetlands habitat conditions

Strategy: Wenatchee National Forest plan, Chelan County Watershed Mgt Plan, North Cascades National Park General Management Plan, WDFW Wildlife Area Management Plan, Colville Tribes Integrated Resource Management Plan

Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan

Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1

- Determine population status of red-eyed vireo (*Vireo olivaceous*) and yellow-breasted chat by 2008

Strategy: Select survey protocol and measure abundance of focal species

Strategy: Select survey protocol and measure diversity and richness of species assemblages within riparian wetland habitats

Biological Objective 2

- Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates

Strategy: Implement federal, state, tribal management and recovery plans

Shrubsteppe

Goal

- Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations

Habitat Objective 1

- Determine the necessary amount, quality, and juxtaposition of shrubsteppe by the year 2008

Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize shrubsteppe habitat in the Wenatchee subbasin

Habitat Objective 2

- Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010

Strategy: Utilize federal, state, tribal, and local government programs, such as USDA Farm Bill programs, to conserve shrubsteppe habitat

Strategy: Achieve permanent protection of shrubsteppe through acquisition, conservation easement, cooperative agreements, etc

Strategy: Emphasize conservation of large blocks and connectivity of high quality shrubsteppe habitat

Strategy: Promote local planning and zoning to maintain or enhance large blocks of habitat

Habitat Objective 3

- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing shrubsteppe

Strategy: Implement habitat stewardship projects with private landowners

Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired shrubsteppe habitat conditions

Strategy: Consider and integrate the following plans for the Subbasin: Wenatchee National Forest Plan, Chelan County Watershed Mgt Plan, North Cascades National Park General Management Plan, Washington Department of Fish and Wildlife (WDFW) Wildlife Area Management Plan, Colville Tribes Integrated Resource Management Plan

Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan

Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1

- Determine population status of Brewer's sparrow by 2008

Strategy: Select survey protocol and measure abundance of focal species

Strategy: Select survey protocol and measure diversity and richness of species assemblages within shrubsteppe

Biological Objective 2

- Within the framework of the Brewer's sparrow population status determination, inventory other shrubsteppe obligate populations to test assumption of the umbrella species concept for conservation of other shrubsteppe obligates

Strategy: Implement federal, state, tribal management and recovery plans

Biological Objective 3

- Maintain and enhance mule deer populations consistent with state/tribal herd management objectives

Strategy: Implement state and tribal mule deer management plans

Strategy: Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning

Strategy: Conserve and enhance winter range habitat for mule deer

Strategy: Replant shrub forage species that were eliminated/reduced due to wildfire

Strategy: Maintain mule deer populations within private landowner tolerances

Strategy: Reduce mortality of mule deer from vehicle collisions

Ponderosa Pine

Goal

- Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations

Habitat Objective 1

- Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitats by the year 2008

Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize ponderosa pine habitat in the Wenatchee subbasin

Habitat Objective 2

- Based on findings of Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010

Strategy: Utilize federal, state, tribal, and local government programs, to conserve ponderosa pine habitat

Strategy: Achieve permanent protection of ponderosa pine through acquisition, conservation easement, cooperative agreements, etc

Strategy: Emphasize conservation of large blocks and connectivity of high quality ponderosa pine habitat

Strategy: Promote local planning and zoning to maintain or enhance large blocks of habitat

Habitat Objective 3

- Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silvicultural practices, fire management, weed control, livestock grazing practices, and road management in existing and restored ponderosa pine habitat

Strategy: Implement habitat stewardship projects with private landowners

Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired ponderosa pine habitat conditions

Strategy: Wenatchee National Forest plan, Chelan County Watershed Mgt Plan, North Cascades National Park General Management Plan, WDFW Wildlife Area Management Plan, Colville Tribes Integrated Resource Management Plan

Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan

Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1

- Determine population status of white-headed woodpecker, flammulated owl, and pygmy nuthatch by 2008

Strategy: Select survey protocol and measure abundance of focal species

Strategy: Select survey protocol and measure diversity and richness of species assemblages within ponderosa pine

Biological Objective 2

- Within the framework of the focal species population status determinations, inventory other ponderosa pine obligate populations to test assumption of the umbrella species concept for conservation of other ponderosa pine obligates

Strategy: Implement federal, state, tribal management, and recovery plans

7.5 Wildlife Research, Monitoring and Evaluation Plan

The Research, Monitoring, and Evaluation (RME) plan for the subbasin is intended as a tool that will allow managers to evaluate the efficacy of employed strategies in achieving corresponding focal habitat objectives for the subbasin. If implemented, elements of the plan will also facilitate coordination and tracking of management activities within the subbasin, periodic review of progress, and a basis for recommended adjustments to management direction over time (adaptive management).

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific wildlife and vegetation surveys, spacial analyses of project location and acreage, to simple enumeration of land-use projects/regulations commented upon by cooperating agencies.

Implementation of the subbasin plans is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an Implementation Oversight Committee, to track and guide research, monitoring and reporting activities included in the plan. Organization of the RME plan is as follows:

7.5.1 Research

- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort

- Existing data gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address

7.5.2 Monitoring and Evaluation

- Focal habitat monitoring methodology, and management plan strategies addressed
- Focal species monitoring methodology, and management plan strategies addressed

Existing Date Gaps and Research Needs

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in Table 70.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 70. Data gaps and research needs in the Wenatchee subbasin

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected species assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale habitat data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
RIPARIAN WETLANDS		
Research Needs, recommended priority order		
Refinement of recommended management conditions for Riparian Wetlands	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Data are needed on all aspects of red-eyed vireo, yellow-breasted chat and beaver ecology in the subbasin.		Coordinated government & NGO effort
Data Gaps		

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current riparian wetland data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Riparian habitat quality data. Assessment data do not address habitat quality.	Monitoring activities	Subbasin managers
Refined habitat type maps	Spatial data collection and GIS analysis	Subbasin managers
Model for predicting suitable heaver habitat	Habitat data collection at active beaver colonies	WDFW
Knowledge of where beaver dams/wetlands could enhance endangered/threatened wildlife and fish species	GIS analysis	WDFW
GIS soils products including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution data for red-eyed vireo, yellow-breasted chat	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
PONDEROSA PINE		
Research Needs, recommended priority order		
Assess the historic and current winter range for mule deer in the Subbasin		Coordinated government & NGO effort
Data are needed on all aspects of white-headed woodpecker nesting ecology and habitat use within the Wenatchee subbasin		Coordinated government & NGO effort
Data are needed on all aspects of pygmy nuthatch nesting ecology and habitat use within the Wenatchee subbasin		Coordinated government & NGO effort
Data are needed on all aspects of flammulated owl nesting ecology and habitat use, specifically related to the size, configuration, and abundance of grassy openings for foraging and clumped thickets of sapling/pole trees for roosting		Coordinated government & NGO effort
Research to determine if restored sites attract white-headed woodpeckers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine if restored sites attract pygmy nuthatches and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine whether an intensively harvested landscape that meets snag and large tree objectives support viable white-headed woodpecker populations		Coordinated government & NGO effort

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
Research to determine whether a managed site attracts flammulated owls and provides viable habitat. Identification of the most effective treatment processes and conditions most effective.		Coordinated government & NGO effort
Data Gaps		
Refinement of recommended management conditions for Ponderosa pine: collect current ponderosa pine structural condition/habitat variable data	Management Objective for Ponderosa pine	Subbasin managers
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current ponderosa pine data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data do not address habitat quality.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
Finer resolution GIS habitat type maps that include structural component and KEC data.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
GIS soils products	Spatial data collection and GIS analysis	Subbasin managers
Identify current distribution and population levels of white-headed woodpeckers, pygmy nuthatches and flammulated owls	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).	Habitat Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor white-headed woodpecker, pygmy nuthatch and flammulated owl distributions within the Wenatchee subbasin, to determine current distributions, population levels and population trends	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
SHRUBSTEPPE		
Research Needs, recommended priority order		
Data are needed on all aspects of Brewer's sparrow nesting ecology, especially area requirements to maintain populations		WDFW, Subbasin managers
Data are needed on all aspects of Brewer's sparrow nesting ecology, particularly relationship to livestock grazing and pesticide use		WDFW, Subbasin managers
An assessment of the viability of small populations of Brewer's sparrow in fragments of habitat versus those in large contiguous blocks		WDFW, Subbasin managers
Data Gaps		

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current shrubsteppe data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data bases do not address habitat quality	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refined habitat type maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
GIS soils products, including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution distribution for Brewer's sparrow	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor Brewer's sparrow distribution within the Wenatchee subbasin, to determine current distribution, population level and population trends	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Evaluate the role of fire, mowing, and other management treatments to maintain/improve shrubsteppe habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers

Monitoring and Evaluation: Focal Habitat and Species Monitoring Methodology

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). Deer and elk sampling methodology follow standard protocols established by the WDFW (pers. comm., P. Fowler, WDFW). In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure (HEP) standards (USFWS 1980a and 1980b). A common thread in the monitoring strategies which follow is the establishment of permanent census stations to monitor bird population and habitat changes.

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions, and target wildlife population responses.

Specific methodology for selection of Monitoring and Evaluation (M&E) sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E

sites will be selected (from WDFW response to ISRP http://www.cbf wa.org/files/province/cascade/projects/199609400resp.pdf):

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrubsteppe and forest are further sub-cover typed based on dominant vegetation features i.e., percent shrub cover, percent tree cover, and/or deciduous versus evergreen shrubs and conifer versus deciduous forest. Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate # 0.10 and P = 0.9 (BLM 1998, Hintze 1999, Block et al. 2001). M&E includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP) and plant community monitoring (Tier 2) i.e., measuring changes in vegetative communities on specific sites.

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting X and Y coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals as described in Part 2 – monitoring section of the proposal. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting X and Y coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

- By systematically collecting and analyzing plant species frequency, abundance, density, height, and percent cover data, vegetative trends through time can be described. Likewise, the effectiveness of exotic weed control methods can be evaluated and weed control plans can be adjusted accordingly.

- Presence of all exotic weeds i.e., knapweeds, yellow starthistle, etc. will be mapped in GIS using Global Positioning System (GPS) equipment. This information will be used to develop an annual exotic vegetation control plan.
- Causes of seeding or planting failure will be identified and planting methods/site preparation will be modified as necessary. Data will be collected and analyzed, and, where necessary, changes in the management plan (adaptive management) will be identified and implemented.
- General and site specific M&E protocols, outlining monitoring goals and objectives and specific sampling designs are included in the following monitoring section.
- In addition to defining habitat and species population trends, monitoring will also be used to determine if management actions have been carried out as planned (implementation monitoring). In addition to monitoring plan implementation, monitoring results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions. Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored each year to determine shrub/seeding survival, and causes of shrub mortality and seeding failure i.e. depredation, climatic impacts, poor site conditions, poor seed/shrub sources.
- Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the Wenatchee subbasin. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

7.6 Wildlife Monitoring and Evaluation

7.6.1 Riparian Wetlands

Focal Species: Red-eyed vireo, yellow-breasted chat (*Icteria virens*), and American beaver (*Castor canadensis*)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Riparian Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Overall Habitat and Species Monitoring Strategy: Establish permanent censusing stations to monitor bird population and habitat changes.

Focal Habitat Monitoring:

Factors affecting habitat: 1)direct loss of riparian deciduous and shrub understory, 2)fragmentation of wetland habitat, 3) flooding and de watering of areas by beaver, 4)agricultural and sub-urban development and disturbance, 5)reduction in water quality, 6)organochlorines such as dieldrin or DDE may cause thinning in egg shells which results in reproductive failure (Graber et al. 1978; Ohlendorf et. al. 1980; Konermann et. al. 1978) (Sec. 5.2.3.3.6).

Riparian Wetlands Working Hypothesis Statement: The proximate or major factors affecting this focal habitat type are direct loss of habitat due primarily to urban/agricultural development; reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation and recreational activities; and changes in habitat due to beaver. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. This coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in riparian habitat obligate wildlife species.

Recommended Range of Management Conditions:

Well-distributed range of 20 to 100% tree canopy closure (cottonwood and other hardwood species), with a young to mature cottonwood component including trees at least 160 feet tall

Multi-structure/age tree canopy (includes trees less than 6 in. in diameter and mature/decadent trees)

Forty to 80% native shrub cover (greater than 50% comprised of hydrophytic shrubs), with scattered herbaceous openings

Multi-structured shrub canopy greater than 3 feet in height, at least 10% of which are comprised of young cottonwoods

Focal Habitat Monitoring Strategies: Establish an inventory and long term monitoring program for protected and restored riparian wetlands to determine success of efforts.

1. Identify riparian wetland sites within the subbasin that support populations of focal species for this habitat.
2. Quantify occupied, unoccupied, and potential beaver habitat using GIS and aerial photos (McCall et al. 1996). Monitor changes in habitat on an annual basis.
3. Monitor areas that have been enhanced for beaver with plantings of cottonwood and aspen (Slough and Sadleir 1977). Every 2 years, measure the survival and growth of plantings.
4. Evaluate habitat site potential on existing public lands and adjacent private lands for protection. (short-term strategy i.e., < 2 years).
5. Enhance habitat on public lands and adjacent private lands, and
6. Identify high quality/functional privately owned riparian wetlands sites that are not adjacent to public lands (long term strategy 2 to 15 years).
7. Establish permanent censusing stations to monitor bird population and habitat changes

Sampling Design: HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type. (Riparian zone width within portions of the subbasin will require modification of this 100 foot buffer requirement.)

In addition, at any permanently established avian species monitoring site established within the Riparian Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003) (http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF).

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

$$\text{Sample size equation: } n = \frac{t^2 \times s^2}{E^2}$$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring:

Beaver, Yellow-breasted chat and Red-eyed vireo

Rationale: Maintaining and enhancing beaver, yellow-breasted chat and red-eyed vireo populations within the subbasin will assure the maintenance and rehabilitation of riparian wetlands.

Limiting Factors: 1) Loss of deciduous tree cover and sub-canopy/shrub habitat in riparian zones. 2.) Conversion of riparian habitat due to channelization, agriculture, and development, 3) flooding of habitat resulting from hydropower facilities, 4) habitat fragmentation, 5) degradation of existing habitats from overgrazing and introduced weedy vegetation, and 6) tree/shrub removal in riparian areas. Proximity to agriculture, suburban development creates a hostile landscape where a high density of nest parasites, such as, brown cowbird and predation by domestic cats may occur. Disturbance from agriculture, silviculture, road management and recreational activities can also cause nest abandonment.

Assumptions: 1) Addressing factors that affect riparian wetlands, will also address yellow-breasted chat, red-eyed vireo, beaver and other wetland obligate species limiting factors. 2) If riparian wetland habitat is of sufficient quality, extent, and distribution to support viable yellow-breasted chat, red-eyed vireo and beaver populations, the needs of most other riparian wetland obligate species will also be addressed and habitat functionality could be inferred. 3) Beaver will persist in these habitats if suitable habitat is maintained.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of yellow warbler with a power of 0.8 or greater. This protocol is based on the point count survey (Ralph et al. 1993, Ralph et al. 1995), with each survey station referred to as a "point count station." In addition to these bird survey data, information about the distance at which individual birds are detected will also be collected, allowing absolute density estimated to be made using distance-sampling methodology (e.g., the program DISTANCE).

Methods: The number and location of active beaver lodges and dams will be determined using a fixed-wing aircraft and inspection of each lodge and dam from the ground to verify activity (McCall et al. 1996).

We will survey birds on randomly selected (stratified) points along the riparian corridor. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Analysis: Analysis is described by Nur et al. (1999). Absolute density estimation (see Buckland et al. 1993) can be estimated using the program DISTANCE, a free program

available on the World-Wide Web (http://www.ruwpa.st-and.ac.uk/distance); an example is given in Nur et al. (1997). In brief: for species richness and species diversity, these can be analyzed as total species richness or as species richness for a subset of species; the same is true for species diversity. Species diversity can be measured using the Shannon index (Nur et al. 1999), also called the Shannon-Weiner or Shannon-Weaver index. Statistical analysis can be carried out using linear models (regression, ANOVA, etc.), after appropriate transformations (examples in Nur et al. 1999).

7.6.2 Ponderosa Pine

Focal Species: Flammulated owl (*Otus flammeolus*), white-headed woodpecker (*Picoides albolarvatus*), pygmy nuthatch (*Sitta pygmaea*)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Ponderosa pine sites to monitor focal species population and habitat changes and evaluate success of efforts.

Focal Habitat Monitoring

Factors affecting habitat:

1. Direct loss old growth forest and associated large diameter trees and snags;
2. Fragmentation of remaining Ponderosa pine habitat;
3. Agricultural and sub-urban development and disturbance;
4. Hostile landscapes which may have high densities of nest parasites, exotic nest competitors, and domestic predators;
5. Fire suppression/wildfire;
6. Overgrazing;
7. Noxious weeds;
8. Silvicultural practices;
9. Insecticide use.

Ponderosa Pine Working Hypothesis Statement: The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressors are the spread and proliferation of mixed forest conifer species within ponderosa pine communities due primarily to fire reduction and intense, stand-replacing wildfires, and invasive exotic weeds. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of existing vegetation (i.e., lack of old growth forest and associated large diameter trees and snags) have resulted in significant reductions in ponderosa pine habitat obligate wildlife species.

Recommended Range of Management Conditions: Recognizing that extant ponderosa pine habitat within the subbasin currently covers a wide range of seral conditions, wildlife habitat managers have identified three general ecological / management conditions that, if met, will provide suitable habitat for multiple wildlife species at the subbasin scale within the ponderosa pine habitat type. These ecological conditions correspond to life requisites represented by a species' assemblage that includes white-headed woodpecker, flammulated owl, and pygmy nuthatch

1. Mature ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH).
2. Multiple canopy ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two layered canopies, tree density of 508 trees/acre (9 foot spacing), basal area of 250 feet2/acre (McCallum 1994b), and snags greater than 20 inches DBH 3-39 feet tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.
3. Heterogeneous stands of ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age: pygmy nuthatches represent those species that depend on snags for nesting and roosting, high canopy density, and large diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests. Connectivity between suitable habitats is important for species, such as pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.

Focal Habitat Monitoring Strategies: Establish an inventory and long term monitoring program for protected and managed Ponderosa pine habitats to determine success of efforts. Subbasin managers recognize that restoration of late-successional forest is a long term process, but these short-term (i.e., up to 15 years) strategies reflect the commitment and initiation of the process of management.

1. Identify Ponderosa pine habitat sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned Ponderosa pine sites that are not adjacent to public lands (long term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird population and habitat changes.

Sampling Design: Permanent survey transects will be located within Ponderosa pine habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Measurement of Attributes (Habitat Conditions):

>10 snags/40 ha (>30cm DBH and 1.8m tall)

Method: A direct count in the 1/10 acre circle plot at the end of each 100

ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

>20 trees /ha (>21" DBH)

Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape.
Ponderosa Pine – old growth: >10 trees/ac (>21" DBH w/ >2 trees >31" DBH)

Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape. 10-50% canopy closure

Method: A line intercept 'hit' or 'miss' measurement. Ten direct measurements along each 100 foot section of the transect (one every 10 feet) taken with a moosehorn densitometer. > 1.4 snags/ac (>8" DBH w/ >50% >25")

Method: A direct count in the 1/10 acre circle plot at the end of each 100 ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

$$\text{Sample size equation: } n = \frac{t^2 \times s^2}{E^2}$$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring

Flammulated Owl

Rationale: The Flammulated owl is listed as candidates for inclusion on the WDFW endangered species list and is considered a species-at-risk by the Washington GAP Analysis and Audubon-Washington. Flammulated owls are highly structurally dependent on the Ponderosa Pine habitat. Therefore, it is important to maintain and enhance the structure and function of ponderosa pine habitats for flammulated owls.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) pesticide use; 3) predation/competitors; 4) exotics.

Assumptions: 1) Addressing factors that affect ponderosa pine, will also address flammulated owl and other ponderosa pine obligate species limiting factors. 2) If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable flammulated owl and white-headed woodpecker populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: The following methods are designed to, 1.) facilitate delineation of current distribution and population levels of flammulated owls, and; 2) identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).

Methods: Nighttime surveys will be conducted throughout potentially suitable Flammulated Owl breeding habitat, which will be determined according to habitat use reported in the literature, other reports, GIS habitat mapping, and other reported sightings the species.

Routes will be randomly selected from within the potential habitat area using a stratified sampling scheme. Each route should have between 10-12 stations, distributed along the route at equal intervals of .5 km, a standard methodology based on the distance owls can be heard on a calm night (at least 1.0 km) and the average size of territories (<500 m across) (Reynolds and Linkhart 1984, Howle and Ritchie 1987, Van Woudenberg and Christie 1997). The location of the starting point of the route, and of each station along the route, should be recorded as precisely as possible using a GPS (Global Positioning System). Each route should be surveyed three times per year during May-July – the time of year when vocal activity of the majority of species is greatest. Conduct surveys between 2200 and 0100 hours (Howle and Ritcey 1987, Groves et al.

1997). An attempt should be made to conduct the survey at the same time of night each year. At the beginning of the breeding season the greatest calling intensity for the Flammulated Owl is during much of the evening, and then after nestling hatching singing is "later at night" (Reynolds and Linkhart 1987).

Surveys should only be conducted under favorable conditions: wind speeds <20 km per hour, a wind speed of Beaufort 3 or less and no precipitation (including rain and/or snow). Temperatures should be close to the average for the season and efforts should be made to avoid extremely cold temperatures because of evidence that owls may be less vocal in very cold weather (Takats 1998a).

Surveys will consist of visiting a point for two minutes to listen for Flammulated Owls calling, and if no owls are heard then a male territorial call will be imitated or played from tape for one minute. After listening for an additional two minutes, the observer will then walk to the next point while still listening for calling owls. (Two minutes appears to be adequate for most spontaneously calling owls to be detected, at least during the period of peak calling activity. In Alberta, relatively few additional owls were detected during a third minute of listening (Takats, pers. comm.). In Ontario, more than 70% of 5 species of owls that were detected over a 5 minute period (included playback) were detected in the first two minutes (Takats 1997, 1998b)

Playback recordings should be as clear and loud as possible without distortion. Digital technology is recommended (CD-ROM, solid state, or digital tape) as the sound quality can be better controlled and is less likely to deteriorate over time. The audio equipment should be of sufficient quality that it will not distort the sound at loud volumes. We suggest the volume be such that the recording can be heard at 400m, but not at 800m (to minimize bias at the next survey station due to owls hearing the recording from the previous station). If possible, the volume should be measured at a standard distance (e.g., 1m from the speakers) using a decibel meter.

The recording should include both the silent listening periods as well as the playback sequence time period. A soft ‘beep’ or other sound can be used to indicate the start of the first silent listening period, and another beep to indicate the end of the final listening period. This will ensure that the time is fully standardized at each station, and reduce the need for participants to keep checking their watches.

Surveyors should be asked to estimate the approximate direction and distance to the first position where they detect each owl and plot location on a map. This data can help to determine whether the same owls are being detected at different stations along the route, to adjust for some of the variation in detection rates, and to aid in daytime nest searches.

Male presence is not adequate to determine habitat suitability as many males may remain unmated (Reynolds and Linkart 1987a, McCallum 1994a). The nests should be monitored so that success can be determined. Parallel transects 50 m apart through areas where owls were detected were surveyed in June and early July to try and find nest site locations. Since most of the calls heard in the field are from territorial reproductive males, nests can be located by systematic nest searches during the day (Bull et al. 1990). Once territory boundaries are delineated, all suitable nesting cavities (tree cavities with entrance diameters >4 cm) within territories will be checked for nesting owls (Linkart and Reynolds 1997).

Nest sites will be searched for using a pinhole camera system attached to a telescoping pole that reaches approximately 11 m high (Proudfoot 1996). This is an effective nest finding technique, but is limited to cavities within reach. Tree scratching (with a stick) can also used, which imitates a predator climbing the nest tree and often stimulates incubating or brooding females to look out of the nest cavity entrance (Bull et al. 1990). Observation of a female Flammulated Owl at a cavity entrance will document a nest site.

Analysis: Data from the surveys described here are similar to those of the Breeding Bird Survey, though some modifications may be required in the future. A wide variety of methods have been developed for analysis of BBS data (James et al. 1996, Link and Sauer 1994, 1998), but there is still some disagreement as to which methods are best (James et al. 1996, Link and Sauer 1994a, Link and Sauer 1994b, Thomas 1996). There are two main methods currently being used by the coordinators of the BBS. One involves route regression using estimating equations (Link and Sauer 1994), which assumes that trends may differ among routes, and calculates a weighted mean of the trends within routes. The selection of weighting factors is strongly dependent upon the sampling scheme used to select routes. An alternate approach involves a generalized linear model assuming over-dispersed Poisson residuals and a log-link function (Link and Sauer 1998). This approach assumes that trends are similar within a broader region, and allows more robust modeling of nonlinear population changes (e.g., year to year fluctuations). A simplified version of this latter approach has been used for analysis of population trends in Ontario (Lepage et al 1999, Francis and Whittam 2000), but it is not yet known whether this is the most appropriate analysis method.

The power of the survey technique will be investigated after its first three years in its present design to determine the actual variance. This will allow us to determine the number of routes required to detect our objective of a 35% change by 2020.

Finally, we recommend that relevant data be made publicly available, preferably over the Internet. This will encourage further research into analysis methods, thus ensuring that maximum use is made of the data for conservation purposes. However, care should be taken to protect sensitive information, such as precise nesting locations of rare species.

White-headed woodpecker

Rationale: Suitable white-headed woodpecker habitat includes large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH). Maintaining white-headed woodpecker populations will require that this mature/old growth component of ponderosa pine habitat is maintained or enhanced within the Ecoregion.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) pesticide use; 3) predation/competitors; 4) exotics.

Assumptions: If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable white-headed woodpecker populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power

analysis with the goal of being able to detect a 25% increase in abundance of white-headed woodpecker with a power of 0.8 or greater.

Methods: The method used, point counts, is derived from Dixon (1998)

POINT COUNTS

Each observer will conduct one transect per day individually. Survey low-elevation transects first to assure accessibility. The protocol for point counts will follow standardized methods for variable circular plots (Reynolds et al. 1980, Ralph et al.1995, Hutto and Hoffland 1996), but modified to better census White-headed Woodpeckers.

WHEN TO SURVEY: Point counts should be conducted between April 1 and May 15 when the detectability of White-headed Woodpeckers is highest and most stable. After this period the woodpeckers typically excavate from within the nest cavity and become less visible and less vocal. Counts should begin at official sunrise and end no later than 1030 and 1100. Each transect will be visited once.

POINT COUNTS: Counts will begin as soon as the observer arrives at the station and will be comprised of a 5-minute listening period without the use of tape playbacks followed by a 6-minute sequence of tape playbacks of White-headed Woodpecker calls and drums for a total count of 11 minutes. Data from the two types of counts will be recorded separately-with a code-on a the bird data sheet.

TAPE PLAYBACK PROCEDURE: Tape playback procedures will essentially follow the Payette National Forest Protocol for Broadcast Vocalizations (Payette National Forest 1993). The tape playback sequence should begin immediately after the 5-min unsolicited point count-be ready to start the tape at exactly 5 min. A total of four 30-second tape-playbacks of White-headed Woodpecker drums and calls will be projected at 1-min intervals (e.g. using a Johnny Ste wart™ game caller); that is, begin the first sequence of vocalizations to the north. During the one minute pause after the first sequence, rotate 90° for the second sequence, pause, then rotate another 90° for the third sequence of vocalizations after the second one minute break. When the third sequence is complete, rotate 90° for the fourth and final sequence for a total of 6 minutes of tape-playbacks.

WHEN NOT TO SURVEY: Surveys will not be conducted during heavy rain, fog, or when wind interferes with an observer's ability to detect calls (greater than 20 mph). If the weather appears prohibitive, wait 1 to 1.5 hours, or until you cannot reasonably complete the transect by 1100 hours. If the weather puts you in danger, STOP-your safety comes first.

WHAT TO RECORD: Record all species detected, visual or auditory. At the bottom of the data sheet, record any birds you might have detected either before or after a point count, or between stations.

Pygmy nuthatch

Rationale: Suitable pygmy nuthatch habitat contains heterogeneous stands of ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age. Pygmy nuthatch represents those species that depend on snags for nesting and roosting, high canopy density, and large diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests.

Connectivity between suitable habitats is important for species, such as pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) fragmentation; 3) predation/competitors; 4) exotics.

Assumptions: If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable pygmy nuthatch populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: This is a survey development need.

7.6.3 Shrubsteppe

Focal Species: Sharp-tailed Grouse, Brewer's sparrow (*Spizella breweri*), mule deer (*Odocoileus hemionus hemionus*)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed shrubsteppe sites to monitor focal species population and habitat changes and evaluate success of efforts.

Focal Habitat Monitoring

Factors affecting habitat:

1. Direct loss shrubsteppe due to conversion to agriculture, residential, urban and recreation developments
2. Fragmentation of remaining shrubsteppe habitat, with resultant increase in nest parasites
3. Fire Management, either suppression or overuse, and wildfires
4. Invasion of exotic vegetation
5. Habitat degradation due to overgrazing, and invasion of exotic plant species
6. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.

Shrubsteppe Working Hypothesis Statement: The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and knapweeds that either supplant and/or radically alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of extant vegetation have resulted in extirpation and/or significant reductions in shrubsteppe obligate wildlife species.

Recommended Range of Management Conditions:

1. Condition 1: Sagebrush dominated shrubsteppe: The Brewer's sparrow was selected to represent wildlife species that require sagebrush dominated sites, but prefer a patchy distribution of sagebrush clumps 10-30 percent cover, lower sagebrush height (between 20 and 28 inches),

native grass cover 10 to 20 percent (Dobler 1994), non-native herbaceous cover less than 10 percent, and bare ground greater than 20 percent (Altman and Holmes 2000).

Sage sparrows are still common throughout sagebrush habitats and have a high probability of being sustained wherever large areas of sagebrush and other preferred native shrubs exist for breeding. Similar to other shrubsteppe obligate species, sage sparrows are associated with habitats dominated by big sagebrush cover and perennial bunchgrasses (Paige and Ritter 1999; Vander Haegen et al. 2000). Habitat attribute conditions recommended for sage sparrows include; dominant sagebrush canopy with 10 to 25 percent sagebrush cover, mean sagebrush height greater than 20 inches, high foliage density, mean native grass cover greater than 10 percent, mean exotic annual grass cover less than 10 percent, mean open ground cover greater than 10 percent, and, where appropriate, suitable habitat conditions in patches greater than 400 acres (Altman and Holmes 2000).

2. Recommended Condition 2 - Diverse shrubsteppe habitat: Mule deer were selected to represent species that require/prefer diverse, dense (30 to 60 percent shrub cover less than 5 feet tall) shrubsteppe habitats comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld et al. 1973; Sheehy 1975; Jackson 1990; Ashley et al. 1999) with a palatable herbaceous understory exceeding 30 percent cover (Ashley et al. 1999).

Focal Habitat Monitoring Strategies: Establish an inventory and long term monitoring program for protected and managed shrubsteppe habitats to determine success of management strategies. Subbasin managers recognize that restoration of shrubsteppe is still very much a fledgling field, and complete restoration of degraded or converted shrubsteppe may not be feasible. These monitoring strategies reflect the commitment to and initiation of the process of long term management.

1. Identify shrubsteppe habitat sites within the subbasin that support populations of Brewer's sparrow
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned shrubsteppe sites that are not adjacent to public lands (long term strategy 2 to 15 years).
5. Establish permanent censusing stations to monitor bird population and habitat changes.

Sampling Design: Permanent survey transects will be located within shrubsteppe habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian species monitoring site established within the Shrubsteppe habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Bare ground or cryptogram crust measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

The percentage of the microplot consisting of either bare ground or cryptogram crust is estimated via ocular estimate.

2. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

Herbaceous cover % is measured via an ocular estimate of the percentage of the microplot shaded by any grass or forb species.

3. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible “hits” per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible “hits” per 100 ft segment).

Shrub canopy cover is measured on a line intercept ‘hit’ or ‘miss’. Measurements are taken every 2 or 5 feet, depending upon shrub density.

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

4. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a “running mean” to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring

Brewer's Sparrow

Rationale: The main premise for focal species selection is that the requirements of a demanding species assemblage such as Brewer's sparrow encapsulate those of many co-occurring less demanding species. By directing management efforts to ward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage comprised of these three species should provide life requisite needs for most other shrubsteppe obligate species.

Limiting Factors: 1) Conversion of native shrubsteppe habitat for agricultural purposes, 2) habitat fragmentation; 3) degradation of existing habitats from overgrazing and introduced weedy vegetation, 4) brush removal, 5.) wildfire

Assumptions: 1) Addressing factors that affect shrubsteppe habitat will address Brewer's sparrow; 2) If shrubsteppe habitat is of sufficient quality, extent, and distribution to support Brewer's sparrow populations, the needs of most other shrubsteppe obligate species will also be addressed and shrubsteppe functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 35% increase in abundance of key species with a power of 0.8 or greater.

Methods: We will survey birds on 64 sites in different vegetation types and levels of fragmentation. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). The outer points of the point-count circles will describe a rectangular plot of 16ha that will be the focus of all survey work in Objectives 2-4. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Mule Deer

Rationale: Mule deer inhabit all habitats within the subbasin. Shrubsteppe habitat quality determines the size and persistence of mule deer populations within the subbasin, as they are both critical winter habitat and the limiting factor for this species in the subbasin. Mule deer have been selected as a focal species due to the significant economic, recreational, and cultural values this species provides.

Limiting Factors: 1) flooding of habitat resulting from hydropower facilities, 2) loss of habitat due to urban and suburban development, 3) road and high way construction, 4) degradation of existing habitats from overgrazing and introduced weedy vegetation, 5) alteration of historic fire regimes, 6) past silvicultural practices, 7) deer control efforts necessitated by agricultural damage, 8) natural predation and over-harvest by hunters, 9) disease and parasites

Assumptions: Addressing factors that affect shrubsteppe habitats, will also address mule deer and other shrubsteppe obligate species limiting factors.

Management Objective: The population management objective for mule deer will be to increase or maintain populations within the limitations of available mule deer habitat and landowner tolerance (agricultural damage). Population monitoring variables and objectives are established in the Washington Department of Fish and Wildlife Game Management Plan (WDFW 2003). In areas with periodically high mule deer populations and significant agricultural damage complaints, WDFW will regulate populations as appropriate through hunter harvest.

Monitoring Methods: Mule deer populations will be monitored using a combination of post hunting surveys, winter surveys and harvest data. Current surveys allow the monitoring of age/sex ratios to determine if management objectives established in the Game Management Plan (WDFW 2003) are being met for post-season buck survival (> 15 bucks/100 does) and fawn production and recruitment. Harvest data is used as an indicator of population trend.

Evaluation Strategies:

1. Use winter aerial and ground surveys to classify mule deer to determine post-hunt buck/fawn to doe ratios and population size trends
2. Monitor harvest level of bucks and antlerless deer using mandatory hunter report system
3. Model the Chelan PMU mule deer population
4. [No information listed here]

7.7 Fisheries Biological Objectives

Recovery and maintenance of key populations must achieve two broad objectives:

- Restore populations to a point where they no longer require the protection of the ESA
- Maintain populations at a level that allows meaningful opportunity for tribal and non-tribal hunting and fishing rights

Achievement of these objectives requires a healthy ecosystem and application of sound management principles. Four parameters form the key to evaluating and measuring the status of a population's health. They are: 1)abundance (population size), 2)population growth rate, 3)population spatial structure and 4)life history diversity. These parameters are reasonable predictors for extinction risks. They reflect general processes that are important to all populations of all species, and they are measurable.

Below is a synopsis of the biological objectives underlying each of these four parameters. This information is derived from the NOAA Fisheries Technical Memorandum NMFS-NWFSC-42 (2000). Although many of the principles established in this work are technically sound, use of NOAA Fisheries concepts in this subbasin plan does not imply adoption of the referenced document. The subbasin plan recognizes the biological objectives for cutthroat and bull trout contained in the USFWS Draft Bull Trout Recovery Plan, (2004) and incorporates by reference this document and biological objectives.

Abundance

Populations are large enough to have a high probability of surviving environmental variation of the patterns and magnitudes observed in the past as well as those expected in the future.

Populations have sufficient abundance for compensatory processes to provide resilience to environmental and human caused disturbances.

Populations should be sufficiently large to maintain genetic diversity over a long term.

Populations should be sufficiently abundant to provide important ecological functions throughout its life cycle.

Population Growth Rate

Population natural productivity is sufficient to maintain its abundance above the viable level.

The population that includes naturally spawning hatchery fish exhibits sufficient productivity from naturally produced spawners to maintain population abundance above viability thresholds in the absence of supplemented hatchery production.

Populations exhibit sufficient productivity during fresh water life history stages to maintain abundance above thresholds, even during poor ocean (or other relevant environmental) conditions.

Populations do not exhibit sustained declines in abundance that span multiple generations and affect multiple broodyear cycles.

Populations do not exhibit trends or shifts in traits that portend declines in a population's growth rate.

Salmonid habitat should not be destroyed faster that is naturally created.

Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions.

Some salmonid habitat should be maintained that appear suitable or marginally suitable, even though it currently contains no fish.

Key subpopulations (highly productive) should be maintained to support other subpopulations with lower productivity.

Life History Diversity

Human caused changes such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not alter variation in traits such as migration timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics.

Natural processes of dispersal should be maintained. Human caused factors should not substantially alter the rate of gene flow among populations.

Natural processes that cause ecological variation should be maintained.

Contribution to Recovery of Salmonids and Pacific lamprey

[No information to date]

7.8 Fisheries Habitat Objectives and Desired Future Conditions

7.8.1 Introduction

Habitat objectives are organized in a manner consistent with the information presented in the assessment of the Wenatchee subbasin plan. The intent is to provide specific and measurable objectives for habitat attributes important to maintain long term viability to native aquatic and riparian dependent species within the subbasin. Resource managers attaining these objectives will provide a baseline for long term environmental desired future conditions. (The following habitat objectives come primarily from "A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation watershed Scale" (US Fish and Wildlife Service 1999)).

It is understood that not all environments and habitat are inherently capable of achieving or maintaining these general standards. Human developments will also preclude attainment of these standards in some cases. However, to the extent feasible, the objective of the Wenatchee subbasin plan is to maintain and improve healthy ecosystems within the Wenatchee subbasin, via measurable habitat objectives that can be monitored.

7.8.2 Watershed Conditions

Disturbance Regime

Environmental disturbances (wildfire, etc.) are short lived with little or no long term change to the hydrograph. High quality habitats and watershed complexity continue to provide refuge and rearing space for the expected assemblage of organisms, for all life stages and/or multiple life history forms. Natural processes are stable and resilient to significant changes over time.

Road Density/Location

At the watershed scale (6^{th} field hydrologic unit code – HUC) road densities do not exceed one linear mile per square mile. Roads are maintained to provide adequate drainage and to minimize sediment transport. Valley bottom roads are relocated where feasible to minimize the affects to riparian and floodplain habitat, and functional attributes.

Refugia

Landscape scale habitats capable of supporting strong and significant populations are maintained and are well distributed and connected for the expected assemblage of organisms and for all life stages.

Water Quality

Temperature

Water temperatures will be at or near normative conditions throughout the year. Where possible the 7-day average maximum temperature in a stream reach will not exceed 2-5°C during incubation periods; 4-12°C during juvenile rearing periods and 4-9°C during spawning periods. Also, water temperatures do not exceed 15°C in areas usedby adults during migration thereby providing no thermal barriers to movement.

Sediment

Fine sediment (< 0.85mm) measured in spawning and incubation habitat is less than 12% of the total substrate composition. (If surface fines (< 0.6mm) are included, then total substrate composition should not exceed 20%.

Cobble and gravel substrate embedded by fine sediment/materials in juvenile rearing areas does not exceed 20%.

Contaminants and Nutrients

Low levels of chemical contaminants, waste materials (nutrients) from agricultural, industrial and other sources are measured in surface and ground water systems. There are no stream reaches designated as impaired (303d) under the CWA.

Water Quantity

The watershed hydrograph is at or near normative condition (peak flow, base flow and flow timing characteristics) compared to other watersheds of similar size, geology, and geography.

Riparian/Floodplain Condition

Riparian Condition

Riparian areas provide adequate shade, large woody debris (LWD) recruitment, and habitat protection and connectivity in sub watersheds. Riparian areas provide buffers and includes refugia for sensitive aquatic species (>80% intact). Riparian areas maintain at least 50% similarity of riparian vegetation to the potential natural community/composition.

Floodplain Connectivity

Off-channel and side channel areas are frequently (annually) hydrologically linked to main river. High flows that exceed the natural stream bank capacity are allowed to occur to reduce water velocity and energy within the stream channel and to maintain wetland functions, riparian vegetation, and succession.

In-Channel Conditions

A relatively high degree of in-channel structural diversity exists throughout stream reaches where expected. LWD occupies the channel at greater than 20 pieces per mile. LWD pieces must be >12 in. diameter at the small end and at least 35 ft. in length. Also, there is an adequate source of woody debris available within the riparian corridors for both long and short-term LWD recruitment into the stream channel.

Pool Quantity and Quality

In streams that are greater than 9.8 ft. in wetted width at base flow, large pools (those that occupy most of the channel width and are greater than one meter deep) are commonly found in reaches with adult holding, juvenile summer or overwintering rearing.

Pool frequency is known to be variable, typically depending upon the stream width. Pool frequency in a stream reach closely approximates:

Table 71. Pool frequency in the Wenatchee subbasin

Wetted width (ft)	#pools/mile
0-5	39
5-10	60
10-15	48
15-20	39
20-30	23
30-35	18
35-40	10
40-65	9
65-100	4

Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment

Off-Channel Habitat

Watersheds have many ponds, oxbows, back waters, and other off-channel areas with adequate hiding cover. Side channels provide areas with low hydrologic energy that act as refuge for juvenile fish, especially during high flow events.

Channel Condition/Dynamics

Channel width to depth ratios, as measured for the stream reach, is at or near the expected normative value as described by Rosgen (1996).

Stream bank condition as measured for the stream reach is approximately 90% stable for approximately 80% of the linear stream channel.

Fish Passage

Man-made barriers present in watershed allow upstream and downstream fish passage at all flows. There are no barriers to fish passage within the subbasin.

Ecological

To the extent possible, non-native and non-desirable species are not present or do not have a significant affect through competition or predation on other native or desired species within the watershed.

7.8.3 Recommendations for Management

Strategies, Objectives, and Near-term Opportunities

The following pages summarize recommendations for management strategies, management objectives and near-term opportunities at both the subbasin scale and for each of the individual assessment units. For each assessment unit important information from the assessment and key findings are summarized. For each of the habitat attributes, recommended management strategies are provided that identify general direction for future management emphasis. For each management strategy, one or more management objectives are listed that imply certain types of actions that might be employed to successfully achieve the management strategy. Concluding the recommendations for each assessment unit, near-term opportunities are suggested.

Near term opportunities are a list of evaluations and potential restoration/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, nor is it intended to provide the basis for prioritization. Rather, these are projects that could be accomplished within a 10-year time frame and would significantly contribute towards achievement of long term objectives and desired future conditions related to salmon recovery. Due to the nature of the landscape and/or the project type, near-term opportunities are likely to be more easily implemented than many other actions. Many other activities should be considered, although development of these projects is expected to be more complex and requiring more time than available within the scope of this planning process.

7.8.4 Lower Wenatchee River Assessment Unit

Assessment Unit Summary

Table 72. Lower Wenatchee River assessment unit summary

Summary of Lower Wenatchee River Assessment Unit	
Focal species Spring chinook, Late-run chinook, Coho, Steelhead, Bull trout	Assessment Unit Priority Category 1
	Key Sub watersheds Lower Wenatchee
Limiting Factors Key Habitat Quantity Habitat Diversity Channel Stability Sediment Low Flow Elevated Temperature	Hypothesized Effect on Focal Species Water Quality (Moderate-Low) Water Quantity (Moderate) Riparian (Moderate-High) In-Channel (Moderate-High) Fish Passage (Low) Ecological (Low)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Reduce late summer mainstem temperatures

Management Objectives

- Improve low flow conditions
- Increase riparian shade and floodplain function
- Enhance or improve tributary stream temperatures by improving riparian and channel conditions

Sediment

Management Strategy

- Reduce elevated fine sediment percentages in the mainstem and tributary stream substrates

Management Objectives

- Improve streambank conditions
- Increase riparian ground cover
- Continue monitoring sediment on an annual basis

Contaminants

Management Strategy

- Enhance water quality for both mainstem and tributary streams

Management Objectives

- Develop programs and strategies for the application of toxic pesticides and herbicides that also restrict these materials from contacting surface water
- Support efforts that restrict waste materials from entering subbasin waters

Water Quantity

Management Strategy

- Enhance mainstem flows

Management Objectives

- Improve overall watershed vegetative and hydrologic conditions
- Support the development and use of programs that increase water use efficiency
- Restore tributary flows to the natural hydrograph by improving the road network and relocating valley bottom roads where feasible

Riparian and Floodplain

Management Strategy

- Improve riparian and floodplain conditions and functional characteristics in both mainstem and tributary streams

Management Objectives

- Re-establish riparian vegetation corridors where they have been lost using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function
- Retain high quality riparian patches as refuge habitats
- Where feasible, relocate valley bottom roads to allow for channel migration, riparian vegetation recolonization, and improved floodplain function
- Avoid the loss of wetland and off-channel habitat
- Reconnect and increase side-channel habitat to the main stream channel
- Where appropriate, establish areas where natural channel migration can occur
- Retain fluvial processes and floodplain function

- Evaluate the condition of the hyporheic zone with respect to existing and future floodplain developments (Data Gap)

In-Channel

Management Strategy

- Restore and enhance in-channel habitat diversity and structural complexity for native species in both mainstem and tributary streams
- Management Objectives
- Where appropriate, provide instream structures (large wood, rock, or other natural materials) that will enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity
- Improve natural stream bank stability by increasing riparian vegetation
- Where approprioate restore natural channel form, including reconnection to floodplain

Passage

Management Strategy

- Continue to monitor and evaluate fish passage at Dryden Dam

Management Objectives

- Restore unhindered juvenile and adult passage if determined to be appropriate
- Evaluate and restore fish passage in tributary streams

Ecological

[No information to date]

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Increase the amount of riparian area by 50 acres. Most of this would be associated with side channel enhancement and/or developments.

Monitoring Indicator:

- Increase in riparian ground cover, vegetation structure and composition
- Evaluate the existing condition of the hyporheic zones and determine how flow conditions may influence biological and physical attributes of the hyporheic zone.

Monitoring Indicator:

- Report on biological and physical attributes and condition and long term monitoring strategy

Stream Channel Condition and Function

- Increase the amount of useable side channel habitat by 20% over current condition to provide additional juvenile summer and winter rearing habitat.

  Monitoring Indicator:

- Increase acres side channel habitat; useable habitat for focal species at various flow and environmental conditions

- Evaluate and implement the appropriate placement of 10 in-channel structures. These structures would be designed to control flows and maintain developed side channels and/or to develop pool habitat. These structures will serve as a pilot project for potential future similar developments.

  Monitoring Indicator:

- Number of structures implemented; amount useable habitat for focal species made available at various flow conditions, effect on side channel maintenance

- Initiate surveys and begin long term monitoring of sediment yield and substrate embeddedness in spawning gravels.

  Monitoring Indicator:

- Annual sediment monitoring scheme developed and implemented by year 2006

Water Quality

- Determine point and non-point source pollution and establish a plan to prevent pollutants from entering the water system.

  Monitoring Indicator:

- Annual water quality monitoring scheme developed and implemented by year 2006

Water Quantity

- Continue evaluating flow conditions and identify potential actions, benefits and risks to increase low flows (i.e. surface or ground water storage). Implement appropriate actions as identified.

  Monitoring Indicator:

- Implementation to begin on priority findings and objectives in 2007 (Report completed by 2006)

- Continue to evaluate various scenarios and improvements to increase efficiencies in water delivery and use. Identify areas and specific improvements where irrigation diversions do not directly impair salmonid habitat. Determine the feasibility for pumping Columbia River water for exchange of diverting portions of the Wenatchee River system.

Monitoring Indicator:

- Implementation to begin on priority findings and objectives in 2007 (Report completed by 2006)

Obstruction to Fish Passage

- Replace all culverts that are currently blocking fish (rainbow/steelhead trout) passage in Derby Canyon

Monitoring Indicator:

- All priority obstructions to passage identified and replaced

Ecological Conditions

- Near-term opportunity not identified to date. Reference: Monitoring Strategy for the Wenatchee Subbasin

7.8.5 Middle Wenatchee River Assessment Unit

Assessment Unit Summary

Table 73. Middle Wenatchee River assessment unit summary

Summary of Middle Wenatchee River Assessment Unit	
Focal species Spring chinook, Late-run chinook, Coho, Steelhead, Bull trout	Assessment Unit Priority Category 1
	Key Sub watersheds Tumwater Canyon Chiwakum Creek
Limiting Factors Riparian/Floodplain Function Habitat Diversity Obstructions	Hypothesized Effects to Focal Species Water Quality (Data Gap) Water Quantity (None) Riparian/Floodplain (Moderate) In-Channel (Moderate) Fish Passage (Moderate) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Reduce late summer mainstem temperatures

Management Objectives

- Enhance by increasing riparian shade and floodplain function in the upper reaches of this assessment unit
- Enhance or restore tributary stream temperatures by improving riparian and channel conditions

Sediment

Management Strategy

- Reduce elevated fine sediment percentages in the mainstem and tributary stream substrates

Management Objective

- Improve riparian condition and increase natural streambank stability

Contaminants

Management Strategy

- Maintain existing good water quality

Management Objective

- Support efforts that restrict waste materials from entering subbasin waters

Water Quantity

Management Strategy

- Maintain flows and hydrograph to current condition

Management Objective

- Enhance or restore flows in some tributary streams by improving overall watershed condition and reducing stream channel confinement where possible

Riparian Floodplain

Management Strategy

- Maintain and improve mainstem riparian and floodplain conditions, particularly above Tumwater Canyon

Management Objectives

- Avoid activities within riparian corridors that disrupt riparian function
- Maintain existing floodplains connectivity with the river system
- Avoid the loss of wetland and off-channel habitat
- Maintain and enhance fluvial processes and floodplain function
- Improve riparian and floodplain conditions in some tributaries

In-Channel

Management Strategy (mainstem)

- Maintain and improve mainstem in-channel structural diversity and habitat quality

Management Objectives (mainstem)

- Enhance riparian areas to ensure long term recruitment of large wood into the stream channel
- Evaluate the feasibility of improving existing large wood contribution to habitat diversity
- Reduce channel confinement where feasible

Management Strategy (tributaries)

- Improve tributary habitat quality and quantity in some locations

Management Objectives (tributaries)

- Improve degraded channel form and function, including reconnection to floodplain
- Enhance riparian areas to ensure long term recruitment of large wood into the stream channel
- Where appropriate, provide instream structures that will enhance habitat diversity and channel integrity

Passage

Management Strategy

- Continue to monitor and evaluate fish passage at Tumwater Dam. Restore unhindered juvenile and adult passage if determined to be appropriate

Management Objectives

- Evaluate and restore fish passage in tributary streams

Ecological

[No information to date]

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Implement and maintain approximately 30-50 acres of riparian plantings primarily on the mainstem Wenatchee but also in appropriate locations in tributary streams.

Monitoring Indicator:

- Increase in riparian ground cover, vegetation structure and composition

Obstruction to Fish Passage

- Replace all culverts that are currently blocking fish passage in Skinney and Beaver creeks.

Monitoring Indicator:

- All priority obstructions to passage identified and replaced

Ecological Conditions

- Develop a short-term (2-3 years) pilot program to determine the feasibility and benefit for pike minnow control program downstream of Tumwater Dam.

Monitoring Indicator:

- Program developed and fully implemented by 2008, Report completed and long term management strategy developed

7.8.6 Mission Creek Assessment Unit

Assessment Unit Summary

Table 74. Mission Creek assessment unit summary

Summary of Mission Creek Assessment Unit	
Focal species Steelhead Coho	Assessment Unit Priority Category 3
	Key Sub watersheds Sand Creek Devils Gulch Lower Mission
Limiting Factors Key Habitat Quantity Riparian/Floodplain Function Habitat Diversity Channel Stability Elevated Temperature Flow Obstructions	Hypothesized Effects to Focal Species Water Quality (High) Water Quantity (High) Riparian/Floodplain (High) In-Channel (High) Fish Passage (Moderate-High) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Improve water temperatures in Mission Creek and tributaries

Management Objectives

- Develop strategies to improve low flow conditions
- Increase riparian shade and floodplain function

Sediment

Management Strategy

- Reduce elevated fine sediment percentages in the mainstem and tributary stream substrates

Management Objectives

- Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel
- Improve riparian vegetation and stream bank conditions to reduce or eliminate elevated sediment delivery to streams

Contaminants

Management Strategy

- Enhance water quality primarily for the mainstem of Mission and Brender creeks and preserve water quality in tributary streams

Management Objectives

- Develop programs and strategies for the application of toxic pesticides and herbicides that also restrict these materials from contacting surface water
- Support efforts that restrict waste materials from entering subbasin waters

Water Quantity

Management Strategy

- Enhance mainstem flows by improving overall watershed vegetative and hydrologic conditions and water use efficiency

Management Objectives

- Support the development and use of programs that increase water use efficiency
- Evaluate the potential and feasibility for water storage within the assessment unit

Management Strategy (tributaries)

- Restore tributary flows towards the natural hydrograph

Management Objective (tributaries)

- Reduce the road network where roads are no longer needed and relocate valley bottom roads where feasible
- Minimize stream channel confinement where possible

Riparian/Floodplain

Management Strategy

- Improve riparian and floodplain characteristics throughout the assessment unit where feasible

Management Objectives

- Improve lost sections of riparian vegetation corridors using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function or preventing recovery
- Maintain high quality riparian patches as refuge habitats
- Where feasible, relocate valley bottom roads to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration

- Where applicable, remove bank armoring/dikes
- Increase habitat diversity by reconnecting or increasing off-channel habitat back waters with cover and low energy refugia
- Maintain and increase floodplain connectivity to re-establish and dissipate high flow energy within the stream channel, maintain and enhance wetland complexes, and enhance ground water recharge
- Where applicable, remove bank armoring/dikes
- Increase natural nutrient recruitment from riparian vegetation
- Where possible increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD
- When growing tall trees is not desirable, increase shrub and deciduous (willow) tree cover
- Where appropriate, establish areas where natural channel migration can occur
- Maintain fluvial processes and floodplain function

In-Channel

Management Strategy

- Improve in-channel attributes for the mainstem and tributary streams throughout the assessment unit

Management Objectives

- Maintain and enhance riparian vegetation along unstable stream banks
- Increase natural stream bank stability using active and passive restoration techniques
- Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity
- Where appropriate, restore natural channel form, including reconnection to floodplain

Passage

Management Strategy

- Restore adult and juvenile fish passage throughout the assessment unit

Ecological

Management Strategy

- Control or eliminate brook trout from the assessment unit

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Create approximately two acres of off-channel habitat that would provide additional perennial wetland habitat and ground water storage.

  Monitoring Indicator:

- Acres of perennial wetland habitat

Water Quality

- Determine point and non-point source pollution and establish a plan to prevent pollutants from entering the water system.

  Monitoring Indicator:

- Report for annual water quality monitoring scheme developed and begin implementation by 2007

Water Quantity

- Continue evaluating flow conditions and identify potential actions, benefits and risks to increase low flows (i.e. surface or ground water storage, conveyance and/or on-farm efficiencies, etc.). Implement appropriate actions as identified.

  Monitoring Indicator:

- Report completed in 2007. Begin implementing priority items

Obstruction to Fish Passage

- Identify priority fish passage obstructions and replace as identified

  Monitoring Indicator:

- Report identifying all priority passage issues completed by 2007. Implement all priority actions

Ecological Conditions

- Encourage beaver populations and developments where appropriate

  Monitoring Indicator:

- Number of colonies of beaver families. Identify suitable areas by 2007

7.8.7 Peshastin Creek Assessment Unit

Assessment Unit Summary

Table 75. Peshastin Creek assessment unit summary

Summary of Peshastin Creek Assessment Unit	
Focal species Spring chinook Coho Steelhead Bull trout Cutthroat trout	Assessment Unit Priority Category 2
	Key Sub watersheds Upper Peshastin Lower Peshastin Ingalls Creek
Limiting Factors Key Habitat Quantity Riparian/Floodplain Function Habitat Diversity Channel Stability Elevated Temperature Flow Obstructions	Hypothesized Effects to Focal Species Water Quality (Low) Water Quantity (Moderate) Riparian/Floodplain (High) In-Channel (High) Fish Passage (Moderate-High) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategies

- Improve elevated water temperatures in Peshastin Creek by improving low flow conditions and increasing riparian shade and floodplain function
- Improve elevated water temperatures in tributaries by reducing channel confinement and improving degraded riparian conditions

Sediment

Management Strategy (tributaries)

- Reduce elevated fine sediment percentages in the mainstem and tributary stream substrates

Management Objectives (tributaries)

- Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel
- Improve riparian vegetation and stream bank conditions to reduce or eliminate elevated sediment delivery to streams

Contaminants

Management Strategy

- Enhance water quality in the mainstem Peshastin Creek

Management Objectives

- Develop programs and strategies for the application of toxic pesticides and herbicides that also restrict these materials from contacting surface water
- Support efforts that restrict waste materials from entering subbasin waters

Management Strategy (tributaries)

- Preserve water quality in tributary streams

Water Quantity

Management Strategy

- Enhance mainstem flows by improving overall watershed vegetative and hydrologic conditions, and water use efficiency

Management Objectives

- Support the development and use of programs that increase water use efficiency
- Evaluate the potential and feasibility for water storage within the assessment unit

Management Strategy (tributaries)

- Improve tributary flows to the natural hydrograph by improving the road network, improving stream channel confinement, and relocating valley bottom roads where feasible

Management Objectives (tributaries)

- Improve the road network by minimizing the restrictive interactions with streams
- Minimize stream channel confinement
- Relocate valley bottom roads where feasible

Riparian Floodplain

Management Strategy

- Improve riparian and floodplain characteristics throughout the assessment unit where feasible

Management Objectives

- Improve riparian vegetation corridors where they have been lost using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function

- Preserve high quality riparian patches as refuge habitats
- Where feasible, relocate valley bottom roads to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration
- Increase habitat diversity by reconnecting or increasing off-channel habitat, back waters with cover, and low energy refugia
- Maintain and increase floodplain connectivity to re-establish and dissipate high flow energy within the stream channel, maintain and enhance wetland complexes, and enhance ground water recharge
- Where applicable, remove bank armoring/dikes
- Increase nutrient recruitment of detritus from riparian vegetation
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of large woody debris
- Where appropriate, establish areas where natural channel migration can occur
- Maintain fluvial processes and floodplain function
- Avoid the loss of wetlands and off-channel habitats
- Explore sediment data gap

In-Channel

Management Strategy

- Improve in-channel attributes for the mainstem and enhance or maintain tributary streams throughout the assessment unit

Management Objectives

- Maintain and enhance riparian vegetation along unstable stream banks
- Increase stream bank stability using active and passive restoration techniques
- Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity
- Where appropriate, restore natural channel form, including reconnection to floodplain

Passage

Management Strategy

- Restore adult and juvenile fish passage throughout the assessment unit

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Implement and maintain approximately 5-10 acres of riparian plantings throughout the Assessment Unit. Focus of these efforts is to increase shrub and tree vegetation and increase streambank stability and stream shade.

  Monitoring Indicator:

- Increase in riparian ground cover, vegetation structure and composition

Stream Channel Condition and Function

- Evaluate and implement 15 in-channel structures that would provide additional pool habitat, provide for reduction of channel width to depth ratio, sort substrates and provide for additional spawning gravels and increase structural diversity in the stream channel.

  Monitoring Indicator:

- Number of in-channel structures implemented. Increase in amount of useable habitat available for focal species; width to depth ration; substrate composition

- Create approximately two acres of off-channel habitat that would provide additional perennial wetland habitat and ground water storage.

  Monitoring Indicator:

- Number acres of perennial wetlands and off channel habitat created

Water Quantity

- Continue evaluating flow conditions and identify potential actions, benefits and risks to increase low flows (i.e. surface or ground water storage, conveyance and/or on-farm efficiencies, etc.). Implement appropriate actions as identified.

  Monitoring Indicator:

- Report completed by 2007. Priority actions begin implementation

Obstruction to Fish Passage

- Identify and replace all culverts that are currently blocking fish passage and would provide significant benefit for additional habitat availability.

  Monitoring Indicator:

- Report identifying all priority passage issues completed by 2007. Implement all priority actions

- Continue to evaluate and develop a fish passage structure in the lower Peshastin River to restore year-around passage into the upper watersheds.

  Monitoring Indicator:

- Passage restored throughout the year

Ecological Conditions

- Encourage beaver populations and developments where appropriate

  Monitoring Indicator:

- Number of colonies of beaver families. Identify suitable locations for beavers by 2007

7.8.8 Chumstick Creek Assessment Unit

Assessment Unit Summary

Table 76. Chumstick Creek assessment unit summary

Summary of Chumstick Creek Assessment Unit	
Focal species Steelhead, Coho	Assessment Unit Priority Category 3
	Key Sub watersheds None
Limiting Factors Key Habitat Quantity Riparian/Floodplain Function Habitat Diversity Channel Stability Sediment Flow Obstructions	Hypothesized Effects to Focal Species Water Quality (None) Water Quantity (Moderate –High) Riparian/Floodplain (High) In-Channel (Moderate-High) Fish Passage (High) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Enhance elevated stream temperatures in the mainstem and tributaries throughout the assessment unit

Management Objective

- Improve low flow by improving channel confinement and degraded riparian conditions

Sediment

Management Strategy (tributaries)

Reduce elevated fine sediment percentages in the mainstem and tributary stream substrates

Management Objectives (tributaries)

- Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel
- Improve riparian vegetation and stream bank conditions to reduce or eliminate elevated sediment delivery to streams

Contaminants

Management Strategy

- Enhance water quality primarily for the mainstem of Chumstick Creek

Management Objectives

- Develop programs and strategies for the application of toxic pesticides and herbicides that also restrict these materials from contacting surface water
- Support local and regional efforts that restrict waste materials from entering subbasin waters

Management Strategy (tributaries)

- Enhance water quality in tributary streams

Management Objective (tributaries)

- Support efforts that restrict waste materials from entering subbasin waters

Water Quantity

Management Strategy

- Enhance mainstem flows by improving overall watershed vegetative and hydrologic conditions and water use efficiency

Management Objectives

- Support the development and use of programs that increase water use efficiency
- Evaluate the potential and feasibility for water storage within the assessment unit

Management Strategy (tributaries)

- Restore tributary flows towards the natural hydrograph

Management Objectives (tributaries)

- Reduce the road network where roads are determined to no longer be needed
- Minimize stream channel confinement where possible
- Relocate valley bottom roads where feasible

Riparian/Floodplain

Management Strategy

- Improve riparian and floodplain characteristics throughout the assessment unit where feasible

Management Objectives

- Improve riparian vegetation corridors where they have been lost using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function
- Preserve high quality riparian patches as refuge habitats
- Where feasible, relocate valley bottom roads to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration
- Increase habitat diversity by reconnecting or increasing off-channel habitat, back waters with cover, and low energy refugia
- Maintain and increase floodplain connectivity to re-establish and dissipate high flow energy within the stream channel, maintain and enhance wetland complexes, enhance ground water recharge, and remove bank armoring where applicable
- Increase nutrient recruitment of detritus from riparian vegetation
- Where possible, increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD
- When growing large trees is not desirable increase shrub and deciduous tree cover
- Where appropriate, establish areas where natural channel migration can occur
- Maintain fluvial processes and floodplain function

In-Channel

Management Strategy

- Improve in-channel attributes for the mainstem and tributary streams throughout the assessment unit

Management Objectives

- Maintain and enhance riparian vegetation along unstable stream banks
- Replace the invasive reed canary grass (Phalaris arundinacea) with a native ground cover to maintain stream bank stability
- Increase stream bank stability using active and passive restoration techniques
- Provide in-stream structures (large wood, rock or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity and channel integrity
- Where appropriate, restore natural channel form, including reconnection to floodplain

Passage

Management Strategy

- Restore adult and juvenile fish passage throughout the assessment unit

Ecological

Management Strategy

- Control or eliminate brook trout from the assessment unit

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Implement and maintain approximately 50 acres of riparian plantings throughout the Assessment Unit. Focus of these efforts is to increase shrub and tree vegetation and reduce Canary Reed Grass where ever feasible.

Monitoring Indicator:

- Increase in riparian ground cover, vegetation structure and composition.
- Identify and relocate approximately 5-miles of roads embedded in riparian reas.

Monitoring Indicator:

- Number of miles road relocated from riparian areas
- Create approximately two acres of off-channel habitat that would provide additional perennial wetland habitat and ground water storage.

Monitoring Indicator:

- Number acres of perennial wetlands and off channel habitat created

Stream Channel Condition and Function

- Evaluate and implement 10 in-channel structures that would provide additional pool habitat and increase structural diversity in the stream channel.

Monitoring Indicator:

- Number of in-channel structures implemented. Increase in amount of useable habitat available for focal species; width to depth ration; substrate composition

Water Quality

- Determine point and non-point source pollution and establish a plan to prevent these pollutants from entering the water system.

Monitoring Indicator:

- Monitoring Indicator: Report for annual water quality monitoring scheme developed and begin implementation by 2007

Water Quantity

- Continue evaluating flow conditions and identify potential actions, benefits and risks to increase low flows (i.e. surface or ground water storage, conveyance and/or on-farm efficiencies, etc.). Implement appropriate actions as identified.

  Monitoring Indicator:

- Report completed by 2008. Implementation to begin on priority findings and objectives in 2009

Obstruction to Fish Passage

- Restore year-around passage above the North Road culvert
- Identify and replace 10-15 culverts that are currently blocking fish passage and would provide the greatest benefit for additional habitat availability

  Monitoring Indicator:

- Report identifying all priority passage issues completed by 2007. Implement all priority actions

Ecological Conditions

- Encourage beaver populations and developments where appropriate.

  Monitoring Indicator:

- Number of colonies of beaver families. Identify suitable areas by 2007

7.8.9 Icicle Creek Assessment Unit

Assessment Unit Summary

Table 77. Icicle Creek assessment unit summary

Summary of Icicle Creek Assessment Unit	
Focal species Spring chinook, Late-run chinook, Coho, Steelhead, Bull trout (lower watershed) Bull trout, Cutthroat trout (upper watershed)	Assessment Unit Priority Category 2
	Key Sub watersheds: Upper Icicle Creek Jack Creek French Creek Head waters Icicle Creek
Limiting Factors Competition (Leavenworth NFH) Habitat Diversity (lower watershed) Elevated Temperature (lower watershed) Flow (lower watershed) Obstructions	Hypothesized Effects to Focal Species Water Quality (Low-Moderate) Water Quantity (Moderate) Riparian/Floodplain (Moderate) In-Channel (Moderate) Fish Passage (Low) Ecological (1)

(1)Hypothesized Effects to Focal Fish Species pertains primarily to the lower mainstem of Icicle Creek

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Enhance elevated stream temperatures in the lower mainstem creek by improving low flow and degraded riparian conditions

Management Strategy

- Maintain existing condition and trend in tributary streams

Sediment

Management Strategy (tributaries)

- Reduce fine sediment level in the lower mainstem

Management Objective (tributaries)

- Improve streambank stability and riparian ground cover

Management Strategy

- Maintain existing condition and trend in tributary streams

Contaminants

Management Strategy

- Maintain or enhance water quality in the lower mainstem

Management Objectives

- Develop programs and strategies for the application of toxic pesticides and herbicides that also restrict these materials from contacting surface water
- Support efforts that restrict waste materials from entering subbasin waters

Water Quantity

Management Strategy

- Improve stream flow in lower mainstem

Management Objectives

- Support the development and use of programs that increase water use efficiency
- Continue to evaluate and improve irrigation, municipal, and rural efficiencies that conserve waters of Icicle Creek
- Evaluate the potential and feasibility for additional water storage within the assessment unit

Management Strategy (tributaries)

- Maintain tributary existing condition and trend

Riparian Floodplain

Management Strategy

- Improve riparian and floodplain characteristics in the lower portion of the assessment unit (mainstem river below Snow Creek)

Management Objectives

- Improve riparian vegetation corridors where they have been lost using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function
- Increase habitat diversity by reconnecting or increasing off-channel habitat, back waters with cover and low energy refugia
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD

- Where appropriate, establish areas where natural channel migration can occur
- Maintain fluvial processes and floodplain function
- Where feasible, relocate valley bottom roads to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration

Management Strategy (tributaries)

- Maintain and enhance existing condition and trend in the upper mainstem river and tributary streams

Management Objectives (tributaries)

- Where feasible, relocate valley bottom roads and recreational facilities (campgrounds) to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration
- Continue to allow for passive restoration of riparian vegetation and natural recruitment of large wood in fire damaged areas

In-Channel

Management Strategy

- Enhance in-channel attributes in the lower portion of the assessment unit (mainstem river below Snow Creek)

Management Objectives

- Provide in-stream structures (large wood, rock or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity
- Where appropriate, restore natural channel form, including reconnection to floodplain
- Increase natural stream bank stability using active and passive restoration techniques

Management Strategy (tributaries)

- Maintain and enhance in-channel characteristics in the upper mainstem river (above Snow Creek) and tributaries

Management Objective (tributaries)

- Maintain natural riparian, floodplain and fluvial processes

Passage

Management Strategies

- Restore adult and juvenile fish passage within the lower Icicle Creek (below Snow Creek)
- Maintain existing condition and trend in the upper Icicle Creek and tributaries

Ecological

Management Strategy

- Control and eradicate brook trout from the upper watershed

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Complete on-going investigations considering suitable in-channel and riparian habitat improvement projects and implement the priority and appropriate recommendations.

Monitoring Indicator:

To be determined upon findings of assessment.

Stream Channel Condition and Function

- Complete on-going investigations considering suitable in-channel and riparian habitat improvement projects and implement the priority and appropriate recommendations.

Monitoring Indicator:

- To be determined upon findings of assessment

Water Quality

- Near-term opportunity not identified to date. Reference: Monitoring Strategy for the Wenatchee Subbasin.

Water Quantity

- Complete on-going USFWS in-stream flow study from Snow Creek to the Leavenworth NFH Project area. Implement the priority and appropriate recommendations. Complete evaluation of re-connecting all or portions of historic river channel to existing channel.

Monitoring Indicator:

- Report completed in 2007. Begin implementing priority actions Measure changes in stream flow

Obstruction to Fish Passage

- Evaluate the feasibility and benefit/risks of enhancing fish passage through the "boulder field" at river mile 5.6. Implement passage if determined appropriate.
- Allow passage of bull trout and steelhead past the Leavenworth National Fish Hatchery.
- Identify and replace all culverts that are currently blocking fish passage and would provide significant benefit for additional habitat availability.

Monitoring Indicator:

- Report identifying all priority passage issues completed by 2007. Implement all priority actions.

7.8.10 Nason Creek Assessment Unit

Assessment Unit Summary

Table 78. Nason Creek assessment unit summary

Summary of Nason Creek Assessment Unit	
Focal species Spring chinook, Coho, Steelhead, Bull trout, Cutthroat trout	Assessment Unit Priority Category 1
	Key Sub watersheds Head waters Nason, Upper Nason Lower Nason
Limiting Factors Key Habitat Quantity Riparian / Floodplain Condition Channel Stability Habitat Diversity Sediment Elevated Temperature Obstructions Competition (Brook trout)	Hypothesized Effects to Focal Species Water Quality (Moderate) Water Quantity (None) Riparian/Floodplain (High) In-Channel (High) Fish Passage (Moderate-High) Ecological (Low-Moderate)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategies

- Improve elevated stream temperatures in the lower mainstem creek (below Mill Creek) by improving low flow conditions, channel confinement, and degraded riparian conditions
- Maintain and enhance elevated temperatures in the upper mainstem and tributary streams by improving riparian conditions where needed

Sediment

Management Strategy

- Reduce fine sediment level in the lower mainstem

Management Objective

- Improve stream-bank stability, floodplain connectivity and riparian conditions and ground cover

Management Strategy

- Maintain and reduce sediment delivery in tributary streams

Management Objective

- Improve riparian road conditions to reduce sediment delivery

Contaminants

Management Strategy

- Enhance water quality in the lower mainstem (below Mill Creek)

Management Objective

- Continue to augment and coordinate programs that restrict waste materials from the transportation systems, rural sources, failing septic systems and livestock from entering surface and ground water

Management Strategy (tributaries)

- Maintain water quality in tributary streams

Water Quantity

Management Strategy

- Enhance mainstem flows by improving overall watershed vegetative and hydrologic conditions and water use efficiency

Management Strategy

- Maintain or improve tributary flows towards the natural hydrograph
- Improve the road network, where roads are determined to no longer be needed
- Improve stream channel confinement where possible
- Relocating valley bottom roads where feasible

Management Objective

- Evaluate the potential to decrease summer surface withdrawals by converting water withdrawals to ground water wells
- Evaluate the potential and feasibility for water storage within the assessment unit

Riparian Floodplain

Management Strategy

- Improve riparian and floodplain characteristics in the lower mainstem (below Mill Creek) where feasible

Management Strategy (tributaries)

- Maintain and enhance tributary riparian and floodplain characteristics

Management Objectives

- Improve riparian vegetation corridors where they have been lost using active restoration practices
- Avoid activities within riparian corridors that disrupt riparian function
- Preserve high quality riparian patches as refuge habitats
- Where feasible, relocate valley bottom roads to allow for restoring riparian vegetation, enhancing floodplain function, and providing for channel migration
- Increase habitat diversity by reconnecting or increasing off-channel habitat, back waters with cover and low energy refugia
- Maintain and increase floodplain connectivity to re-establish and dissipate high flow energy within the stream channel, maintain and enhance wetland complexes, enhance ground water recharge, and where applicable, remove bank armoring/dikes
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of large woody debris
- Establish areas where natural channel migration can occur (where appropriate)
- Maintain fluvial processes and floodplain function

In-Channel

Management Strategy

- Improve in-channel attributes for the mainstem (focus on lower 15 miles of Nason Creek) and some tributary streams throughout the assessment unit

Management Objectives

- Maintain and enhance riparian vegetation along unstable stream banks
- Increase natural stream bank stability using active and passive restoration techniques
- Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity
- Where appropriate, restore natural channel form, including reduction of channel confinement, reconnection to tributary confluences, side channels, and floodplain

Passage

Management Strategy

- Restore adult and juvenile fish passage throughout the assessment unit

Ecological

Management Strategy

- Control or eradicate brook trout throughout the assessment unit

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Implement and maintain approximately 5-10 acres of riparian plantings throughout the Assessment Unit. Focus of these efforts is to increase streambank stability and stream shade and to enhance re-connected side channel habitat.

Monitoring Indicator:

- Increase in stream shade, riparian ground cover, vegetation structure and composition. Lineal measurements of stable stream channel.
- Create approximately two acres of off-channel habitat that would provide additional perennial wetland habitat and ground water storage

Monitoring Indicator:

- Acres of off-channel and wetland habitat
- Maintain the existing high quality riparian and perennial wetland, side channel and off-channel habitats within the assessment unit.

Monitoring Indicator:

- Increase acres side channel habitat; useable habitat for focal species at various flow and environmental conditions

Stream Channel Condition and Function

- In the lower 14-miles of Nason Creek, identify approximately 10 sites to reconnect side-channel habitat to the mainstem river and implement the appropriate actions.
- In the lower 14-miles of Nason Creek, evaluate and implement 10-15 in-channel structures that would provide additional pool habitat and increase structural diversity in the stream channel.

Monitoring Indicator:

- Number of miles of additional side channel habitat and number of sites of new in-channel structures that are useable habitat for focal species at various flow and environmental conditions

Water Quantity

- Continue evaluating flow conditions and identify potential actions, benefits and risks of actions that would increase base flows (i.e. surface or groundwater storage). Implement appropriate actions as identified.

Monitoring Indicator:

- Report completed by 2008. Implementation to begin on priority findings and objectives in 2010

Ecological Conditions

- Encourage beaver populations and developments where appropriate.

Monitoring Indicator:

- Number of colonies of beaver families. Identify suitable areas by 2007

7.8.11 Little Wenatchee River Assessment Unit

Assessment Unit Summary

Table 79. Little Wenatchee assessment unit summary

Summary of Little Wenatchee Assessment Unit	
Focal species Spring chinook, Coho, Sockeye, Steelhead, Bull trout, Cutthroat trout	Assessment Unit Priority Category 1
	Key Sub watersheds Head waters Little Wenatchee Upper Little Wenatchee Lower Little Wenatchee Rainy Creek Lake Creek
Limiting Factors Competition (Brook trout)	Hypothesized Effects to Focal Species Water Quality (None) Water Quantity (None) Riparian/Floodplain (None) In-Channel (None) Fish Passage (None) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Maintain existing condition and trend in mainstem and tributary streams

Management Objective

Continue to monitor for condition and trend in the lower mainstem due to exceedences of water quality standards (focus on lower mainstem)

Sediment

Management Strategy

Maintain existing condition and trend in mainstem and tributary streams

Management Objective

- Continue to monitor condition and trend for sediment and cobble embeddedness. (focus on Rainy Creek due to potential past hydrologic disturbance from logging activities)

Contaminants

Management Strategy

- Maintain existing condition in mainstem and tributaries

Management Objective

- Monitor for trend

Water Quantity

Management Strategy

- Maintain existing condition for mainstem and tributaries

Management Objectives

- Monitor for trend (focus on Rainy Creek)
- Evaluate the potential and feasibility for additional water storage within the assessment unit

Riparian/Floodplain

Management Strategy

- Maintain and enhance lower mainstem riparian vegetation along the Little Wenatchee River

Management Strategy (tributaries)

- Maintain existing condition and trend in tributary streams

Management Objective

- Where feasible, relocate valley bottom roads and recreational facilities (campgrounds) to allow for restoring riparian vegetation, enhancing floodplain function and connection to stream channel, and providing for channel migration

In-Channel

Management Strategy

- Enhance lower Little Wenatchee River habitat diversity

Management Strategy (tributaries)

- Maintain existing condition and trend in tributary streams

Management Objective

- Where appropriate, provide instream structures (large wood or other natural materials) that will increase pool habitat and enhance salmonid habitat diversity, habitat quality and quantity, and channel integrity

Passage

Management Strategy

- Maintain existing condition throughout watershed

Ecological

Management Strategy

- Control or eradicate brook trout

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Maintain the existing high quality riparian and perennial wetland, side channel and off-channel habitats within the assessment unit.

Monitoring Indicator:

- No net loss of these habitat variables measured by aerial photography and GIS technology.

7.8.12 White River Assessment Unit

Assessment Unit Summary

Table 80. White River assessment unit summary

Summary of White River Assessment Unit	
Focal species Spring chinook, Sockeye, Steelhead, Bull trout, Cutthroat trout	Assessment Unit Priority Category 1
	Key Sub watersheds: Head waters White Rive Upper White River Lower White River Napeequa Creek Panther Creek
Limiting Factors Key Habitat Quantity (lower stream reaches only) Competition (Brook trout)	Hypothesized Effects to Focal Species Water Quality (None) Water Quantity (None) Riparian/Floodplain (Low) In-Channel (Low) Fish Passage (None) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Maintain existing condition for mainstem and tributaries

Sediment

Management Strategy

- Maintain existing condition for mainstem and tributaries

Contaminants

Management Strategy

- Maintain existing condition for mainstem and tributaries

Water Quantity

Management Strategy

- Maintain existing condition for mainstem and tributaries

Riparian/Floodplain

Management Strategy

- Improve lower mainstem (11 miles) interaction with floodplain

Management Objectives

- Where possible, remove berms and reconnect floodplain with mainstem channel
- Allow large trees to begin growing next to mainstem where possible
- Where feasible, relocate valley bottom roads and recreational facilities (campgrounds) to allow for restoring riparian vegetation, enhancing floodplain function and connection to stream channel, and providing for channel migration
- Avoid activities within riparian corridors that disrupt riparian function
- Where applicable, maintain and increase floodplain connectivity to re-establish and dissipate high flow energy within the stream channel, maintain and enhance wetland complexes, enhance ground water recharge, and remove bank armoring/dikes
- Enhance fluvial processes and floodplain function
- Maintain existing conditions in tributary streams

In-Channel

Management Strategy

- Enhance in-channel attributes for the mainstem (focus on lower 11 miles of the White River)

Management Objective

- Increase habitat diversity by reconnecting or increasing off-channel habitat, back waters with cover and low energy refugia

Passage

Management Strategy

- Maintain existing condition throughout the assessment unit

Ecological

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Improve 5-10 acres of riparian condition and channel connectivity with the floodplain.
- Monitoring Indicator: Increase in stream shade, riparian ground cover, vegetation structure and composition.

- Maintain the existing high quality riparian and perennial wetland, side channel and off-channel habitats within the Assessment Unit.

  Monitoring Indicator:

- No net loss of these habitat variables measured by aerial photography and GIS technology

Stream Channel Condition and Function

- Improve 2-3 river miles of in-channel habitat diversity.

  Monitoring Indicator:

- Evaluate pool quality, pools per mile and amount of large wood complexes in stream channel

7.8.13 Chiwawa River Assessment Unit

Assessment Unit Summary

Table 81. Chiwawa River assessment unit summary

Summary of Chiwawa River Assessment Unit	
Focal species Spring chinook, Steelhead, Bull trout, Cutthroat trout.	Assessment Unit Priority Category 1
	Key Sub- watersheds: Head waters Chiwawa Upper Chiwawa Middle Chiwawa Lower Chiwawa Rock Creek Chikamin Creek
Limiting Factors Competition (Brook trout)	Hypothesized Effects to Focal Species Water Quality (None) Water Quantity (None) Riparian/Floodplain (None) In-Channel (None) Fish Passage (None) Ecological (Data Gap)

Management Strategy Recommendations

Water Quality

Temperature

Management Strategy

- Maintain existing condition for mainstem

Management Strategy (tributaries)

- Reduce elevated temperatures in Big Meadow Creek

Management Objective

- Maintain trend for increased riparian vegetating and improving stream channel conditions

Sediment

Management Strategy

- Bring sediment delivery into the range of natural conditions in Big Meadow Creek

Management Objective

- Maintaining existing reforestation trend

Contaminants

Management Strategy

- Maintain existing condition for mainstem and tributaries

Water Quantity

Management Strategy

- Maintain existing condition for mainstem and tributaries

Riparian Floodplain

Management Strategy

- Maintain and enhance lower mainstem

Management Objectives

- Where feasible, relocate valley bottom roads and recreational facilities (campgrounds) to allow for restoring riparian vegetation, enhancing floodplain function and connection to stream channel, and providing for channel migration
- Avoid activities within riparian corridors that disrupt riparian function
- Preserve high quality riparian patches as refuge habitats
- Reduce impacts to floodplain and riparian characteristics from future developments, agricultural practices and livestock management
- Where appropriate, establish areas where natural channel migration can occur
- Maintain fluvial processes and floodplain function
- Maintain existing condition in tributaries

In-Channel

Management Strategy

- Enhance lower Little Wenatchee River

Management Objective

- Enhance and maintain in-stream characteristics that will provide high quality pool habitat and structural diversity

Management Strategy

- Maintain existing condition and trend in tributary streams

Passage

Management Strategy

- Maintain existing conditions in the mainstem

Management Objective

- Continue to monitor potential affects to passage at the Chiwawa (spring chinook) brood stock collection weir

Management Strategy

- Enhance fish passage in some tributary streams

Management Objective

- Evaluate and replace culverts as needed

Ecological

[No information to date]

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Maintain the existing high quality riparian and perennial wetland, side channel and off-channel habitats within the assessment unit.

Monitoring Indicator:

- No net loss of these habitat variables measured by aerial photography and GIS technology

7.8.14 Lake Wenatchee Assessment Unit

Assessment Unit Summary

Table 82. Lake Wenatchee assessment unit summary

Summary of Lake Wenatchee Assessment Unit	
Focal species: Sockeye, Bull trout	Assessment Unit Priority Category 1 Key Sub watersheds: NA
Limiting Factors: Nutrients/Food Competition	Hypothesized Effects to Focal Species Water Quality (Data Gap) Water Quantity (None) Riparian/Floodplain (Moderate) In-Channel (Moderate) Fish Passage (Low-Moderate) Ecological (Data Gap)

Management Strategy Recommendations

[No information to date]

Near Term Opportunities and Measurable Objectives

Riparian/Floodplain Condition and Function

- Maintain the existing high quality riparian and perennial wetland habitats surrounding Lake Wenatchee.

  Monitoring Indicator:

- No net loss of these habitat variables measured by aerial photography and GIS technology.

Water Quality

- Develop and implement long term water quality evaluation strategy to monitor condition and trend of Lake Wenatchee.

  Monitoring Indicator:

Report for annual water quality monitoring scheme developed and begin implementation by 2007.

Ecological Conditions

- Develop and implement a long term biological community evaluation and strategy to monitor condition and trend with a particular focus on bull trout and sockeye salmon abundance and ecological relationships.

- Evaluate the effects of existing and future developments surrounding the lake on the associated floodplains and biological conditions.
- Evaluate the benefits and risks of enhancing nutrients in Lake Wenatchee to salmonid, specifically sockeye production.

Monitoring Indicator:

- Reports identifying long term management and/or monitoring completed by 2008. Begin implementing priority actions by 2010

7.8.15 Subbasin Wide Opportunities

The following actions are in common to most or all assessment units. These actions should be evaluated for their level of need and suitability for each individual assessment unit and be implemented as appropriate.

Riparian Floodplain Conditions

- Near-term opportunity identified within the assessment unit.

Stream Channel Condition and Function

- 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.
- Monitoring Indicator: Complete a long term management plan which is coordinated between all parties with authority and responsibility for road systems by 2007.
- Evaluate existing and potential salmonid carrying capacity in all of the Assessment Units to increase our knowledge and understanding on what population target numbers for salmon recovery may be supportable by the available habitats.
- Monitoring Indicator: Complete report by 2008 for all assessment units.

Water Quality

- Evaluate bio-accumulation of toxic materials within the flesh of indicator species to determine the extent that these materials are entering into the ecological and human food chain.

Monitoring Indicator: Develop long term strategy and complete the Report by 2008. Begin implementing priority actions.

- Continue to use FLIR (forward looking infrared) 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 made available during winter months.

Monitoring Indicator: Complete additional FLIR flights by 2006 and complete analytical report by 2008. Begin implementing priority actions.

Water Quantity

- As demand for water use continues to grow within the subbasin, so does the need to evaluate critical flows to support geo-fluvial processes and the stream/floodplain ecosystems. Evaluation of annual flow and potential withdrawals using, but not limited to the IFIM methodology should be completed. This work will contribute to a completed long term strategy for water management within the subbasin.

Monitoring Indicator: Complete IFIM (instream flow incremental methodology) and related work by 2007 and adopt instream flows by 2009. Begin implementing priority actions.

Obstruction to Fish Passage

- Identify and replace all priority culverts that are currently blocking fish passage into good quality habitat.

Monitoring Indicator: Report identifying all priority passage issues and opportunities completed by 2007. Implement all priority actions.

Ecological Conditions

- The extent of harassment and poaching on salmonids is unknown, especially when pre-spawning adults are holding and are very vulnerable. Develop and implement a long term and sustained public education campaign and increase enforcement activities to reduce harassment and poaching of salmonids.

Monitoring Indicator: Long term program defined and adopted by 2008. Begin implementing priority actions.

- Macro-invertebrate sampling within the Wenatchee 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.

Monitoring Indicator: Long term program defined and adopted by 2006. Sample locations, protocol responsibilities identified. Begin implementing priority actions.

- It is generally assumed that significant biological (primary) productivity has been lost in the mainstem and tributary streams of the Wenatchee 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.

Monitoring Indicator: Develop pilot program by 2006 including monitoring strategy, protocols and responsibilities. Implement pilot program through 2009 and identify appropriate actions thereafter.

- Control and/or eradicate brook trout populations where appropriate within various assessment units to reduce competition and predation on native fish species.

Monitoring Indicator: Develop pilot program by 2006 including monitoring strategy, protocols and responsibilities. Implement pilot program through 2009 and identify appropriate actions thereafter.

7.8.16 Summary of Near-term Opportunities by Focal Species

The following opportunities exist for each of the fish focal species. This summary list is not intended to be all inclusive nor a prioritization of all needed actions. Implementation of these, and many other actions or evaluations would greatly benefit recovery of these focal populations.

Spring Chinook

Understanding the contribution of fall emigrating juveniles to returning adult escapement is an important piece of information that is currently lacking. Understanding the spawning success of hatchery fish and their naturally reproducing progeny is another important concern when making decisions on how to increase populations within the subbasin. This information would aid recovery efforts of this population.

Late-run Chinook

Increased habitat diversity (e.g., off-channel habitat, increased structural diversity, etc.) primarily in the lower Wenatchee River, coupled with increased nutrients and macro-invertebrate production should improve productivity for late-run chhinook.

Sockeye

Increasing understanding of those factors that affect juvenile survival (primarily in Lake Wenatchee) would aid in the ability to improve production of this species. Investigations regarding increased nutrient loads in Lake Wenatchee should be undertaken to determine the benefits and potential risks of this management action.

Coho

Continued development of a locally adapted broodstock is essential to ensure future populations of naturally spawning coho salmon in the Wenatchee subbasin. Increased habitat diversity (e.g. off channel habitat, increased structural diversity, etc,) primarily in Nason Creek, Peshastin Creek, Mission Creek, and the lower Wenatchee River would increase the success of naturally spawning coho and increase productivity. Evaluation of migrational delays in Tumwater Canyon could improve extreme flow passage conditions for adults migrating to the upper Wenatchee subbasin.

Steelhead

Increased habitat diversity (e.g., off channel habitat, increased structural diversity, etc.) primarily in the lower Wenatchee River, coupled with increased nutrients and macro-invertebrate production, and increased access to spawning and rearing habitats in tributary streams should improve productivity for steelhead. Information on spawning distribution and juveniles rearing needs are lacking in the Wenatchee River and collection of this information would increase managers' efforts at recovery.

Bull Trout and Westslope Cutthroat Trout

Population estimates 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. Access to historic habitat is important to preserving life history diversity and increasing overall productivity.

Pacific Lamprey

Very little information about this species is available for the Wenatchee Subbasin. Evaluations should begin that identifies species presence, habitat preferences and habitat availability. Evaluations addressing artificial propagation of this species should be included within a larger and similar effort throughout the Columbia Cascade Province. Habitat improvement work should be implemented as determined appropriate.