Imnaha Subbasin Management Plan

May 2004

Written by
Ecovista

Subbasin Lead Entity:
Nez Perce Tribe

Planning Team:
Wallowa County Natural Resources Advisory Committee

TABLE OF CONTENTS

List of Tables

List of Figures

1 Introduction

The *Imnaha Subbasin Plan* was produced as part of the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program. This plan will help direct Bonneville Power Administration's funding of projects that mitigate for damage to fish and wildlife caused by the development and operations of the Columbia River's hydropower system. Subbasin plans were developed in an open public process that included the participation of a wide range of state, federal and tribal governments, local managers, landowners, local governments, and other stakeholders, a process the Council hopes will ensure support of the final plan and direct funding to fish and wildlife projects that will do the most good.

An adopted subbasin plan is intended to be a living document that increases analytical, predictive, and prescriptive ability to restore fish and wildlife. The Imnaha Subbasin Plan will be updated every three years to include new information that will guide revision of the biological objectives, strategies and implementation plan. The NPCC views plan development as an ongoing process of evaluation and refinement of the region's efforts through adaptive management, research and evaluation. More information about subbasin planning can be found at www.nwcouncil.org.

The Imnaha Subbasin Plan includes three interrelated volumes that describe the characteristics, management, and vision for the future of the Imnaha Subbasin:

Assessment--The assessment is a technical analysis that examines the biological potential of the Imnaha Subbasin to support key habitats and species, and the factors limiting this potential. These limiting factors provide opportunity for restoration. The assessment describes existing and historic resources and conditions within the subbasin, focal species and habitats, environmental conditions, out of subbasin impacts, ecological relationships, limiting factors and a final synthesis and interpretation. A **Technical Team** was formed to guide the development of the assessment and technical portions of the management plan. It was composed of scientific experts with the biological, physical, and management expertise to refine, validate, and analyze data used to inform the planning process.

Inventory-- The inventory summarizes fish and wildlife protection, restoration and artificial production activities and programs within the Imnaha Subbasin that have occurred over the last five years or are about to be implemented. The information includes programs and projects as well as locally developed regulations and ordinances that provide fish, wildlife and habitat protections.

Management plan-- defines a vision for the future of the subbasin, including biological goals and strategies for the next 10-15 years. The management plan includes a research, monitoring and evaluation plan to insure that implemented strategies succeed in addressing limiting factors and to reduce uncertainties and data gaps. The management plan also includes information about the relationship between proposed activities and the

Endangered Species Act and the Clean Water Act. Finally the plan includes a gap analysis that outlines the programs and projects currently addressing the objectives and strategies and where additional work needs to be developed. A **Planning Team** composed of representatives from government agencies with jurisdictional authority and other stakeholders in the subbasin was formed to guide the development of the management plan

The plans for each of the subbasins are developed through a process that involved the public and natural resource management within the subbasin. A **Project Team** composed of staff from Ecovista was formed to develop and document, under the guidance of the Technical and Planning Teams, the Imnaha Subbasin Plan. The completed plan was submitted to the Council by the Nez Perce Tribe on May 28, 2004. The following sections detail the entities contractually involved in producing the Imnaha Subbasin Plan.

1.1 Entities and Authorities for Resource Management

1.1.1 Funding Sources, Regional and State Coordination

Multiple agencies and entities are involved in management and protection of fish and wildlife populations and their habitats in the Imnaha Subbasin. Federal, tribal, state, and local regulations, plans, policies, initiatives, and guidelines are part of this effort. The Nez Perce Tribe and Oregon Department of Fish and Wildlife share co-management authority over the fisheries resources in the subbasin. Federal involvement in this arena stems from Endangered Species Act responsibilities and from management responsibilities for federal lands. Numerous federal, state, and local land managers are responsible for multipurpose land and water use management, including the protection and restoration of fish and wildlife habitat. Major management entities involved in developing the Imnaha Subbasin Plan are outlined below.

1.1.2 Nez Perce Tribe

The Nez Perce Tribe serves as lead entity for subbasin planning for the Imnaha Subbasin. The Tribe contracted with the NPCC to deliver the Imnaha Subbasin Plan. The Tribe ensured the opportunity for participation in the process by fish and wildlife managers, local interests and other key stakeholders, including tribal and local governments.

The NPT is responsible for managing, protecting, and enhancing treaty fish and wildlife resources and habitats for present and future generations. Tribal government headquarters are located in the Clearwater River subbasin in Lapwai, Idaho, with regional offices coving the Imnaha subbasin in Enterprise, Oregon. The NPT has treaty reserved fishing, hunting and gathering rights pursuant to the 1855 Treaty with the United States. Fish and wildlife activities relate to all aspects of management, including recovery, restoration, mitigation, enforcement, and resident fish programs.

1.1.3 Northwest Power Conservation Council

The NPCC, or Council, has the responsibility to develop and periodically revise the Fish and Wildlife Program for the Columbia Basin. In the 2000 revision, the NPCC proposed that 62 locally developed subbasin plans, and plans for the main stem Columbia and Snake Rivers, be adopted into its Fish and Wildlife Program. The NPCC administers subbasin planning contracts pursuant to requirements in its Master Contract with Bonneville Power Administration (NPCC 2003). The NPCC will be responsible for reviewing and adopting each subbasin plan, ensuring that it is consistent with the vision, biological objectives and strategies adopted at the Columbia Basin and province levels.

1.1.4 Bonneville Power Administration

The BPA is a federal agency established to market power produced by the federal dams in the Columbia River Basin. As a result of the Northwest Power Act of 1980, BPA is required to allocate a portion of power revenues to mitigate the damages caused to fish and wildlife populations and habitat from federal hydropower construction and operation. BPA provided the funds for subbasin planning contracts administered by the NPCC.

1.1.5 Project Team

The Nez Perce Tribe subcontracted with Ecovista to facilitate the planning process and write plan documents. Project Team members are listed in Table 1

Table 1. Imnaha project team contact information.

Name	Affiliation	Specialty
Darin Saul	Ecovista	project coordinator, tech writer, and editor
Craig Rabe	Ecovista	fisheries biologist, tech writer
Anne Davidson	Ecovista	wildlife biologist, GIS, tech writer

1.1.6 Planning Team

The Imnaha Planning Team is composed of representatives from government agencies with jurisdictional authority in the subbasin, fish and wildlife managers, county, industry and user group representatives and private landowners. The Planning Team's guided the public involvement process, developed the vision statement, helped develop and review the biological objectives, and participated in prioritizing subbasin strategies. Regular communication and input among team members occurred at the inception of and throughout the planning process. The Planning Team met monthly throughout the project period (Table 2).

Table 2. Imnaha Planning Team contact information.

Name	Affiliation
Cass Botts	Landowner
Jack McClaren	Landowner--alternate
Rod Childers	Soil/Water Conservation
James Yost	Soil/Water Conservation--alternate
Bruce Dunn	Logging
Mike Mahon	Logging--alternate
Ira Jones	Nez Perce Tribe
Bill Knox	Oregon Department of Fish and Wildlife
Meg Mitchell	US Forest Service
Kendall Clark	US Forest Service-alternate
Andrea Mitchell	The Nature Conservancy
Phil Shephard	The Nature Conservancy
Diane Snyder	Wallowa Resources
Gail Hammock	Wallowa Resources--alternate
Tom Smith	Natural Resource Conservation Service
Cynthia Warnock	Natural Resource Cons. Service--alternate
John Williams	Oregon State University
Saralyn Johnson	Oregon State University--alternate

1.1.7 Technical Team

The Technical Team includes members with the biological, physical, and management expertise to refine, validate, and analyze data used to inform the planning process. The technical team also guides and participates in developing the biological objectives, strategies and research, monitoring and evaluation sections of the plan and review all project documents. The Imnaha Technical Team met monthly or bimonthly throughout the process, and participated in day or multi-day workshops focused on filling data gaps. See Table 3 for a listing of Technical Team members.

Table 3. Imnaha Technical Team contact information.

Name	Affiliation
Becky Ashe	NPT
Mike Bianchi	NOAA Fisheries
Ken Bronec	US Forest Service
Ralph Browning	USFS
Debby Colbert	OWRD
Paul Daniello	Oregon Department of Environmental Quality
Bruce Dunn	Logging
Jeff Fryer	CRITFC/TOAST
Alicia Glassford	USFS
Bill Knox	Oregon Department of Fish and Wildlife
Megan Lucas	US Forest Service
Pat Mathews	Oregon Department of Fish and Wildlife
Coby Menton	Grande Ronde Model Watershed
Meg Mitchell	US Forest Service
Drew Parkin	NWPPC
Keith Paul	US Fish and Wildlife Service
Tim Schommer	US Forest Service
Phil Shephard	The Nature Conservancy
Paul Survis	USFS
Teresa Smergut	USFS
Brad Smith	Oregon Department of Fish and Wildlife
Tom Smith	Natural Resource Conservation Service
Angela Sondenaa	NPT-Wildlife Dept.
Randy Tweten	NOAA Fisheries
Andy White	Forest Management
John Williams	Oregon State University
Jack Yearout	NPT- Watershed

1.2 Public Involvement

Four methods of outreach and public participation were implemented as part of the subbasin planning process in the Imnaha subbasin:

1. Technical Team meetings

2. Planning Team meetings

3. Public meetings

4. Website

1.2.1 Technical Team Participation

The Technical Team was composed of members that have technical expertise in fish, wildlife, and habitat resources in the Imnaha subbasin. The Technical Team reviewed and gave input on the technical aspects of the subbasin plan, and this input is in large part documented in the subbasin assessment.

1.2.2 Planning Team Participation

The Planning Team was composed of members that have expertise and knowledge of the management of natural resources and socioeconomic issues in the Imnaha subbasin. Team meetings were held afternoons of the fourth Tuesday of every month in Enterprise, Oregon, at the OSU Wallowa County Extension Office and were open to the public. The Planning Team reviewed and gave input on the management aspects of the subbasin plan, and this input is in large part documented in the subbasin plan.

1.2.3 Public Meeting Outreach

The Planning Team guided the public involvement process for the Imnaha subbasin planning process. The Planning Team met as a regular agenda item of the Wallowa County Natural Resource Advisory Committee (NRAC). All NRAC meetings are open to the public, although few individuals came to these meetings specifically to participate in or comment on subbasin planning for the Imnaha subbasin.

Due to a number of similar public involvement processes taking place in the Wallowa Valley during spring 2003, the Planning Team decided to postpone public meetings until later in the process.

In May 2003, a three-minute radio announcement was made and broadcast on local radio to announce and explain subbasin planning in the Imnaha subbasin.

A first public meeting was scheduled in December 2003, but was cancelled due to weather and some scheduling confusion among participating groups.

A second public meeting was held in the town of Imnaha on April 25, 2004 , which was attended by 12 local residents. The meeting presented the basics of subbasin planning, but largely focused on addressing land owner concerns through an extended question and answer session.

1.2.4 Ecovista Website Information

As the *Imnaha Subbasin Management Plan* was developed, draft documents and information about the meetings, the subbasin, and subbasin planning were posted on the Ecovista website (http://www.ecovista.ws).

1.3 Review Process

The *Imnaha Subbasin Assessment* and *Imnaha Subbasin Management Plan* were made available for review through e-mail notification lists compiled by the project team and during technical and planning team meetings. The focal species, focal habitats, and limiting factors from the assessment were presented at the public meeting in March 2004. The Vision for the subbasins, problem statements, and objectives from the management plan were also presented in March. Prioritizations for the subbasins were presented and discussed during the April technical team meeting. Through this review process, comments, suggestions, and clarifications were received from local, state, tribal, and federal representatives having relevant professional expertise, as well as from landowners and other stakeholders in the subbasin. The review by those involved in the process in the subbasin was completed, within the constraints of time, by May 28, 2004.

The summer schedule for the independent scientific review of subbasin plans has been developed. For a majority of the subbasin plans, the ISRP/ISAB review process will begin immediately following the May 28 deadline and conclude with submittal of final reports to the Council by August 12, 2004. The Imnaha Subbasin Plan will be reviewed during Week 7: July 19th-July 23rd (NPCC 2004).

To complete the review, about ten review teams, and one basin-wide umbrella committee have been established. The review teams are organized to review sets of subbasin plans grouped by province. Each team consists of six or more reviewers and includes a mix of ISRP, ISAB, and Peer Review Group members. The umbrella group will help ensure a consistent level of review scrutiny and comment quality (NPCC 2004).

A review checklist and comment template is being developed for the ISRP/ISAB review of subbasin plans based on the Council's Subbasin Planning Technical Guide and will include the Council's review questions. Reviewers must evaluate: 1) whether the subbasin plans are complete, scientifically sound, and internally consistent following a transparent and defensible logic path; and 2) whether the subbasin plans are externally consistent with the vision, principles, objectives, and strategies contained in the Council's 2000 Fish and Wildlife Program. The checklist also asks reviewers to evaluate whether the plan satisfactorily provides the assessment, inventory and management elements requested by the Council and, to recommend the level of need to further treat a specific element of the subbasin plan before the plan meets the criteria of completeness, scientific soundness, and transparency. A sample of the checklist and template was made available in March (NPCC 2004).

Subbasin Plan Adoptability Framework

The Council's Legal Division is organizing a framework that the Council members and may use to make the determinations required by the Power Act relative to subbasin plan amendment recommendations. The framework is essentially a way of organizing the review around the
Act's standards that apply to program amendments for the Fish and Wildlife Program measures found in section 4(h), and the standards set in the 2000 Fish and Wildlife Program in the unique context of subbasin plans. The framework will be discussed with Council members in the near future.

2 Vision for the Imnaha Subbasin

This vision for the Imnaha subbasin, including a vision statement and guiding principles, was developed by the Wallowa County Natural Resource Advisory Committee at meetings held in April through September 2003.

2.1 Vision Statement

The vision statement describes the desired future condition of the subbasin. It is qualitative and reflects the policies, legal requirements, and local conditions, values, and priorities of the subbasin. The vision statement provides guidance for implementing actions in the future and frames the biological objectives and strategies for the subbasin. Representing a general vision of the subbasin's future, it is both ideal and, at the same time, practical and attainable within the span of a couple of decades. The vision statement is as follows:

> Maintain and enhance the condition of the Imnaha subbasin, providing for abundant, productive, and diverse aquatic and terrestrial species and habitats, while maintaining and enhancing local lifestyles, customs, cultures, and economic viability, including the use of natural resources.

2.2 Guiding Principles

The guiding principles are more specific components of the vision and represent both the processes that need to be followed in obtaining the vision and the specific outcomes necessary for success. The order in which the goals are presented does not represent a hierarchy of values. The goals are meant to be of equal value and to be understood in the context of each other; they also need to be addressed simultaneously. Overemphasis of one goal at the expense of the others will undermine the vision.

2.2.1 Process principles

Respect, recognize, and honor the legal authority, jurisdiction, treaty-reserved rights, and legal rights of all parties.

Coordinate efforts to implement the Pacific Northwest Electric Power Planning and Conservation Act; the Endangered Species Act; the Clean Water Act; tribal treaties; and other local, state, federal, and tribal programs, obligations, and authorities.

Promote and enhance local participation in, and contribution to, natural resource problem solving and subbasin-wide conservation efforts.

Develop a scientific foundation that incorporates local knowledge for prioritizing projects and for monitoring and evaluation.

Promote understanding and appreciation of the need to maintain, protect, enhance, and/or restore a healthy and properly functioning ecosystem.

2.2.2 Outcome principles

Provide ridgetop-to-ridgetop stewardship of natural resources, recognizing all components of the ecosystem, including the human component.

Provide opportunities for natural resource-based economies to recover in concert with aquatic and terrestrial species.

Maintain, enhance, and/or restore habitats to sustain and recover aquatic and terrestrial species diversity.

Enhance and/or maintain species' populations to a level of healthy and harvestable abundance to support tribal treaty and public harvest goals.

3 Problems, Objectives, and Strategies

The various components (problem statements, biological objectives, and strategies) of the *Imnaha Subbasin Management Plan* described in this section have been developed from information presented in the *Imnaha Subbasin Assessment* and *Imnaha Subbasin Inventory*. References to information contained in other volumes of the *Imnaha Subbasin Management Plan*, or sections in this management plan, are provided where applicable to aid readers in finding more detailed information regarding particular problem statements, objectives, and strategies.

Although the problems, objectives, and strategies are commonly related to individual species or communities, none of these ecosystem components functions independently. Any actions that benefit or harm one species within the subbasin will also impact other species (aquatic or terrestrial, including humans) that rely on that species. In addition, every action will have social, political, and economic implications that must be addressed.

Social, economic, and political factors in the Imnaha subbasin are important to consider in determining the success of the implementation phase of this management plan. These factors are referenced in the vision and guiding principles for the Imnaha subbasin and must be considered at all levels of the planning process, including development of appropriate problem statements, objectives, and strategies. Accounting for the human component of the subbasin will increase the probability that this plan will be successfully implemented and viewed as a necessary, socially acceptable, and reasonable step in the protection and recovery of aquatic and terrestrial species in the subbasin.

3.1 Problem Statement Summary

The problem statement summary is technically called the *working hypothesis* in Council documents. Both are intended to provide a scientific basis for developing biological objectives and strategies. In this plan, we follow the recommendation of the ISRP (2003a) to state the hypotheses as problem statements. The problem statement draws from the scientific foundation that underlies the Council's Fish and Wildlife Program. The Council recognizes eight scientific principles (NPCC 2001) that form the scientific foundation, and all actions taken to implement the program must be consistent with these principles. The following problem statement is based on information and findings presented in the subbasin assessment, thereby summarizing the available scientific information and knowledge which forms the basis of the management plan.

Descriptions of how natural resources in the Imnaha subbasin have changed from historical to current times are provided throughout various portions of the subbasin assessment. A chronology of the influence of human occupation and land use activities (historical through current) on terrestrial and aquatic resources is provided at the subbasin level in assessment section 1.1.1.10, including the effects of population growth (p. 36), grazing (p. 38), transportation (p. 42), timber harvest (p. 46), agriculture (p.51), water development (p. 52), and mining (p. 57). Discussions of how water quality (temperature) has been altered in various subwatersheds are provided in assessment Section 1.1.2.3 (p. 65). The influence of natural and anthropogenic disturbance on ecologic processes is described in assessment Section 1.1.3 (p.79) by focusing on climate, hydrology, erosion, fire, and pathogens. Out-of-subbasin conditions and limiting factors are discussed in assessment section 1.3 (p.259).

These factors result in the problems outlined in the summary problem statement.

> Declines in relative abundance of the five aquatic focal species (see assessment Section 1.2) are associated with changes (i.e., from historical to current) in habitat quantity and quality, both within and outside of the subbasin. Natural and anthropogenic disturbance pressures have caused changes to habitat-forming ecological processes (see assessment Section 1.1.3), which have directly and/or indirectly acted to modify habitat conditions.
>
> Within the Imnaha subbasin, high summer water temperatures, insufficient water quantity, areas of inadequate riparian vegetation, low pool quality and frequency, inadequate amounts of LWD, habitat alteration, and excessive sedimentation due to roads are commonly cited as the primary in-basin factors limiting Imnaha fish production, distribution, and population stability (Mason et al. 1993, Huntington 1994, USFS 1994a, Mobrand and Lestelle 1997, Ashe et al. 2000, USFS 2003d). However, factors limiting local fish production or survival may differ from those defined across broader scales, and will vary by species and location.
>
> Declines in quality and quantity of terrestrial focal habitats, and the resulting impacts on associated species result from limiting factors, including loss of ponderosa pine communities, degradation of grassland habitats, degradation of riparian habitats, changes in disturbance regimes and vegetative structure, roads and habitat fragmentation, noxious weeds and other invasive plants, and loss of marine-derived nutrients (see assessment Section 1.5.2).

3.2 Problem Statements, Objectives, and Strategies

The following list of component problem statements, objectives, and strategies is derived from the problem statement summary. Biological objectives describe the physical and biological changes needed to achieve the vision, consistent with the scientific principles. Strategies provide specific steps necessary to accomplish the biological objectives. The biological objectives and strategies were developed to address the factors limiting focal species and habitats in the subbasin and that inhibit natural ecological processes, as described in the subbasin assessment.

For organizational purposes, the problem statements, objectives, and strategies are grouped by three categories: biological, environmental, or socioeconomic components, although these three components are intrinsically linked. The problems, objectives, and strategies under biological components are generally directed toward fish and wildlife populations, when sufficient data exists. Problems and the objectives and strategies meant to address habitat for fish and wildlife populations are listed under environmental components. The biological objectives were developed by the Project and Technical teams, with support from the Planning Team. Objectives and strategies addressing the human components of protecting and enhancing fish and wildlife populations and their habitats are listed under socioeconomic components. Objectives for socioeconomic components were developed by the Planning Team.

The Planning Team considers these three components critical to successfully implementing the Imnaha Subbasin Management Plan. Recommendations for further data collection or prioritization were noted where data gaps limit the development of sound biological objectives and strategies. These information needs were further detailed in the section on research, monitoring, and evaluation in this volume.

The formatting of the problem statements, objectives, and strategies follows the recommendations made by the ISRP (2003a) in its review of the Clearwater Subbasin Plan. The ISRP's suggested format was consistent with guidance in the Technical Guide (NPCC 2001) and used in this document with minor modifications.

Table 4. Problems and objectives addressing factors limiting fish and wildlife habitats and species.

	Problem	Objective
Aquatic	Problem 1: Out-of-subbasin factors are primary in limiting anadromous adult recruitment in the Imnaha subbasin	Aquatic Objective 1A: Achieve escapement objectives shown in Table 5 within 24 years (represents 4-5 generations; timeline is consistent with the NPCC's Fish and Wildlife Program).
	Problem 2: Anadromous fish production in the subbasin is affected by habitat quantity, quality, and connectivity. Human activities have been a primary influence on habitat factors in some areas of the subbasin.	Aquatic Objective 2A: Increase anadromous fish productivity and production, as well as life stage-specific survival, through habitat improvement. Aquatic Objective 2B: Increase anadromous fish productivity and production, as well as life stage-specific survival, through artificial production.
	Problem 3: Small population size of anadromous and resident species leads to an increased risk of extinction.	Aquatic Objective 3A. By fifth code HUC, carry out focused activities designed to improve our understanding and definition of small populations, while protecting the genetic integrity of wild populations that are below historical levels.
	Problem 4: Comanagers in the subbasin currently lack in- and out-of-basin information to adequately define population status of aquatic focal species and associated production and productivity. This supports our ability to prioritize and monitor the effectiveness of management actions.	Aquatic Objective 4A: Establish the abundance and productivity of anadromous stocks and how they compare to other Snake River stocks.
	Problem 5: Research and monitoring, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, is needed to implement and evaluate bull trout recovery activities.	Aquatic Objective 5A: Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats. Aquatic Objective 5B: Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks Aquatic Objective 5C: Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects Aquatic Objective 5D: Develop and conduct research and monitoring to improve information concerning the distribution and status of bull trout. Aquatic Objective 5E: Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

	Problem	Objective
	Problem 6: Long-term persistence and abundance of bull trout within the Imnaha subbasin are threatened by genetic introgression and by loss of fluvial population components, genetic interchange, and population connectivity.	Aquatic Objective 6A: To achieve bull trout distribution criteria, as defined in USFWS (2002), maintain or expand current distribution of bull trout throughout the Imnaha-Snake Rivers Recovery Unit until bull trout are distributed among at least six local populations
	Problem 7. Excessive summer stream temperatures currently represent the dominant limiting environmental factor in the Imnaha and Big Sheep Creek watersheds and are likely limiting seasonal salmonid distribution, which in turn is likely influencing production potential.	Aquatic Objective 7A: Using ODEQs guidelines, reduce stream temperatures in listed segments so cold water biota beneficial uses are restored
	Problem 8: Low flow problems occur in upper Big Sheep Creek, upper Little Sheep Creek, Redmont Creek, Ferguson Creek, Salt Creek, Canal Creek, McCully, Summit, Camp, and Grouse Creeks. Species affected are mainly bull trout, but may also influence steelhead spawning and rearing success and indirectly affect spring chinook.	Aquatic Objective 8A: Improve efficiency of irrigation withdrawal delivery and application to reduce volume of water needed for consumptive purposes Aquatic Objective 8B: Restore flows in limited reaches to support resident and anadromous fish needs.
	Problem 9: Excessive amounts of fine sediment have resulted from human impacts and natural disturbance processes in various portions of the subbasin and may be negatively affecting incubation success, juvenile survival, invertebrate production, habitat availability, and in extreme cases direct mortality	Aquatic Objective 9A: Establish a subbasin-wide database to facilitate monitoring and evaluation of sedimentation trends and provide information relative to its effect on salmonid production Aquatic Objective 9B: In known problem areas, reduce sedimentation impacts to aquatic focal species
	Problem 10: Population connectivity is reduced as a result of structural barriers in the Imnaha and Big Sheep Creek watersheds. This reduction has resulted in a loss of genetic interchange, population refounding capacity, and habitat availability.	Aquatic Objective 10A: Identify and prioritize for modification, structural barriers that limit connectivity
	Problem 11: Legacy effects from land use activities impact channel form, and stability, which in turn are contributing to low flow, temperature, and sediment problems	Aquatic Objective 11A. Within the next 15 years improve channel form and stability in portions of the subbasin where low flow, temperature, and sediment problems also exist
	Problem 12: Thermal and organic pollutants are identified as limiting factors to aquatic focal species in several sixth-field HUCs throughout the subbasin. The effects from these pollutants on aquatic focal species have not been definitively determined.	Aquatic Objective 12A. Conduct research, monitoring, and evaluation to identify and address point and non-point pollutant sources and to determine associated impacts upon various life history stages of aquatic focal species

	Problem	Objective
Terrestrial	Problem 13: Limited available information on the composition, population trends, and habitat requirements of the wildlife and plant (terrestrial) communities of the Imnaha subbasin, limits the ability to effectively manage or conserve these species.	Terrestrial Objective 13A: Increase knowledge of the composition, population trends, and habitat requirements of the terrestrial communities of the Imnaha
	Problem 14: Degradation of areas of grassland habitat in some areas of the Imnaha subbasin has impacted native plant and animal species.	Terrestrial Objective 14A: Maintain grassland quality, condition, and composition Terrestrial Objective 14B: Restore or rehabilitate areas where grasslands have been degraded
	Problem 15: Reductions in the extent of mature ponderosa pine habitats in the subbasin have negatively impacted the numerous wildlife species that utilize these habitats.	Terrestrial Objective 15: Maintain and enhance mature ponderosa pine habitats.
	Problem 16: The loss or degradation of wetland and riparian habitats has negatively impacted the numerous wildlife species that utilize these habitats.	Terrestrial Objective 16A: Maintain currently functioning wetlands and restore degraded wetlands. Terrestrial Objective 16B: Maintain currently functioning riparian areas and restore degraded riparian areas
	Problem 17: The introduction of noxious weeds and nonnative plant species into the Imnaha subbasin has negatively impacted native terrestrial focal species.	Terrestrial Objective 17A: Maintain and enhance the existing quality, quantity and diversity of native plant communities providing habitat to native wildlife species by preventing the introduction, reproduction, and spread of noxious weeds and invasive exotic plants into and within the subbasin.
	Problem18: Changes in the disturbance regime of the forested habitats of Imnaha subbasin have altered forest composition, density and structure, negatively impacting native terrestrial species that depend on these habitat types.	Terrestrial Objective 18A: Restore the composition, structure, and density of forests to within the historic range of variability (HRV).
	Problem 19: Road construction, timber harvest and/or fire suppression have altered the size, quality, distribution and juxtapositions in and between habitat patches in the subbasin.	Terrestrial Objective 19A: Reduce the impact of the transportation system on wildlife and fish populations and habitats
	Problem 20: Reduction in the size of anadromous fish runs in the Imnaha subbasin has reduced nutrient inputs and reduced habitat suitability for salmon-dependent wildlife and the quality of terrestrial ecosystems in general. Forest management practices that strive to reduce fuel loads may be further altering nutrient cycles.	Terrestrial Objective 20A: Restore natural nutrient input cycles and mitigate for damages to aquatic and terrestrial populations due to the loss of these nutrients.

	Problem	Objective
Socioeconomic	Problem 21: In the past, fish and wildlife management activities have been considered as having negative economic impacts on local communities because it was viewed as mitigation for fish and wildlife	Socioeconomic Objective 21A: Consider impacts and benefits of fish and wildlife activities to surrounding communities and their economies
	Problem 22: Many important cultural uses of the Imnaha subbasin are impacted by aquatic and terrestrial management activities	Socioeconomic Objective 22A: Protect and foster both Indian and non-Indian cultural uses of natural resources
	Problem 23: Insufficient coordination and integration limit the economic, social, cultural and biological benefits of aquatic and terrestrial protection and restoration in the subbasin	Socioeconomic Objective 23A: Coordinate with groups and the public when developing and implementing fish and wildlife management activities in the subbasin

3.2.1 Aquatic Ecosystem

3.2.1.1 Biological Components

The following 'biologically-based' problems, objectives, and strategies are linked to information provided in the Species Characterization (Section 1.2) and Limiting Factors (Section 1.5.1) sections of the subbasin assessment. This information summarizes the non-habitat-based problems, such as species interactions, fisheries management issues, research uncertainties, and other issues not addressed by the QHA model that are deemed to be negatively affecting individual focal species, and/or our ability to effectively manage for the continued persistence of these species. Biological problems, objectives, and strategies are not listed in order of importance.

Anadromous Species

Problem 1: Out-of-subbasin factors are primary in limiting anadromous adult recruitment in the Imnaha subbasin (see assessment Section 1.3.1).

Aquatic Objective 1A: Achieve escapement objectives shown in Table 5 within 24 years (represents 4-5 generations; timeline is consistent with the NPCC's Fish and Wildlife Program). Criteria will involve both a time element (persistence) and an abundance element, both of which are currently under review. Achieving these objectives would restore and maintain in-basin treaty-reserved tribal harvest, and recreational fisheries (Table 5).

Strategies:

1A1: Participate in province and basinwide coordinated studies and water management forums designed to examine mainstem and ocean mortality associated with differential migration timing and life histories of anadromous salmonids and lamprey—Conduct research within the context of identifying management versus basinwide environmental effects. Work with other entities to ameliorate and mitigate limiting factors

1A2: Continue annual monitoring of escapement into the subbasin (refer to RM&E section).

1A3: Enforce conservation practices, and laws and regulations applicable to protecting and restoring fish and wildlife populations and habitats

1A4: Utilize a mix of hatchery and natural production strategies for native, localized, and reintroduced populations to meet subbasin goals delineated in Table 5 within 25 years

1A5: Ensure that hatchery programs are implemented in a way that promotes escapement of naturally spawning adults

Table 5. Adult fish return objectives for the Imnaha subbasin.

	Goals[1]	Long-term Return	Natural Spawning Component[2]	Hatchery Component		Harvest Component[3]
				Broodstock Need	Rack Return	
Spring Chinook	Future	5,740	3,800	320	Undefined	> 700
	Existing Condition[4]	4,206	2,789[5]	345	1,503	212[6]
	Unmet Goals	1,534	1,011	NA	NA	488
Fall Chinook	Future	3,000	3,000	Undefined	Undefined	Undefined
	Existing Condition	155 – 179	155	0	0	0
	Unmet Goals	2,845	2,845	NA	NA	NA
A-run Steelhead	Future	4,315	2,100	195	Undefined	2,000
	Existing Condition	> 1,904[7]	> 1,540[7]	195	1,537	148-449
	Unmet Goals	Unknown	Unknown	0	NA	~ 1,500
Bull Trout	Future	5,000 adults[8]	5,000 adults[8]	Undefined	Undefined	Undefined
	Existing Condition	Unknown	Unknown	0	0	0
	Unmet Goals	Unknown	Unknown	NA	NA	NA
Lamprey	Future	Undefined	Undefined	Undefined	Undefined	Undefined
	Existing Condition	Unknown (0)	Unknown (0)	0	0	0
	Unmet Goals	Unknown	Unknown	NA	NA	NA

1 Goals are derived from various management plans as described in Appendix A, Appendix Table 1. This table does not necessarily imply consensus by all management agencies but merely gives direction to managers who must workout the restoration and recovery of each species and population over time through implementation of the plan.
2 Chinook salmon estimates exclude jacks
3 In-basin harvest.
4 Existing condition reflects five-year average (1999-2003).
5 Existing chinook escapement approximately 30% natural origin.
6 No harvest in 1999-2000.
7 Represents a subset of total basin escapement (Cow Creek, Lightning Creek, Little Sheep Creek, and adult outplants into Big Sheep Creek.
8 Represents abundance criteria (USFWS 2002) estimate for bull trout in the Imnaha-Snake River Recovery Unit. Recovered abundance criteria were derived by the recovery unit team and represent estimates of productive capacity of identified local populations. Resident and migratory life history forms are included in the estimate, but the relative proportions of each are considered a research need. The criterion should be achieved within 25-50 yrs.

Discussion: Out-of-subbasin factors—including estuarine and ocean conditions, hydropower impacts such as water quality and fish passage, mainstem Snake/Columbia river water quality and quantity conditions, and downriver and oceanic fisheries—are the primary factors limiting recruitment of anadromous spawners to the Imnaha subbasin (see assessment section 1.3.1). Out-of-subbasin work combined with in-subbasin work is needed to achieve goals in Table 5 and the SARs listed in this objective. Achieving these SARs for anadromous species will reflect progress made toward improving out-of-basin conditions. Increases in both anadromous adult escapement and habitat carrying capacity will be required to achieve anadromous fish objectives set forth in Table 5 and in this objective. Habitat carrying capacity and fish survival have been reduced within the subbasin by land management activities that impact hydrology, sedimentation, habitat distribution and complexity, and water quality. Minimizing the impact of out-of-subbasin effects on subbasin restoration efforts will require coordination and cooperation in province- and basinwide efforts to address problems impacting Imnaha subbasin fish stocks.

BPA has invested significant funding in protecting and restoring aquatic and terrestrial species and habitat in the Salmon subbasin. Enforcement of existing conservation practices, laws, and regulations is necessary to protect this investment and to strengthen the overall protection and restoration effort in the subbasin.

Establishing index stocks is necessary so that long-term monitoring of trends can occur for anadromous population abundance applicable to the Imnaha subbasin (including escapement, life stage-specific survival, etc.; refer to the Research Monitoring and Evaluation section of this document). Life stage information that is relevant specifically to anadromous fish populations of the Imnaha subbasin is necessary for the successful management of those populations.

Problem 2: Anadromous fish production in the subbasin is affected by habitat quantity, quality, and connectivity. Human activities have been a primary influence on habitat factors in some areas of the subbasin.

Aquatic Objective 2A: Increase anadromous fish productivity and production, as well as life stage-specific survival, through habitat improvement.

Strategies

2A1: Implement projects based upon restoration prioritization defined in Section 1.5.1.5 of the Imnaha assessment. Coordinate with implementation of strategies and actions delineated under environmental strategies section (Section 3.2.1.2).

2A2: Develop and implement a monitoring and evaluation plan to obtain a better understanding of how populations respond to habitat improvement efforts throughout the subbasin (refer to Section 4.4.1).

2A3: Establish subbasin-wide baseline conditions for steelhead populations (abundance and life stage-specific survival) to provide an indicator for habitat improvement efforts

2A4: Develop indices to evaluate biological response(s) to habitat improvement projects—Use appropriate fish production models or empirical data to link the developed index to fish production potential.

2A5: Monitor and evaluate habitat improvement projects—Use indices developed in Strategy 4 to monitor the effectiveness of habitat improvement efforts to provide biological benefits. Integrate results and other new information into the process by adapting management to reflect new information (refer to Section 4.4.1).

Aquatic Objective 2B: Increase anadromous fish productivity and production, as well as life stage-specific survival, through artificial production.

Strategies:

2B1: Maximize hatchery effectiveness in the subbasin--continue existing and/or implement innovative hatchery production strategies in appropriate areas to support fisheries, natural production augmentation and rebuilding, reintroduction, and research (LSRCP/NEOH M&E Plan).

2B2: Apply safety net hatchery intervention based on extinction risk analysis and benefit risk assessments[1]

2B3: Implement artificial propagation measures and continue existing natural production strategies via LSRCP/NEOH production programs.

2B4: Monitor and evaluate effectiveness of implementation of hatchery and natural production strategies (refer to Section 4.4.1).

2B5: Modify Strategy 1 as necessary based on information provided by Strategy 3 and other new information

Discussion: The interconnection between the productivity of anadromous species and the condition of anadromous habitats is implicit—the condition of one is essentially a reflection of the condition of the other. Based on this premise, a discussion of habitat improvement is included under the biological objectives header. Specific anadromous habitat-related problems and strategy statements are further delineated and presented in the section on environmental components.

The Lower Snake River Compensation Program is congressionally tasked to implement artificial propagation for mitigation of chinook salmon and steelhead in the Imnaha subbasin. The Northeast Oregon Hatchery program is providing additional hatchery facilities and updates to help meet conservation and restoration objectives in addition to the mitigation goals of the LSRCP production goals. A thorough review of existing data indicates that it is currently not possible to quantitatively establish, with any degree of accuracy, life stage-specific determinations of survival, productivity, and production for anadromous species in the Imnaha subbasin. It is reasonable to assume, however, that anadromous production/productivity would improve if the condition of the habitat improved and that these improvements can only occur with a reduction in limiting factors.

[1] ODFW does not believe the approach outlined in SNAPP is appropriate for any of the focal species populations in the Imnaha subbasin (Bill Knox, ODFW, personal communication, May, 2004).

The general and aquatic limiting factors defined in Sections 1.2.8.3 and 1.5.1 (respectively) of the assessment provide us with an initial starting point for identifying and treating problems affecting anadromous populations throughout the Imnaha subbasin. Treatments may range from fine-scale efforts designed to provide immediate benefits, such as identification and removal of passage barriers, to broad-scale efforts designed to provide long-term benefits. A cost/benefit analysis examining problem rectification and expected ecologic return would assist planners in prioritizing areas throughout the subbasin that are inhabited by multiple anadromous species and stand to immediately benefit from treatments.

Problem 3: Small population size of anadromous and resident species leads to an increased risk of extinction.

Aquatic Objective 3A. By fifth code HUC, carry out focused activities designed to improve our understanding and definition of small populations, while protecting the genetic integrity of wild populations that are below historical levels.

Strategies:

3A1: Preserve Genetic Integrity: Preserve the genetic integrity of existing wild stocks in the Imnaha Subbasin. Protect and monitor wild stocks in wilderness and other portions of the subbasin that have not been influenced by hatchery or mixed stocks

3A2: Continue ongoing programs: In areas where intervention has already occurred, support the refinement of genetic preservation techniques such as captive brood stock, cryopreservation, supplementation (e.g. LSRCP/NEOH)

3A3: Collect steelhead data: Need to move to collect wild adult steelhead abundance data and continue to improve upon our extinction risk analysis so we can get at specific values defining small populations. Use stream-specific weirs on index streams that are within segments of a population (e.g., one index stream per fifth code HUC)

3A4: Define data gaps: Identify where there is a lack of knowledge pertaining to the population size of anadromous and resident focal species. Use this information to further refine enhancement and restoration efforts

3A5: Assess use of safety nets: Use tools that are currently under evaluation by SNAPP (Safety Net Artificial Propagation Program) and other studies as a guide to implement hatchery supplementation as a safety net if and where appropriate[2]

[2] ODFW does not believe the approach outlined in SNAPP is appropriate for any of the focal species populations in the Imnaha subbasin (Bill Knox, ODFW, personal communication, May, 2004).

3A6: Monitor and evaluate: Evaluate effectiveness of ongoing programs during the life of the plan

Discussion: The ESA acknowledges the use of artificial propagation as a tool to mitigate for losses of anadromous and resident stocks. Genetically-sound supplementation efforts and/or other approaches (e.g., cryopreservation, captive broodstock) have been identified as an important tool to recover or stabilize populations in danger of extinction due to low numbers of reproductive individuals. For example, the Big Sheep Creek population is currently considered to have too few individuals available to maintain its viability as a naturally reproducing population (USFS 2003a). Populations approaching or less than 300 breeding adults are considered by some to be in need of corrective strategies to bring the population into compliance with the Wild Fish Management Policy (Chilcote et al. 1992). NPT considers a minimum spawner abundance threshold of 500 required to support long-term population persistence in the Imnaha River subbasin (Jay Hesse, NPT, personal communication, May, 2004). The interim recovery goal (NMFS 2002) is 2,500 natural-origin spawners. Assessment of goal achievement is based on an eight year geometric mean, which has not been met once during the last eight years.

Problem 4: Comanagers in the subbasin currently lack in- and out-of-basin information to adequately define population status of aquatic focal species and associated production and productivity. This supports our ability to prioritize and monitor the effectiveness of management actions.

Aquatic Objective 4A: Establish the abundance and productivity of anadromous stocks and how they compare to other Snake River stocks.

Strategies:

4A1: Evaluate and update ongoing efforts at defining production and productivity for focal species (refer to RM&E section)

4A2: Evaluate Imnaha subbasin-specific adult abundance, life history characteristics, and spawn–recruit relationships as a measure of productivity (refer to RM&E section). Maintain historic (e.g., run reconstruction) data and long-term evaluation protocols for spring Chinook and develop appropriate protocols for assessing steelhead and fall Chinook in order to provide for comparisons with Snake River and other downriver stocks

Discussion: The problem the co-managers face in assessing anadromous stock abundance and productivity in the Imnaha subbasin is not unique throughout the Columbia River Basin. The QHA method employed in the assessment does allow for prioritization of habitat restoration/protection activities, however it fails to factor in production/productivity. The Council's Fish and Wildlife Program and NOAA Fisheries have failed to address this need sufficiently, and it is unlikely that these or other programs will be able to do so in the foreseeable future. Assessing steelhead production/productivity is inherently difficult due to environmental conditions, however there are tools available to facilitate this need. The level of information needed varies depending on management actions' spatial scale. The aspects of these problems are further discussed in the RM&E section.

Biological Components: Resident Species

Problem 5: Research and monitoring, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, is needed to implement and evaluate bull trout recovery activities.

Aquatic Objective 5A: Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

Aquatic Objective 5B: Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks

Strategies:

5B1: Conduct watershed assessments. Evaluate historical and present conditions in each habitat type by watershed

5B2: Determine the range of temperature tolerances for bull trout life stages in different habitats. Use the results of ongoing temperature studies to address the adequacy of existing regulations. The recovery unit team identified this as a range-wide need.

5B3: Determine the seasonal movement patterns of adult and sub-adult migratory bull trout. This action would include bull trout which use different habitat types, including the mainstem Snake River. This information is necessary to determine how bull trout from the Imnaha-Snake Rivers Recovery Unit are related to each other as well as other bull trout populations in Snake River watersheds.

5B4: Evaluate food web interactions. This action is most pertinent to areas affected by introduced fishes, such as the lower Imnaha River.

Aquatic Objective 5C: Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects

Strategies:

5C1: Maintain fish health screening and transplant protocols. This will help reduce risk of disease transmission. Include discussion of fish health in the terms and conditions in permits for hatchery operations for guidance.

5C2: Provide information to the public. Produce a whirling disease informational pamphlet for public distribution. This should contain current information of parasite distribution in Oregon and Washington and list precautions that should be taken by the fishing public to help prevent its spread to other watersheds.

5C3: Monitor for effects of fish pathogens on Oregon bull trout populations. Follow Oregon Department of Fish and Wildlife protocols (in development) for handling and disposition of bull trout mortalities, for example, submission to Oregon Department of Fish and Wildlife fish pathology laboratories for disease assessment

Aquatic Objective 5D: Develop and conduct research and monitoring to improve information concerning the distribution and status of bull trout.

5D1: Determine life history requirements. Local resident and migratory bull trout populations both exist in the recovery unit and may have different requirements.

5D2: Investigate the relationship between bull trout and anadromous species. This relationship is particularly important relative to predator-prey interactions. Evaluate the dependence of bull trout on anadromous prey.

5D3: Continue to survey for bull trout. Periodically monitor for bull trout in potential habitat (*e.g.,* Lightning Creek) where their status is unknown or recolonization is anticipated.

5D4: Compare weak and strong populations. The characteristics of relatively strong (*e.g.,* abundant, well distributed) and relatively weak but otherwise similar populations (for example, the McCully Creek and Little Sheep Creek populations) may be very different. This information is necessary to understand the factors limiting bull trout populations.

Aquatic Objective 5E: Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

Strategies:

5E1: Determine the consequences of genetic fragmentation and isolation. This isolation may be due to human-made or natural barriers (*e.g.,* the Wallowa Valley Improvement Canal). The recovery unit team identified this as a range-wide need.

5E2: Investigate use of the mainstem Snake River by bull trout from the Imanaha core area. It is essential to understand how important this area is in the life history of bull trout from this recovery unit. This should be done in conjunction with studies on bull trout from adjacent recovery units (*e.g.,* Grande Ronde and Clearwater) to determine areas of overlapping use and possible interactions.

5E3: Evaluate the population structure of bull trout in the recovery unit. Assess whether the recovery unit consists of one large population or multiple populations and whether there appears to be any metapopulation structuring. This information would be used to assess, and refine if needed, the current local population designations.

5E4: Evaluate basic life history characteristics. Determine the age- and size- specific fecundity of fluvial and resident bull trout. For both fluvial and resident bull trout, determine the age at first spawning, size at first spawning, longevity, and the number of spawns during a lifetime.

5E5: Evaluate survival rates. Determine the embryo to fry, fry to age 'X', and age 'X' to first spawn survival rates as well as parent to progeny ratios. Generate a life table. Identify which life stages have the greatest mortality and what factors may be associated with that mortality.

Discussion: A standardized, statistically sound monitoring program is needed to facilitate Imnaha bull trout population recovery (USFWS 2002). The proposed RM&E defined in Section 4.4.1 is specific to natural/hatchery anadromous species, but provides a template from which to develop this type of program. Monitoring Objectives 1a and 1b address the need, as identified in USFWS (2002), to collect juvenile and adult (respectively) abundance data. Monitoring Objectives 2b, 3b, and 3c pertain to the assessment of life history characteristics (*e.g.*, reproductive success and migration characteristics), another critical bull trout research need defined in USFWS (2002). Understanding Imnaha bull trout distribution and status (Monitoring Objectives 1a,1c, and 2a) will aid in gauging recovery progress and provide critical information for management of the species. The need for bull trout genetics information, which is addressed in Monitoring Objectives 2c, and 3a, is partly based on establishing whether local populations in the McCully, upper Big Sheep, and Imnaha core areas are genetically independent or function collectively and require connectivity within and between subgroups (USFWS 2002).

Problem 6: Long-term persistence and abundance of bull trout within the Imnaha subbasin are threatened by genetic introgression and by loss of fluvial population components, genetic interchange, and population connectivity.

Aquatic Objective 6A: To achieve bull trout distribution criteria, as defined in USFWS (2002), maintain or expand current distribution of bull trout throughout the Imnaha-Snake Rivers Recovery Unit until bull trout are distributed among at least six local populations

Strategies:

6A1. Provide long-term habitat protection. Use conservation easements, management plans, land purchase from willing sellers, and land exchanges or other means to ensure current habitat is protected and to expand or improve previously occupied areas. Specifically, explore whether these opportunities exist in the Big and Little Sheep Creek watersheds.

6A2. Restore connectivity and opportunities for migration. At least in part, this could be accomplished by restoring instream flows in McCully Creek, Little Sheep Creek, and Big Sheep Creek. To accomplish this, explore options such as purchasing or leasing water rights.

6A3: Monitor and evaluate restoration activities. If instream flows are increased, (and/or barriers are removed) monitor and evaluate bull trout population response. Specifically, monitor for changes in abundance, survival-productivity, genetics, distribution, and life history charateristics. Restoration activities will be considered effective when migratory life history forms are present in all local populations. Integrate an adaptive management approach into M&E efforts, using feedback from implemented, site-specific recovery tasks.

Discussion: The USFWS (2002) recovery criteria for distribution will be achieved when there are at least six local populations in the Imnaha-Snake River Recovery Unit. Genetics data coupled with migration M&E (Monitoring Objective 3c) would enable a scientifically defensible assessment regarding the extent to which bull trout from the three core areas use the mainstem of the Snake River and interact with each other, which would benefit determinations of recovery efforts.

3.2.1.2 Environmental (QHA-based)

The following QHA-based problems, objectives and strategies occur in order of importance. The ranking of this information is based on output from the QHA model, specifically as it relates to importance of restoration needs at the subbasin scale and for all focal species considered. The restoration needs are highlighted in the aquatic limiting factors section of the assessment (Section 1.5.1.5)

Problem 7. Excessive summer stream temperatures currently represent the dominant limiting environmental factor in the Imnaha and Big Sheep Creek watersheds and are likely limiting seasonal salmonid distribution, which in turn is likely influencing production potential.

Aquatic Objective 7A: Using ODEQs guidelines, reduce stream temperatures in listed segments so cold water biota beneficial uses are restored

Strategies:

7A1: Restore riparian zones. Revegetate upland areas or reaches within which riparian shading functionally cools surface flows. For anadromous species, these areas are primarily associated with the perennial tributaries (*e.g.*, Big and Little Sheep Creek, Grouse Creek and associated tributaries, Summit Creek, and Gumboot Creek and tributaries) while for bull trout riparian areas have been defined in Big Sheep Creek from Coyote to Owl Creek, as well as in upper Little Sheep Creek and its tributaries. Based on the multi-species prioritization, riparian restoration work would benefit the most focal species and associated life history stages in sixth-field HUCs 07M (Big Sheep Creek 2) and 07P (Big Sheep Creek 3).

7A2: Maintain functional riparian zones. Riparian zones that are considered to be functionally cooling surface flows in the Imnaha are critical for the maintenance of current cold-water biota habitat and therefore warrant management designed to ensure their continued utility. Functional riparian habitat in the mainstem occurs from the Crazyman Creek confluence up to the headwaters. Critical riparian habitat in the Big Sheep Creek watershed occurs in headwater, sixth-field HUCs (07R and 07Q), Little Sheep Creek headwaters (07J), McCully Creek (07I), and in portions of other un- or semi-developed perennial tributaries (*e.g.*, upper Horse (08G), upper Lightning (08J) and upper Cow (08L) Creeks). Based on the multi-species prioritization, riparian protection would benefit the most focal species and associated life history stages in sixth-field HUCs 09L, 09M, and 09N (Imnaha River segments 8, 9, and 10 respectively). Wilderness protection is afforded stream segments occurring in HUCs 09N, 09P, 090, 07R, and 07I.

7A3: Reduce grazing impacts. Management alternatives exist (*e.g.*, fencing, changes in timing and use of riparian pastures, off-site watering and salting) which have been proven to reduce grazing impacts. The most notable areas for which these strategies should be considered occur in the Big Sheep Creek watershed (*e.g.*, Big Sheep Creek from Coyote to Owl Creek).

7A4: Reduce consumptive water uses. (*Refer to Objective 8A and associated strategies*)

7A5: Restore natural floodplain processes. A lack of floodplain interaction has reduced natural recruitment of riparian vegetation, and limited the infiltration and exchange of surface and groundwater flows and reduced cooling from hyporheic inflows. These problems are most notable in reaches constrained by roadbeds, or reaches that have been constrained in some manner (*e.g.*, rip-rapped reaches) to protect landowner infrastructure. It is unlikely that floodplain interaction will be restored in mainstem reaches bordered by primary roads (*e.g.*, Imnaha River road), however there should be additional investigation regarding the feasibility of returning the channel to it's floodplain in less critical areas within which reestablishment of riparian function and surface/groundwater exchange would decrease stream temperatures. Select HUCs within which channels are restricted from their floodplain (excluding segments bordered by primary roads) include 07L (Squaw Creek), 07N (Marr Creek), 08B (Imnaha River mainstem (including associated tributaries such as Dodson Fork, a tributary to Corral Creek).

7A6: Restore Channel Form. Many reaches in the Imnaha are characterized by excessively wide, shallow profiles. These areas promote the heating of water and functionally limit habitat availability. In areas known to have high width:depth ratios (*e.g.,* HUC 07E-Summit Creek[3]; HUC 07K-Big Sheep Creek 1; HUC 07L – Squaw Creek; 07N-Marr Creek; 08B-Imnaha River mainstem – specifically Dodson Fork; 09D and 09F-Grouse Creek watershed plateau area; 09H-Summit Creek[1]), work with willing landowners to restore natural channel-forming processes (*e.g.,* allowing for overbank flows, planting riparian vegetation, etc.) and decrease width:depth ratios to values that are within their natural range of variability.

7A7: Monitor and evaluate restoration activities. Continue and expand ongoing stream temperature monitoring efforts throughout the subbasin to evaluate restoration effectiveness (Monitoring Objective 4a). For temperatures only, coordinate methodolgies developed by ODEQ, USFS, NPT, and SWCS with those defined in the EPA Environmental Monitoring and Assessment Program (EMAP; *refer to* http://www.epa.gov/nheerl/arm/).

Supplement temperature monitoring with fish population monitoring. Specifically, monitor for changes in abundance, survival-productivity, distribution, and life history charateristics. Restoration activities will be considered effective when stream temperatures fall within ODEQ beneficial use criteria. Integrate an adaptive management approach into M&E efforts, using feedback from implemented, site-specific recovery tasks.

Discussion: Excessive stream temperatures are identified as the primary factor limiting focal salmonid species in the Imnaha subbasin. High stream temperatures are natural in many portions of the subbasin, especially in those areas dominated by a grassland ecosystem, however they have been exacerbated in other areas by land use activities and natural disturbances that have reduced riparian function.

In the Imnaha, the most functional, temperature-ameliorating riparian vegetation occurs in the higher elevation portions of the subbasin where stream width is reduced. Riparian

[3] There are two Summit Creek tributaries in the subbasin; one drains into the Big Sheep watershed and one drains into the Imnaha watershed

function in the lower elevation reaches, where stream channels are wider, is critical to wildlife habitat, bank stabilization, and sediment trapping.

Based on the differences in riparian function and ecosystem type, riparian restoration activities designed to decrease stream temperatures will be most beneficial in the smaller, high-elevation tributaries and mainstem reaches. Work in the lower elevation portions of the subbasin should be focused on restoring natural hydrologic processes, including the maintenance of a natural hydrograph and reestablishment of floodplain interaction.

Active and passive restoration approaches, such as riparian fencing, creation of off-site watering areas, and changes to grazing management, have proven effective for reestablishment of riparian function. Continuing to implement and develop best grazing practices will protect these critical areas and allow for areas that have been damaged by grazing to recover.

Problem 8: Low flow problems occur in upper Big Sheep Creek, upper Little Sheep Creek, Redmont Creek, Ferguson Creek, Salt Creek, Canal Creek, McCully, Summit, Camp, and Grouse Creeks. Species affected are mainly bull trout, but may also influence steelhead spawning and rearing success and indirectly affect spring chinook.

Aquatic Objective 8A: Improve efficiency of irrigation withdrawal delivery and application to reduce volume of water needed for consumptive purposes

Strategies:

8A1: Cooperative agreements. Work with local irrigation districts to investigate opportunities to improve water management and system infrastructure.

8A2: Reduce withdrawals through diversion improvements. Identify opportunities where an increased efficiency of water transfer and delivery would result in a reduction in volume removed from natural channels

Aquatic Objective 8B: Restore flows in limited reaches to support resident and anadromous fish needs.

8B1. Determine need: Continue ongoing research into minimum and adequate flows for specific life histories and species compositions, focusing on reaches identified in QHA.

8B2. Prioritize problems and activities for protection and restoration: Flow related problems have a long history and a complex legal and social context that must be taken into account while planning and implementing activities. Prioritize activities based on cost-effectiveness and expected biological response, taking account of and working with the social economic complexity and its restraints in the subbasin.

8B3. Determine adequate/minimum flow requirements: Complete designation of adequate/minimum flow requirements where appropriate by 2008: Conduct appropriate consultation amongst local, state, tribal, federal, water user, and other relevant agencies/entities to designate adequate flow requirements by 2008 (for an overview of any existing minimum-flow requirements, see section 3.1.3.3 in the *Imnaha Subbasin Assessment*).

8B4. Restore hydrographs: Restore adequate flows where hydrographs have been altered and are limiting production. Continue and expand efforts aimed at increasing base flows and restoring natural flow timing through riparian, floodplain, and wetland enhancements. Implement forest and agricultural BMPs. Need to refine to better address actual subbasin problems.

8B5. Public Involvement: Cooperate with user groups where hydrographs have been altered by high surface water withdrawals. Work with water users to develop cooperative efforts to improve water conservation and decrease water withdrawals.

8B6. Secure water rights: Coordinate efforts with the ODEQ to secure water rights designated to meet flows where necessary and possible

8B7. Implement adaptive management approach: Monitor and evaluate outcomes of Strategies 4, 5, and 6. Integrate new data with information from Strategy 7. Revise Strategies 1–3 as necessary to reflect new information. Continue or repeat Strategies 4–8 until all flows are adequate.

Discussion: Operation of the Wallowa Valley Improvement District canal is considered to limit streamflow for bull trout during the peak irrigation season (NPT and ODFW 1990), and may act cumulatively during low precipitation years to limit anadromous spawning and rearing habitat availability (USFS 2003a). Low flow problems resulting from operation of the canal are most common in Big and Little Sheep Creeks, which have been identified as areas of high priority for streamflow restoration by OWRD and ODFW.

In the Imnaha watershed, streamflow diversion is most problematic to steelhead in Summit, Camp, and Grouse Creeks. For example, in lower Grouse, migration into and out of the watershed is impaired by the lack of flows at the diversion structure. The effects of streamflow withdrawals become most pronounced during low snowfall years.

Problem 9: Excessive amounts of fine sediment have resulted from human impacts and natural disturbance processes in various portions of the subbasin and may be negatively affecting incubation success, juvenile survival, invertebrate production, habitat availability, and in extreme cases direct mortality

Aquatic Objective 9A: Establish a subbasin-wide database to facilitate monitoring and evaluation of sedimentation trends and provide information relative to its effect on salmonid production

Strategies:

9A1: Obtain additional information through assessment, monitoring and evaluation. Roads are a main source of sediment in the Imnaha subbasin. Use existing Oregon Department of Transportation as well as proposed U.S. Forest Service road assessments to identify additional (*e.g.,* areas in addition to those defined in this assessment) areas where action is necessary to correct problems associated with roads. Landslides and/or bank instability also represent significant sediment sources. Use existing habitat surveys to improve our knowledge of where sediment sources are creating problems and then design and implement a standardized monitoring program to assess changes in habitat conditions relative to habitat improvements/disturbances. Integrate an adaptive management approach into M&E efforts, using feedback from changes in conditions.

9A2: Data collection and dissemination. Work with agencies responsible for collection of sediment data and ensure that the information is collected consistently year to year and is available to all interested entities. A potential vehicle for data dissemination is the Streamnet database, provided sufficient resources are available for timely and accurate data entry

9A2: Assess sedimentation effects upon salmonids. Determine the direct and/or indirect effects of fine sediment on local populations of focal salmonid species. Investigations should focus upon survival/productivity, distribution, and life history characteristics. Investigations should occur in areas known to be impacted by fines and areas where fines are not a problem. Supplement efforts with ongoing processes such as the Total Maximum Daily Load or SB1010.

Aquatic Objective 9B: In known problem areas, reduce sedimentation impacts to aquatic focal species

Strategies:

9B1: Target known problem areas. Sediment problems have been defined for various species throughout the subbasin. For spring chinook, high priority restoration areas have been identified in HUC 09G (Imnaha River Mainstem 6), 07P (Big Sheep Creek 3), and 08B (Imnaha River 1). Excessive sediment was not defined a high priority factor limiting fall chinook populations. For steelhead, sediment restoration priorities occur in HUCs 07P (Big Sheep Creek 3), 09F (Upper Grouse Creek), 07E (Summit Creek), 08B (Imnaha River 1), 07O (Cow Creek), 09K (Gumboot Creek), 07J (Little Sheep Creek 3 (Redmont, Ferguson, Canal)), and in 07B (Lower Camp Creek). For bull trout, sediment restoration priorities occur in HUC 07Q (Lick Creek) and in HUC 07P (Big Sheep 3). Based on the multi-species prioritization matrix, sedimentation restoration activities would benefit the most species and associated life history stages in HUC 07P (Big Sheep Creek 3) and in HUC 08B (Imnaha River 1).

Based on differences in sedimentation processes, it will be up to the project planner to define sediment reduction actions pertinent to the given HUC. Planners should consider whether treatment actions should occur in upland areas within the HUC (*e.g.,* landslide-prone hillslopes or roads), along streambanks of reaches within the HUC (*e.g.,* areas defined by bank instability), or in upstream HUCs that are defined as source areas (*e.g.,* treatment of burn areas).

9B2. Implement treatment actions. Based on defined problem areas, implement preventative or mitigation actions designed to ameliorate impacts of instream sediment. Actions include (but are not exclusive of);

- Riparian management – Use approaches designed to reduce, prevent, or ameliorate sedimentation such as riparian corridor exclusion, riparian pastures

- Upland management – Focus range and timber management on sediment reduction. Management strategies include (but are not exclusive of) rest rotation, adjusting frequency and timing, low-impact harvesting, etc

- Access management – Focus transportation system management on sediment reduction. Management alternatives include moving roads, closing roads, decommissioning roads, etc. Use existing roads inventory databases to identify and treat roads that contribute chronic amounts of fine sediment to salmonid habitat, and to identify roads that pose a high potential risk of failure and threat of adding catastrophic volumes of fine sediment to critical spawning and rearing habitat

- Floodplain restoration - Restore floodplain connectivity and riparian function as they affect sediment transport processes

- Hydro-modification - Mimic the shape and timing of the natural hydrograph so as to ensure the proper transport and deposition of sediment

9B3. Monitor and evaluate restoration activities. Prior to, during, and following restoration activities, monitor for changes in fine sediment and for changes in fish populations. Sediment-specific monitoring should follow Region 6 protocols. Fish population monitoring should include examination of changes in abundance, survival-productivity, distribution, and life history charateristics. Integrate an adaptive management approach into M&E efforts, using feedback from implemented, site-specific recovery tasks.

Discussion: Excess fine sediment will negatively impact all salmonid species in those habitats; in the Imnaha subbasin, this includes spring/summer chinook, fall chinook, steelhead, bull trout, and possibly Pacific lamprey. Based on QHA results, fine sediment is a priority restoration issue for each of the four salmonid species evaluated (*refer to* Section 1.5.1.5 in the assessment), and is identified as a limiting factor in the multi-species analysis (*see* Section 6.1.1 in this document). Project planning and implementation undertaken to address sedimentation should evaluate the potential cost effectiveness and biological response of proposed efforts, and modify priorities identified in the subbasin assessment as necessary to account for that information. Methods used (QHA) in the subbasin assessment to identify restoration needs and priorities in tributary habitats are not designed to account for all potential impacts to habitat conditions nor cumulative effects of issues identified. Existing forums designed to more stringently evaluate impacts to local fish and wildlife populations and finer scales (e.g. TMDLs, EAWSs, and other watershed scale assessments) should be maintained in order to further define and prioritize factors negatively influencing sediment regimes.

Existing sediment standards used in TMDL development are typically narrative and not numeric, making them difficult to implement and enforce. Standards applied in TMDL development (e.g. TSS), are a way to measure sediments entrained in the system, but which rarely inhibit fish production directly. Riparian restoration measures aimed at providing terrestrial benefits and for mitigating water temperatures will address sediments. Additional reductions in sediment can be expected via TMDL sediment control activities. The effectiveness of sediment reduction/control and other water quality projects should be measured by comparing changes in sediments/turbidity/TSS with trends in fish populations. In addition, success of sediment control projects should be measured by monitoring sediment and sediment-related conditions that directly affect fish survival and production (e.g., percent fines in spawning gravels, embeddedness, habitat alterations, etc.) Restoration efforts aimed at sediment reductions should coordinate with and continue implementation of activities defined in existing or future TMDLs, although project monitoring and evaluation of success should be tied more closely to conditions directly related to aquatic species production.

Problem 10: Population connectivity is reduced as a result of structural barriers in the Imnaha and Big Sheep Creek watersheds. This reduction has resulted in a loss of genetic interchange, population refounding capacity, and habitat availability.

Aquatic Objective 10A: Identify and prioritize for modification, structural barriers that limit connectivity

Strategies:

10A1: <u>Target known problem areas and inventory unknown areas.</u> Examine existing barrier inventories and other assessments to define more clearly where the highest priority barriers occur throughout the subbasin. Based on work completed for this assessment, structural barriers may impede spring chinook access to habitats in HUCs 09J (Imnaha River 7) and 09D (Grouse Creek 1). Obstructions do not impede fall chinook in the Imnaha. For steelhead, structural barriers have been defined in 07J (07J Little Sheep Creek 3 (Redmont, Ferguson, Canal), and in 07I (McCully Creek). Seasonal, structural barriers for steelhead also occur in Summit (HUC 09H), Camp (HUC 07B), and lower Grouse (09D) Creeks. Bull trout migration is impeded by structural barriers in HUCs 07R (Big Sheep Creek 4 – headwaters), 07J (Little Sheep Creek – headwaters), 07I (McCully Creek), and in 07Q (Lick Creek).

Based on the multi-species prioritization matrix, only one HUC (07J – Little Sheep Creek headwaters) was defined as a high priority area for obstruction restoration. The fact that only one HUC emerged as a high priority restoration area illustrates the need to review, individually, species-specific matrices.

10A2. Depending upon outcome from Strategy 10A1, assess the feasibility of reestablishing connectivity between populations occurring above and below the given structural barrier. For example, it may be appropriate to screen the canal so that focal species (*e.g.*, bull trout) remain in their natal stream. However, during certain times of the year, it may be difficult to maintain screens that function properly.

10A3. Assess whether hatchery weirs are impacting bull trout. Hatchery weirs in the Imnaha River (Oregon Department of Fish and Wildlife) acting as passage barriers may be influencing the spawning distribution and spawning time of bull trout. This potential impact should be evaluated.

10A4. Assess whether hatchery intakes are impacting bull trout. Assess the impacts to bull trout of operating hatchery intakes at Oregon Department of Fish and Wildlife's Imnaha Satellite Facility. Ensure that these intakes are screened properly.

10A5. Avoid genetic introgression—Where elimination of barriers may pose a high risk to the genetic make-up of upstream fish stocks, de-emphasize barrier removal or elimination until the risk of introgression is minimized or eliminated

10A6. Adaptively integrate M&E results to examine biological response resulting from the reestablishment of connectivity. Use standard survey techniques to document fish use in the reconnected habitat and genetics information to establish which local populations are utilizing the habitat.

Discussion: Connectivity between salmonid habitats throughout the Imnaha subbasin is essential for maintaining opportunities for genetic exchange, population refounding, thermal refuge, spawning and rearing habitat availability, and expression of various life history forms. Barriers to migration, both manmade and natural, currently represent limiting factors to this connectivity.

The Imnaha Aquatics Technical Team considered structural barriers to represent one of the most important and readily addressable factors currently limiting aquatic focal species in the subbasin, yet agreed that its' ordering of importance should be consistent with the overall prioritization methods.

Irrigation diversions, culverts, and low flow conditions currently represent the primary problems to focal species migration. The USFS (2003a) rated a total of ten subwatersheds as "functioning at risk" due to culverts, and one subwatershed as "functioning at unacceptable risk" due to an irrigation diversion. A diversion ditch for the Wallowa Valley Improvement District canal currently impedes upstream migration of steelhead and bull trout into the upper Little Sheep Creek subwatershed and into creeks such as Big Sheep, McCully, Ferguson, Canal, Redmont, and Salt (USFS 2003a). Irrigation diversions obstructing migration were also identified in lower Camp Creek and in lower Grouse Creek (during low flow periods). Stock ponds in the upper Camp Creek subwatershed and in the Lightning Creek subwatershed were also considered to impede the migration of salmonids into otherwise usable habitat areas. Fish weirs on Little Sheep Creek and the Imnaha River are manmade physical barriers, but because nontarget fish are allowed passage, the facility is not considered a permanent barrier (USFS 2003a).

Culverts on streams within the middle Little Sheep Creek (07H), McCully Creek (07I), Carrol Creek (07Q), Big Sheep Creek (RM 25) (07P), Lick Creek (07Q), Big Sheep (RM 34)

(07R), Imnaha River (RM 51) (09J), Gumboot Creek (09K), Imnaha River (RM 55) (09L), and Imnaha River (RM 58) (09M) subwatersheds act as barriers to juveniles only (USFS 2003a). These obstructions are currently considered to represent fish passage barriers at least part of the year and are being evaluated for replacement or removal by the USFS. A culvert on Summit Creek was identified during the QHA modeling process as an obstruction to salmonids, although the specific life history stage impeded was not defined.

Problem 11: Legacy effects from land use activities impact channel form, and stability, which in turn are contributing to low flow, temperature, and sediment problems

Aquatic Objective 11A. Within the next 15 years improve channel form and stability in portions of the subbasin where low flow, temperature, and sediment problems also exist (*refer to* Section 1.5.1.5 of the Assessment for specific sixth-field HUC's within which channel stability, form, and diversity are assessed to limit aquatic focal species)

Strategies:

11A1. Retard downcutting. In areas of high channel incision, install low-head rock weir structures to encourage sediment accrual and raise the elevation of the streambed

11A2. Improve floodplain interaction. Identify areas where road encroachment has limited stream channel interaction with the floodplain and assess viability of road relocation, reengineering, or removal

11A3. Implement bioengineering approaches. With the assistance of geomorphologists and hydrologists, work with local contractors to modify channel form so as to improve width:depth ratios, sinuosity, and bank stability.

11A4. Implement passive restoration approaches. Where channel form and riparian problems occur in the same 'high restoration' HUC (*refer to* Section 1.5.1.5 in the assessment for specific sixth field HUCs), plant riparian vegetation and place rootwads or pieces of LWD in the stream channel

11A5. Address headcuts. Where there are headcuts, conduct restoration activities to stop upstream progression

11A6. Monitor and evaluate. Conduct regionally accepted effectiveness monitoring using Tier 3 RM&E assessment approaches, as defined in CSMEP 2004.

Discussion: Despite recent (last 10 years) riparian restoration efforts, channel form, stability, and habitat diversity continue to pose a limitation to habitat suitability for key aquatic focal species. Channel incision, advancement of headcuts, and a loss of floodplain interaction are among the primary symptoms. In some cases, short-term, active restoration approaches, such as the placement of instream woody debris or construction of low-head weirs are warranted, as channel response to passive restoration actions has either not occurred or has been deemed ineffective.

Reaches where channel stability is low occur in geologically unstable areas, in select portions of the Big Sheep Creek watershed, and in areas impacted by the January 1997 flood event (*e.g.,* central portions of the mainstem Imnaha). Land use activities that demonstrably contribute to bank destabilization (*e.g.,* riparian grazing) or retard riparian development (*e.g.,* the powerline right of way on the mainstem Imnaha; RM 56.9–RM 60) should be limited to the extent possible. Some of the high-gradient, mainstem tributaries have channel instability issues due to their flashy flow regimes. For example, the upper reaches of Lightning, Sleepy, and Cow Creek (including tributaries) are defined by naturally occurring high flows, and contribute to considerable bedload movement at the bottom of the reach.

Large woody material (LWM), which contributes substantially to habitat diversity, is functionally absent throughout the lower 16 miles of the mainstem Imnaha, and in the lower reaches of Lightning Creek (USFS 2003d). LWM frequency is also considered to be "functioning at unacceptable risk" in the lower reaches of Big and Little Sheep creeks, Bear Creek, and the middle reach of Little Sheep Creek (USFS 2003a; *refer to* Section 1.2.8.3 in the Assessment for additional discussion).

Habitat refugia, as provided through undercut banks, large boulder substrate, overhanging riparian vegetation, bedrock shelves, etc., is abundant throughout the majority of federally managed lands and is rated as "functioning appropriately" at the subbasin scale. Refugium is notably lower in the Sheep Creek system, especially throughout the middle and lower mainstem reaches of Big and Little Sheep Creek. In the mainstem Imnaha, refugia is considered to be "functioning at risk" from RM 16 to RM 37, a factor possibly due to the presence of the Imnaha River road and/or the conversion of floodplain areas to cultivated fields.

Problem 12: Thermal and organic pollutants are identified as limiting factors to aquatic focal species in several sixth-field HUCs throughout the subbasin. The effects from these pollutants on aquatic focal species have not been definitively determined.

Aquatic Objective 12A. Conduct research, monitoring, and evaluation to identify and address point and non-point pollutant sources and to determine associated impacts upon various life history stages of aquatic focal species

Strategies:

12A1. <u>Identify study sites.</u> Using ODEQ BURP data, and professional opinions, establish where water quality criteria are in exceedance of State standards due to thermal and organic pollutants. Identify additional sites where appropriate.

12A2. Collect Data. Using appropriate water quality survey protocol, establish monitoring sites above and below affected areas, as well as at sites in similar, but undisturbed drainages containing similar fauna. Use continuous water quality samplers at monitoring sites to obtain necessary water quality information. Non-point sources of thermal pollution that have been defined in the subbasin watershed include modified riparian vegetation structure, reduced instream flows, altered groundwater dynamics, and altered channel morphology.

12A3. Assess pollutant effects on focal species. Using a combination of literature reviews, in situ laboratory experiments, and field observations, determine the degree to which identified thermal and chemical pollutants may be affecting the various life history stages of focal species. Provided sufficient empirical information is not available, assess biological response of test organisms (*e.g.*, fish species or aquatic macroinvertebrates) to varying levels of organic pollutants in both field and laboratory studies. Also assess response (*e.g.*, avoidance, tolerance, decreased metabolic function, etc.) of test organisms to varying flows and temperatures. In the field, ensure that sampling at all sites occurs before, during, and after storm events

12A4. Develop a nutrient budget. Using sediment, develop a nutrient budget to help determine the impact of organic pollutants upon focal aquatic species

12A5. Assess groundwater and/or hyporheic influence. If possible, determine the degree to which groundwater or hyporheic flows ameliorate or enhance organic and thermal pollutants. Use available techniques (*e.g.*, Forward Looking Infrared Radar (FLIR), wells, continuous water quality monitoring stations, etc.) to make determinations.

12A6. Implement restoration. Based on the outcome from assessment and associated laboratory studies, treat point and non-point pollution sources using appropriate actions.

If identified pollutants are organic (*e.g.*, nitrogen or phosphorus) consider 1) modifying grazing practices in allotments; 2) working with willing landowners to identify and repair any leaking domestic sewage disposal systems; and 3) assisting willing landowners in managing confined animal feedlot operation (CAFO) runoff.

12A7. Conduct effectiveness monitoring. Following restoration efforts, continue to monitor treatment areas to determine relative effectiveness. Ensure that an adaptive management approach is used and appropriate feedback loop exists so as to incorporate findings into biological objectives designed to evaluate fish distribution, reproductive success, and life history-specific habitat utilization

Discussion: Excluding thermal modification and temperature as pollutants, currently none of the Imnaha subwatersheds are on Oregon's §303(d) list for chemical contamination or nutrients, and based on analyses conducted by the USFS, all three watersheds (Big Sheep Creek, upper Imnaha River, and lower Imnaha River) have been classified as "functioning appropriately" for this indicator.

Despite the lack of listing, localized problems with chemical and organic pollutants have been reported in some portions of the subbasin. Septic tanks and feedlots have been cited as potential sources of chemical contaminants to some habitats in the Big Sheep Creek watershed (USFS 1998; Wallowa County and NPT 1999). The Nez Perce Tribe and ODFW (1990) also report that feedlots, located on private lands along Little Sheep Creek and the upper and lower mainstem Imnaha, contribute varying amounts of nutrients to surface water, most notably following localized, high-intensity thunderstorms. The impacts of this pollution on the aquatic environment are, however, considered to be short in duration and scope due to the volume and velocity of flows in the affected areas. Restoration efforts should focus on achieving compliance with Oregon water quality standards, starting first in spawning and rearing areas, then in migratory corridors.

3.2.2 Terrestrial Ecosystem

Problem 13: Limited available information on the composition, population trends, and habitat requirements of the wildlife and plant (terrestrial) communities of the Imnaha subbasin, limits the ability to effectively manage or conserve these species.

Terrestrial Objective 13A: Increase knowledge of the composition, population trends, and habitat requirements of the terrestrial communities of the Imnaha

1. Collect data--develop a survey program and database for terrestrial focal, ESA listed, and sensitive species within the subbasin and surrounding areas.

2. Increase documentation--Support the efforts of the Oregon Natural Heritage Program to document the occurrence of rare species and work toward increased reporting of sightings.

3. Strategy: Continue existing and expand research on the population dynamics, habitat requirements and Key Environmental Correlates (KEC) of the terrestrial species of the Imnaha subbasin, focus efforts on focal, ESA listed and sensitive species.

4. Strategy: Continue existing and expand research on processes such as fire regimes, hydrology, plant community dynamics etc. that influence the terrestrial communities of the subbasin.

5. Strategy: Continue existing and expand research on the biotic interactions and Key Ecological Functions (KEF) of the terrestrial communities of the subbasin (e.g. big game-livestock interactions)

6. Monitor and Evaluate research needs in relation to limiting factors as implementation of habitat projects continues. Apply research and growing information base to management.

Discussion: Increasing the amount of data collection focused on terrestrial species will improve our understanding and ability to manage these species. Establishing a baseline understanding of current habitat conditions, ecosystem functions and population numbers will allow managers to evaluate the effects of future management activities and swiftly adapt them if necessary.

Problem 14: Degradation of areas of grassland habitat in some areas of the Imnaha subbasin has impacted native plant and animal species.

Terrestrial Objective 14A: Maintain grassland quality, condition, and composition

1. Strategy: Inventory and map the location of grassland communities in a mid-late seral condition.

2. Strategy: Manage for the persistence and enhancement of large mid-late seral grassland areas, through the implementation of BMPs.

3. Strategy: Maintain and enhance rare plant population through proper management, conservation easements, land acquisitions, incentive programs and other tools.

4. Strategy: Develop grazing management plans to limit adverse impacts to areas of intact grasslands.

5. Strategy: Monitor and evaluate the effectiveness of the above strategies for maintaining and enhancing the grassland habitats of the subbasin and supporting grassland dependent wildlife species. Integrate new information into and adapt Strategies 1-4 as necessary.

Discussion The Imnaha subbasin contains some of the healthiest grassland communities remaining in the Columbia Basin. Grassland habitats in the subbasin are inhabited by numerous rare plant species including two species listed as Threatened under the Endangered Species Act, MacFarlane's four o'clock and Spalding's catchfly.

The subbasins high quality grasslands may be providing critical refuges for grassland dependent wildlife species that have lost habitat over much of their range. The relatively natural species composition and structural condition of sites in the subbasin may provide important reference information that will help guide future restoration efforts in grassland communities in other parts of the Columbia Basin.

Identifying and protecting high quality grassland areas in the subbasin should be a priority. Management agencies in the subbasin have begun efforts to identify high quality grassland habitats in the subbasin and these efforts need to be expanded and continued. Once the highest quality areas in the subbasin are identified, the need for protection should be assessed. Large intact areas that may be capable of supporting area dependent grassland species like the grasshopper sparrow or areas with rare or endangered elements should be given priority (see assessment section 1.2.9.4).

Terrestrial Objective 14B: Restore or rehabilitate areas where grasslands have been degraded

1. Strategy: Research native grassland restoration methods-- explore techniques for effectively restoring grassland habitats.

2. Strategy: Maintain coordination between the Wallowa County Natural Resource Advisory Committee (NRAC), Wallowa County Soil and Water Conservation District (SWCD) the Natural Resource Conservation Service, the U.S. Forest Service and other interested landowners, agencies and organizations.

3. Strategy: Prioritize areas for grassland restoration. Consider expected biological response and cost effectiveness in prioritization process. Integrate information from previous Objective strategy 1 into the prioritization process to improve grassland habitat connectivity.

4. Strategy: Actively improve or create grassland habitats through noxious weed control, management practices and seeding. Use native species or if necessary for effective restoration non-invasive, non-native species in existing state, federal, and tribal habitat programs.

5. Strategy: Monitor and evaluate the effectiveness of the above strategies at restoring areas of degraded grassland. Modify Strategies as necessary based on new information.

Discussion: Although the grassland habitats of the Imnaha subbasin are some of the healthiest remaining in the Columbia Basin they have still been affected by the disturbances that have eliminated most of these communities in the region (USFS 2003c). The primary causes of grassland degradation in the subbasin have been livestock grazing and the introduction of noxious weeds and cheatgrass. Strategies for reducing the impacts of these factors are described in Objective 17A.

Once established cheatgrass outcompetes native bunchgrasses and is very difficult to remove. In the past, efforts at restoring areas dominated by cheatgrass have been marginally successful at best. The development of more successful and cost effective techniques for reducing and eliminating cheatgrass and restoring native bunchgrass communities, would have immeasurable benefits to grassland restoration efforts and grassland dependant wildlife species. Given the low success rate of restoring grassland areas that have become dominated by cheatgrass or noxious weeds to native grassland communities, it is sometimes necessary to use a more competitive non-native grass species such as crested wheatgrass to rehabilitate degraded areas. While using non-native species is not ideal for wildlife species and should be considered carefully their establishment can help prevent further degradation (e.g. cheatgrass being replaced by medusahead) and restore economically valuable forage.

Problem 15: Reductions in the extent of mature ponderosa pine habitats in the subbasin have negatively impacted the numerous wildlife species that utilize these habitats.

Terrestrial Objective 15A: Maintain and enhance mature ponderosa pine habitats.

1. Strategy: Inventory and map existing mature ponderosa pine habitats

2. Strategy: Maintain existing mature ponderosa pine communities through conservation easements, land acquisition, land exchanges or other strategies. Give priority to larger remnants and those with highest potential to be lost.

3. Strategy: Manage for the persistence of ponderosa pine communities--where appropriate to the habitat type, use understory removal followed by early spring or fall burning to protect mature stands from stand-replacing fire events.

4. Strategy: Use selective thinning and early spring burning or fall burning to encourage succession and the establishment of mature ponderosa pine communities on appropriate habitat types.

5. Strategy: Encourage the planting of ponderosa pine on appropriate habitat types in existing state, federal and tribal reforestation efforts.

6. Strategy: Monitor and evaluate efforts to maintain and enhance ponderosa pine habitats in the subbasin. Modify implementation strategies as necessary.

Discussion: Ponderosa pine forests have decreased across the Columbia Basin with an even more significant decrease in mature ponderosa pine habitats (Quigley and Arbelbide 1997). The distribution of ponderosa pine habitats in the Imnaha subbasin has been estimated to have declined by more than 22,000 acres (47%) from historic conditions (see assessment section 1.2.10.1 in the assessment for details).

Before the initiation of logging and fire suppression, ponderosa pine was maintained by regular underburning. Many areas of the subbasin covered by open ponderosa pine habitats are now dominated by denser stands of shade-tolerant tree species. These changes have likely impacted populations of ponderosa pine dependent wildlife species in the subbasin. Ponderosa pine habitats are important to a variety of wildlife in a variety of ways. Bald eagles are commonly observed were perched in mature ponderosa pine trees (Cassirer 1995). The focal species, white-headed woodpecker is completely dependant on the seeds of the

Ponderosa pine for winter feeding and show a preference for these habitat types for nesting and foraging during other seasons of the year. Flammulated owl habitat includes open stands of fire-climax ponderosa pine or Douglas-fir forests (see assessment section 1.2.9.1 for details). Six focal or concern wildlife species in the subbasin are closely associated with ponderosa pine habitats and many more use these habitats (see assessment section 1.5.2 for details). Management for the restoration of ponderosa pine to areas of historic dominance and encouragement of natural succession processes, will increase the amount of ponderosa pine habitats (and eventually mature ponderosa pine habitats) available to dependent wildlife.

Only the 07B, 07D, 7E and 07K subwatersheds have been identified as containing more than 200 acres of mature stands of ponderosa pine, these areas should be verified through field surveys and considered for protection actions similar to those described in strategies 2 and 3 (see Appendix C in this document for subwatershed locations). The 07D, 7E, 7K, 8B, 08C, 08G, 08H, 08J, 08K and 09A subwatersheds have been identified has containing more than 1000 acres of ponderosa pine habitats each. These areas would be prime areas for the implementation of strategy 4, which will encourage their persistence and development into mature habitats (assessment sections 1.1.1.9 and 1.2.91 and 1.5.2 for details on ponderosa pine habitats).

Problem 16: The loss or degradation of wetland and riparian habitats has negatively impacted the numerous wildlife species that utilize these habitats.

Terrestrial Objective 16A: Maintain currently functioning wetlands and restore degraded wetlands.

1. Strategy: Finalize, digitize and ground truth National Wetlands Inventory maps for the subbasin, develop restoration priorities and assess wetland functionality (build upon work completed by the USFWS, SWCD, NRCS and cooperators).

2. Strategy: Maintain high quality wetland habitats, through conservation easements, land acquisition, public education, promotion of BMPs, incentive programs, continued use of alternative grazing strategies and additional installation of alternative forms of water for livestock. Adjust seasonal timing of livestock grazing to minimize soil compaction, erosion and noxious weed propagation.

3. Strategy: Continue existing programs such as CREP, and WHIP and develop new programs that work to restore wetland habitats.

4. Strategy: Monitor and evaluate efforts to maintain and restore high quality wetlands. Modify strategies as necessary

Terrestrial Objective 16B: Maintain currently functioning riparian areas and restore degraded riparian areas.

1. Strategy: Maintain and enhance riparian communities through conservation easements, land acquisition, promotion of BMPs, land stewardship, continued use of alternative grazing strategies, installation of additional alternative forms of water for livestock and increased enrollment by landowners in the Continuous Conservation Reserve Program (CCRP) and the Conservation Reserve Enhancement Program (CREP).

2. Strategy: Increase understanding of the importance of riparian habitat through education programs for both the general public and road maintenance personnel.

3. Strategy: Restore the structural diversity and species composition of overstory and understory riparian vegetation. Maintain and improve the availability and distribution of important KECs.

4. Strategy: Identify winter feeding operations not already covered under Confined Animal Feeding Operation (CAFO) regulations that are impacting water quality, and design management actions to minimize sediment and nutrient inputs to streams.

5. Strategy: Fund existing programs and develop new programs that restore riparian habitats.

6. Strategy: Monitor and evaluate efforts to maintain and restore riparian habitats. Integrate new information and modify implementation strategies as necessary.

Discussion: Riparian and wetland habitats in the Imnaha subbasin have been altered through various human activities. Riparian and wetland habitats are very important to both terrestrial and aquatic communities in the subbasin and these changes have the potential to impact numerous species. Heavy grazing has impacted the health of the riparian and wetland communities in some areas of the subbasin but recent efforts to exclude cattle from sensitive areas, the use of best management practices, alternative grazing strategies, changes in grazing timing etc. have resulted in recent improvements in riparian condition across much of the subbasin. Riparian and wetland habitats in the subbasin area are also threatened by invasive plant species; implementation of the strategies described in Objective 17 should help to protect these important communities

Continued and expanded implementation of the type of actions described in the above strategies should result in continued improvements in the riparian and wetland habitats of the subbasin and provide abundant, well distributed, high quality riparian habitat that will support the many wildlife and fish species that depend on these habitats. The Imnaha subbasin Multi-species Biological Assessment identified 17 subwatershed in the subbasin where riparian conditions are functioning at risk (7A,7D,7E,7H,7J,7K,7M,7O,7P,7Q, 8D, 9A,9D,9E,9F,9H,9K) (see Appendix C for locations, USFS 2003a). These areas should be considered priority areas for riparian restoration.

Problem 17: The introduction of noxious weeds and nonnative plant species into the Imnaha subbasin has negatively impacted native terrestrial focal species.

Terrestrial Objective 17A: Maintain and enhance the existing quality, quantity and diversity of native plant communities providing habitat to native wildlife species by preventing the introduction, reproduction, and spread of noxious weeds and invasive exotic plants into and within the subbasin.

1. Use the Wallowa County Noxious Weed List to prioritize noxious weed eradication, containment or control efforts in the subbasin. The Wallowa county list prioritizes efforts based on the threat of the particular species to the ecosystem, its invasibility, the degree to which it is established, the effectiveness of biocontrol and the potential for eradication or control (see assessment section 1.5.2).

2. Fund and support efforts to map noxious weed locations and areas with a high risk of invasion.

3. Research innovative techniques for reducing the spread of noxious weeds and reducing established populations.

4. Minimize establishment of new invaders by supporting early detection and eradication programs.

5. Develop and implement programs and policies designed to limit the transportation of weed seeds from vehicles and livestock

6. Minimize the potential for livestock to facilitate the spread of noxious weeds through weed-free hay programs, quarantine requirements, and other actions. Support the Wallowa County certified hay program. . Adjust seasonal timing of livestock grazing to minimize soil compaction, erosion and noxious weed propagation

7. Use integrated pest management principles to eradicate noxious weed populations when possible and to contain or control the spread of noxious weed populations when eradication is not feasible. Coordinate with existing efforts including those of the Tri-County Cooperative Weed Management Area, Tri-State Weed Management Area and the Wallowa County Weed Board.

8. After treatment, rehabilitate infested sites with desirable plant species.

9. Increase public participation--develop education and awareness programs in noxious weed identification, spread prevention and treatment.

10. Monitor and evaluate the effort to protect native plant communities from exotic plants and reduce the prevalence of noxious weeds in the subbasin. Integrate new information into Strategy 1 and modify implementation strategies as necessary.

Discussion: Noxious weeds and other invasive plant species pose one of the greatest threats to the wildlife habitats of the subbasin. They often outcompete native plant species, and alter ecological processes reducing habitat suitability (Quigley and Arbelbide 1997). Many invasive species are not palatable to either livestock or wildlife, nor do they provide suitable habitat for wildlife species.

Weed problems in the subbasin are most severe in the grassland habitats. The naturally open structure of the subbasins grassland vegetation, its soils, and climate, have predisposed it to invasion by weeds, especially by species of Mediterranean origin. Preventing the spread of noxious weeds and other invasive plants into areas of relatively pristine habitat is one of the highest priorities for wildlife management in the subbasin (see section 6.1.2 in this document). Effective education programs that help residents and visitors to the subbasin identify noxious weeds and learn how to reduce or prevent their spread will be critical to this effort. The introduction and spread of invasive species is tied to other activities in the subbasin including road construction and use, livestock grazing, fire, timber harvest and other soil disturbing activities. Strategies developed by the technical team to address these issues were developed in objectives 14, 18, 19. Implementing these strategies will also help to reduce the impact of introduced plant species on the subbasin (see assessment section 1.5.2 for more details).

Problem18: Changes in the disturbance regime of the forested habitats of Imnaha subbasin have altered forest composition, density and structure, negatively impacting native terrestrial species that depend on these habitat types.

Terrestrial Objective 18A: Restore the composition, structure, and density of forests to within the historic range of variability (HRV).

1. Strategy: Continue and refine efforts to identify and map the historic range of variability for the vegetative communities of the subbasin.

2. Strategy: Continue efforts to map and inventory current vegetative conditions including existing old growth and potential old growth areas.

3. Strategy: Continue research into innovative and cost effective techniques for restoring the composition, structure and density of forested habitats to a more natural condition.

4. Strategy: Restore the species composition of the forested habitats of the Imnaha subbasin to within the HRV using a combination of precommercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions. Focus efforts on restoring ponderosa pine and western larch communities, and enhancing shrub/forb layer diversity.

5. Strategy: Restore the structural composition of the forested habitats of the Imnaha subbasin to within the HRV using a combination of precommercial and commercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions. Maintain and enhance existing late seral habitats and associated KECs.

6. Strategy: Reduce densities in forest areas that exceed the HRV to reduce the potential for insect and disease outbreaks and lethal fires. Use a combination of precommercial and commercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions.

7. Strategy: Monitor and evaluate efforts to restore forest communities to the Historic Range of Variability, modify strategies as necessary.

<u>Discussion:</u> The distribution and abundance of forest structural condition across the subbasin is near the edge of the range of what occurred historically and many areas within the subbasin are outside the HRV (see assessment section 1.2.10). In most areas mid-seral structural conditions are more prominent than what would have occurred historically under natural disturbance regimes, while late seral stages are reduced. These changes are primarily a result of changes in the disturbance regime that have occurred due to timber harvest, and fire suppression. Where timber harvest has occurred in the subbasin most forests are deficient in the late and old structural stages and associated KECs (snags, hollow boles etc.) (see assessment section 1.2.10).

Fire suppression has resulted in increased accumulation of fuels, higher vegetation densities, and a major shift in species composition and size class distribution of trees. The accumulation of duff, as well as increased density of vegetation and fuels, has created conditions in which even light severity fires can be damaging due to the concentrated heating of the tree bole. The accumulation of ground fuels along with denser, multi storied stand conditions has also created “fuel ladders” that cart fire into the tree canopy, resulting in high intensity crown fires. Unlike the moderate severity fires that burned historically, many wildfires now have the potential to impact soil productivity and increase erosion through the consumption of organic matter and high temperature that may result. In mid elevation forests, fire exclusion and other factors (e.g., timber harvest) have resulted in a shift from young and old single layer stands dominated by shade-tolerant tree species (e.g., Douglas-fir and grand fir). The development of dense, multi-layered stands has resulted in larger, more frequent stand-replacing fires and a greater susceptibility to insects and disease. Higher fuel loads also increase the potential for soil heating and higher mortality of trees and understory vegetation. The net result is wildfires that are more severe and more difficult to control (see section 1.1.3.4 and 1.5.2).

These changes have decreased the suitability of the subbasin to many species adapted to native structural conditions (see assessment sections 1.2.1). Exclusion of fire as a forest process has significantly changed wildlife habitat conditions. Lack of areas with fire-killed or weakened trees has impacted the black-backed woodpecker and other snag-dependent species in some areas. Thinning effects of ground fires has allowed shade tolerant-tree species to crowd out important forage plants and compete for moisture and nutrients, discouraging the growth of large trees and maintenance of old growth conditions (BLM 2002). Due to dense forest conditions the possibility of large-stand replacing fires is now greater than it was historically. These types of fires can negatively impact wildlife species that require mature stands or associated KECs. Large fires result in a more homogenous distribution of structural conditions and can reduce the diversity of species an area can support. The above strategies strive to restore the subbasin to more natural disturbance regimes, which will begin to move forest structural conditions and compositions in the subbasin back within the HRV and provide more suitable habitat conditions for native wildlife that are adapted to these natural forest conditions (see assessment sections 1.2.10).

Problem 19: Road construction, timber harvest and/or fire suppression have altered the size, quality, distribution and juxtapositions in and between habitat patches in the subbasin.

Terrestrial Objective 19A: Reduce the impact of the transportation system on wildlife and fish populations and habitats

1. Strategy: Implement the recommendations of the HCNRA CMP and other Forest Service documents for the transportation system of the public lands of the subbasin

2. Strategy: Conduct a subbasin wide transportation system analysis of the roads system of the Imnaha subbasin. Recommend for decommissioning, relocation or reconstruction roads not critical for transportation, recreation and land management activities which most negatively impact terrestrial and/or aquatic habitats. Consider relocation, reconstruction or the addition of erosion control structures to necessary roads having negative impacts on fish and wildlife populations. Assess fish passage and make culvert removal or improvement recommendations.

3. Strategy: Implement the recommendations of the transportation system analysis when completed.

4. Strategy: Monitor and evaluate efforts to reduce the impact of roads on the fish and wildlife populations of the subbasin. Modify implementation strategies as necessary.

Discussion: Roads have been documented to have numerous negative effects on fish and wildlife populations. Wisdom et al. (2000) identified 13 factors consistently associated with roads in a manner deleterious to terrestrial vertebrates (see assessment section 1.5.2 for details). Even though road densities in the subbasin are relatively low, the transportation system of the Imnaha subbasin may be a limiting factor to wildlife populations in some areas. Road densities or road locations in subwatersheds 07J, 07L, 07O, 07P, 07Q, 09E, 09I, 09K, and 09L have been identified as impacting ecosystem function (see Appendix C for location of subwatersheds). Efforts are currently underway by the Wallowa-Whitman National Forest to reduce road densities in many of these areas, the implementation of the above efforts should complement and expand these efforts.

Problem 20: Reduction in the size of anadromous fish runs in the Imnaha subbasin has reduced nutrient inputs and reduced habitat suitability for salmon-dependent wildlife and the quality of terrestrial ecosystems in general. Forest management practices that strive to reduce fuel loads may be further altering nutrient cycles.

Terrestrial Objective 20A: Restore natural nutrient input cycles and mitigate for damages to aquatic and terrestrial populations due to the loss of these nutrients.

1. Strategy: Assess nutrient inputs and cycling in the Imnaha subbasin. Where appropriate, consider carcass additions or other innovative approaches to restore nutrient recycling.

2. Strategy: Research restoration practices--Investigate innovative methods to restore nutrient loading to upland areas similar to those currently used to restore nutrient loads to streams (compensatory loads to offset salmon loss).

3. Strategy: Research the impacts of fuel load reduction activities on nutrient input and cycling processes.

4. Strategy: Monitor and evaluate efforts to restore nutrients to upland areas. Integrate new information into effort and revise strategies as needed.

Discussion: The flow of nutrients into the subbasin has been altered by reduction of anadromous fish runs. The reduction of these nutrient flows has potentially impacted numerous wildlife species and the subbasins ecosystem as a whole. For example, 94 of the wildlife species with habitat in the subbasin have been demonstrated to have a relationship to salmon; 25 of these species are concern or focal species (see assessment section 1.4.3 for details). Quantify the impact of reduced nutrient inputs into the subbasin and expanded research into nutrient cycling processes will allow for more a more in-depth understanding of the ecosystem and more effective management of the subbasins resources. Maintaining and enhancing salmon runs in the subbasin through implementation of strategies outlined in objectives 1-12 will be critical aspects of restoring natural nutrient cycles.

3.2.3 Socioeconomic Components

These social and economic objectives are designed to provide operational guidance for implementing the terrestrial and aquatic protection and restoration objectives and strategies outlined in the Imnaha Subbasin Plan. They are operational objectives and strategies essential to the short- and long-term success of overall efforts in the subbasin. The problem statements and socioeconomic objectives in Table 6 were developed to address factors limiting the successful implementation of the Vision in the Imnaha subbasin. They are not meant to be optional or to be implemented to the detriment of aquatic and terrestrial objectives and strategies, but are process-oriented objectives and strategies that should be addressed whenever possible as part of all planning and implementation activities. They address important aspects of the context within which aquatic and terrestrial protection and restoration occur. The successful management of fish and wildlife in the subbasin is partially dependent on implementing the strategies detailed in this section.

The following objectives and strategies were developed by the planning team during regular subbasin planning meetings. These objectives, strategies and discussions were developed within a collaborative, consensus-based discussion. All changes and revisions were reviewed and approved by the planning team

Table 6. Problems statements, socioeconomic objectives, and limiting factors in the Imnaha subbasin.

Problem Statements		Socioeconomic Objectives		Limiting Factors
21	In the past, fish and wildlife management activities have been considered as having negative economic impacts on local communities because it was viewed as mitigation for fish and wildlife	21A	Consider impacts and benefits of fish and wildlife activities to surrounding communities and their economies	Impacts to local economies
22	Many important cultural uses of the Imnaha subbasin are impacted by aquatic and terrestrial management activities	22A	Protect and foster both Indian and non-Indian cultural uses of natural resources	Cultural considerations
23	Insufficient coordination and integration limit the economic, social, cultural and biological benefits of aquatic and terrestrial protection and restoration in the subbasin	23A	Coordinate with groups and the public when developing and implementing fish and wildlife management activities in the subbasin	Coordination

Problem 21: Wallowa County's social and economic conditions have changed over the last 20 years. In the past, fish and wildlife management activities have been considered as having negative economic impacts on local communities because it was viewed as mitigation for fish and wildlife. In the future, it is important that local communities account for both the long-term social and economic impacts and benefits of fish and wildlife related activities.

Objective 21A: Consider impacts and benefits of fish and wildlife activities to surrounding communities and their economies.

Strategies:

1. Minimize negative impacts on the communities in and surrounding the Imnaha subbasin and their economies while achieving sustainable aquatic and terrestrial populations in the subbasin.

2. Maximize positive impacts on surrounding community culture and custom.

3. To maximize benefits, utilize local labor forces, contractors, and suppliers when implementing habitat improvement projects when possible.

4. The NRAC will evaluate the economic efficiency and impacts of projects as part of this prioritization process in the subbasin.

5. Maximize positive impacts of management activities on recreation when possible.

Discussion: Seventy-one percent of the Imnaha subbasin is under public ownership (Imnaha Assessment pg 68). Most private lands in the subbasin are used for ranching. The economy of the Imnaha is a natural resource-based economy. Agriculture and timber, and to a lesser extent government are the backbone of the Wallowa County's economic base (Wallowa County). The custom and culture associated with agricultural and timber production are central to the area's self-identity and necessary to the livelihood and well-being of its citizens (Wallowa County Comprehensive Land Use Plan). Public timbered and grazing lands contribute a significant portion to the agricultural base of the county (Wallowa County). More than 56% of forest lands in Wallowa County are managed by the federal government. With this high percentage of timber resources under federal management, management plans and decisions can and do have a direct effect on the local economy (Wallowa County). Farm income in Wallowa County has decreased 167% over the last twenty years and farm employment has decreased by 36% over the last ten years (Wallowa County 2003). The local community is very sensitive to activities that will further decrease the agricultural sector.

Healthy fish and wildlife populations provide economic and cultural benefits. Additional social values, in addition to economics, need to be considered when implementing activities. The social and economic benefits and impacts of restoring and protecting fish and wildlife in the Imnaha subbasin need to be determined. Low cost tools need to be developed that can be used at the subbasin scale. Trend information is particularly important to understanding benefits and impacts that may take decades to manifest. Baseline data needs to be collected or augmented to allow for development of trend analysis. This analysis needs to be targeted towards the specific economic and social factors affecting resource decision making. Once these tools have been developed, a baseline established and an evaluation of current conditions made, this information needs to be integrated into prioritization processes.

Also important is to involve local labor and resources in protection and restoration efforts, when possible. This provides direct participation in the process while providing work and economic benefits to local areas. Also important is to involve local labor and resources in protection and restoration efforts.

Problem 22: Many important cultural uses of the Imnaha subbasin are impacted by aquatic and terrestrial management activities. Indian tribes are continually losing opportunities to practice long standing traditions that keep their cultures alive - traditions related and contingent upon responsible natural resource management. Non-Indian users also face difficulty in maintaining important cultural uses in the subbasin. Local industries that support these users suffer or benefit from impacts on these uses.

Objective 22A: Protect and foster both Indian and non-Indian cultural uses of natural resources in the Imnaha subbasin.

Strategy 22A:

1. Integrate information on important Indian and non-Indian cultural practices into project selection and implementation.

2. Provide information and education on important Indian and non-Indian cultural practices to land managers, regulatory agencies, policy makers.

<u>Discussion:</u> General changes to land management in the area impact traditions and cultural uses. Wallowa County has been the home of Native American people for thousands of years. Archaeological sites and artifacts spanning thousands of years have been documented in the county (Wallowa County-Nez Perce Tribe 1999). The living culture of the tribes is reliant on the harvest of resources from the federally managed public lands. The protection of treaty rights is very important and the Nez Perce Tribe has been actively engaged in protecting and asserting these cultural uses and rights. Information on cultural uses and treaty rights needs to be integrated into project and program development and implementation from the beginning to avoid damage to culture resources and to reduce conflicts later in the process. The Nez Perce Tribe has initiated this process through holding a treaty workshop in Wallowa County during January 2004. This type of activity must be continued to further integrate cultural values into aquatic and terrestrial resource planning and implementation activities.

Non Indians also engage in important cultural uses of public lands that need to be protected and fostered. Recreation is important to the communities and economies in and around the subbasin. Hunting, fishing, boating, hiking, skiing, snowmobiling and other recreational activities make the Imnaha an important recreation center in Oregon and the northwest. Recreation and tourism are increasingly important part of Wallowa County's economy (Wallowa County 2003). These activities not only provide economic benefits to the area, but represent traditional cultural activities in their own rights for many of those engaged in them.

Problem 23: As reflected in the inventory, numerous agencies and entities are implementing programs and projects in the subbasin. Insufficient coordination and integration limit the economic, social, cultural and biological benefits of aquatic and terrestrial protection and restoration in the subbasin. A lack of local support can undermine long-term implementation success.

Objective 23A: Coordinate with groups and the public when developing and implementing fish and wildlife management activities in the subbasin.

Strategies:

1. The NRAC will identify a coordinator to lead implementation of the Imnaha Subbasin Plan among the various entities.
2. Involve user groups in finer scale subbasin planning efforts, and in program and project planning.
3. Organize project goals and implementation strategies and coordinate plan implementation with federal, tribal, state, local, and other interests to avoid program and project duplication.
4. Prioritize and make recommendations to funding sources about project proposals for the subbasin.
5. Include entities with vested interest in the subbasin in fish and wildlife planning and implementation.
6. Promote stewardship of natural resources through enhanced local involvement and support.
7. Implement information and education actions identified in this management plan.
8. Implement subbasin-wide information distribution, such as periodic public meetings, newsletters, web sites, etc.
9. Develop ongoing public involvement process.

Discussion: Coordination of programs and plans in the subbasin will achieve benefits beyond the value of an individual program or project, and will promote the application of ecosystem management principles. Existing programs and projects are listed in the Inventory. The most efficient and practical way of doing this will be for the NRAC to identify a coordinator to lead in organizing and implementing these tasks.

The NRAC is a broadly representative group that includes the county, state, and federal agencies, and the Nez Perce Tribe. The coordinator will work to integrate local efforts with subbasin scale efforts while working develop as many projects as possible that provide cultural, social and economic benefits to local communities. Long-term program implementation is more successful where projects are developed in cooperation with local entities. The primary current local groups need to coordinate with the subbasin scale effort. The coordination needs to work both ways.

Implementation of the subbasin plan will require efforts at multiple scales including subbasin, population, watershed and finer scales. Technical expertise needs to be available for participation in finer scale efforts. This will help achieve continuity and consistency in local efforts as well as informing subbasin scale efforts.

NRAC has already been implementing most of these strategies in Wallowa County. Now, the need is to build on existing momentum and activities, not to start from scratch. This work needs to continue as part of future activity implementation.

Over the long run, broad public understanding and commitment to fish and wildlife efforts need to be developed in the Imnaha subbasin and surrounding communities. This strategy supports the more general Wallowa County goal to involve citizens in all phases of planning efforts (Wallowa County Comprehensive Land Use Plan). This effort needs to involve individuals as well as agencies. Everyone needs to be involved throughout the process to avoid problems. Information and resources from the agencies, tribes and subbasin scale efforts need to be provided to local groups, while local data, information and priorities need to be integrated into the subbasin scale effort. Better integration of efforts will require further involving communities in subbasin planning. A sustained, long-term effort to provide information to communities and residents of the subbasin needs to be maintained indefinitely. If a single organization cannot spearhead this effort, then it should be woven into projects and programs when possible. If possible, multiple roles and efforts should be underway at once.

4 Research, Monitoring, and Evaluation Plan

4.1 Ecological management framework

This section describes conditions identified in the *Imnaha Management Plan* that will require research, monitoring, and evaluation (RM&E) activities to aid in resolving management uncertainties and allow for effective adaptation of management practices when necessary. This RM&E section is closely related to the objectives, and strategies described in Section 3 of this subbasins management plan, which were developed to address the limiting factors identified in the *Imnaha subbasin assessment* and promote the vision for the Imnaha subbasin.

The need for adaptive management and monitoring and evaluation of project implementation was an issue of focus during the development of the objectives and strategies. Each objective has a set of strategies focused on either gaining further understanding of the limiting factors or taking actions to improve or correct the limiting factor. Each objective also has a strategy focused on evaluating the effectiveness of these strategies in obtaining the objective and modifying the approach taken to achieve the objective as necessary. In order to effectively assess the effectiveness of a strategy, data on the impact of implementing the strategy on the environmental conditions or the understanding of environmental conditions in the subbasin will need to be collected throughout its implementation. This section seeks to guide the collection of the most appropriate data to allow for effective adaptive management.

The development of this RM&E section was guided by a series of meetings with technical personnel representing various tribal, federal, state, and county agencies involved in the management of fish and wildlife resources in the Imnaha subbasins. The group reviewed the guidance in *A Technical Guide for Subbasin Planners* (NPCC 2001) and incorporated the elements they considered appropriate and feasible based on the projects timeline, the needs of the subbasin, and the current state of knowledge in the subbasin. The group attempted to develop an integrated and iterative monitoring and evaluation plan that is consistent with the three tiered system advocated by the ISRP (2003a) and the Columbia Basin Fish and Wildlife Authority's (CBFWA) Collaborative Systemwide Monitoring and Evaluation Project (CSMEP; CBFWA 2004). The three tiers integral to this type of RM&E plan are described below as they were defined by the Independent Scientific Review Panel in their 2003 review of the Draft Clearwater subbasin management plan (ISRP 2003a). The three tiers and their relationship to adaptive management are illustrated in (Figure 1).

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit over a period of time, with a view to quantifying changes over time. Changes must be distinguished from background noise. In general, Tier 1 monitoring does not establish cause and effect relationships (i.e., is not research) and does not provide statistical inductive inferences to larger areas or time periods (ISRP 2003a).

Tier 2 (statistical) monitoring provides statistical inferences to parameters in the study area as measured by certain data collection protocols (i.e., the methods in a report). These inferences apply to areas larger than the sampled sites and to time periods not studied. The inferences require both probabilistic selection of study sites and repeated visits over time. Individual proposals can support larger Tier 2 statistical monitoring projects such as the Oregon Plan by using the same field methods and methods to select study sites that contribute information to Tier 2 statistical monitoring. Most large projects should implement sampling designs that allow Tier 2 statistical monitoring or contribute data to statistical monitoring (ISRP 2003b).

Tier 3 (research) monitoring is for those projects or groups of projects whose objectives include establishment of mechanistic links between management actions and salmon or other fish or wildlife population response. Bisbal (2001) defines this level of effort as *effects* or *response monitorin*g; the repeated measurement of environmental variables to detect changes caused by external influences. The key words here are "establishment of mechanistic links" and "detect changes caused by external influences." Tier 3 research monitoring requires the use of experimental designs incorporating "treatments" and "controls" randomly assigned to study sites (ISRP 2003b).

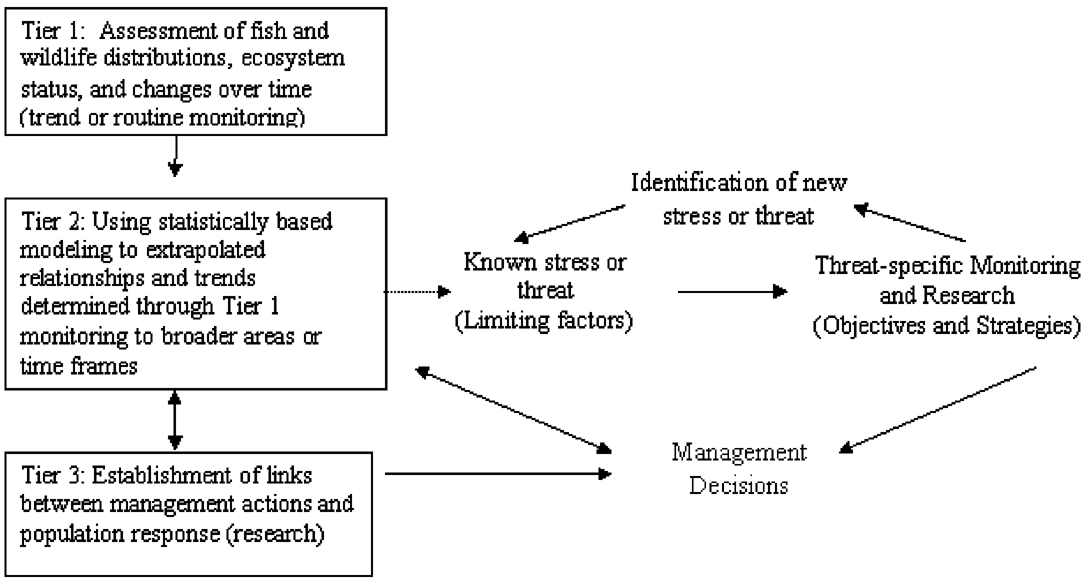

Figure 1. The three tiers of an RM&E program and their relationship to the adaptive management feedback loop

In the context of a subbasin plan, RM&E is needed to: (1) ensure that strategies selected and implemented are addressing the limiting factors as anticipated, and (2) verify that the limiting factors identified in the assessment are, in fact, the elements that are limiting the environmental expression and biological performance desired. The RM&E plan is structured around the objectives and strategies section. In that section three main types of strategies were identified for achieving the objectives and improving the limiting factors in the subbasin; strategies focused on filling data gaps, addressing research needs, or implementing actions to improve or preserve conditions. The types of data that will be need to be collected to assess the successfulness of each strategy in contributing to meeting the objective will vary among the three above mentioned types of strategies. Additionally the amount of information available to the technical team to make these recommendations varied among the three types of strategies.

4.2 Aquatic and Terrestrial Research Needs

A variety of research needs were identified during development of this subbasin plan. In most instances the broad nature of identified research needs will likely result in the delineation of multiple focused research projects which, when results are combined, will address the overall need. For this reason, details regarding research methods (e.g. sampling frequencies and protocols, experimental design, and statistical analysis) were not delineated, and should be addressed in individual project proposals focused on addressing individual components of the identified research needs.

Given this situation, different approaches were taken by the aquatic and terrestrial technical teams in developing information for. Both teams attempted to delineate the anticipated spatial scale at which the research needs would most likely be addressed, and the temporal scale anticipated to be necessary for addressing each identified need.

The following research needs (Table 7) were defined based on the preceding objectives (Section 3) for both aquatics and terrestrial technical teams.

Table 7. Research needs defined for aquatic and terrestrial focal species in the Imnaha subbasin

	Objective		Strategy	Expected outcomes	Spatial Scale	Project duration
1A	Achieve escapement objectives shown in Table 3 within 24 years	1A1	Participate in province and basinwide coordinated studies and water management forums—Conduct research within the context of identifying management versus basinwide environmental effects. Work with other entities to ameliorate and mitigate limiting factors	Improved understanding of in and out of basin survival and associated limiting factors	Aggregate populations	Annual - ongoing
3A	Improve our understanding of small populations and their relative viability	3A4	Identify where there is a lack of knowledge pertaining to the population size of anadromous and resident focal species. Use this information to further refine enhancement and restoration efforts	Improved ability to manage anadromous populations in the Imnaha	Aggregate populations	Annual - ongoing
4A	Establish the abundance and productivity of anadromous stocks and how they compare to other Snake River stocks.	4A1	Evaluate and update ongoing efforts at defining production and productivity for focal species	Improved ability to manage anadromous populations in the Imnaha	Aggregate populations	Annual - ongoing
		4A2	Evaluate Imnaha subbasin-specific adult abundance, life history characteristics, and spawn–recruit relationships as a measure of productivity	Improved ability to manage anadromous populations in the Imnaha	Aggregate populations	Annual - ongoing
5B	Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks	5B2	Determine the range of temperature tolerances for bull trout life stages in different habitats.	Use the results of temperature studies to address the adequacy of existing regulations. The recovery unit team identified this as a range-wide need.	Subbasin	Annual

Objective		Strategy		Expected outcomes	Spatial Scale	Project duration
		5B3	Determine the seasonal movement patterns of adult and sub-adult migratory bull trout. This action would include bull trout which use different habitat types, including the mainstem Snake River. This information is necessary to	Provide determinations of how bull trout from the Imnaha-Snake Rivers Recovery Unit are related to each other as well as other bull trout populations in Snake River watersheds.	Imnaha Recovery Unit	10 years (annual ongoing)
		5B4	Evaluate food web interactions. This action is most pertinent to areas affected by introduced fishes, such as the lower Imnaha River.	Assess the degree to which introduced species prey upon juvenile bull trout	Recovery Unit	10 years
5D	Develop and conduct research and monitoring to improve information concerning the distribution and status of bull trout.	5D1	Determine life history requirements. Local resident and migratory bull trout populations both exist in the recovery unit and may have different requirements.	Enable determinations of habitat importance	Recovery Unit	10 years
		5D2	Investigate the relationship between bull trout and anadromous species.	Establish predator-prey interactions; Evaluate the dependence of bull trout on anadromous prey.	Imnaha Recovery Unit	10 years
		5D4	Compare weak and strong populations.	Refine our understanding of limiting factors and the degree they effect discrete bull trout populations	Imnaha subbasin (bull trout CHSUs)	10 years

Objective		Strategy		Expected outcomes	Spatial Scale	Project duration
5E	Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.	5E1	Determine the consequences of genetic fragmentation and isolation	Define the importance of maintaining/establishing connectivity between discrete bull trout populations/CHSUs	Sixth field HUC	5 years
		5E2	Investigate use of the mainstem Snake River by bull trout from the Imanaha core area	Improved ability to manage bull trout populations in the Imnaha Recovery Unit	Imnaha Recovery Unit	10 years
12A	Conduct research, monitoring, and evaluation to identify and address point and non-point pollutant sources and to determine associated impacts upon various life history stages of aquatic focal species	12A3	Assess pollutant effects on focal species	Determine the degree to which identified thermal and chemical pollutants may be affecting the various life history stages of focal species.	Watershed	5 years
13A	Increase knowledge of terrestrial communities	3	Continue existing and expand research on the population dynamics, habitat requirements and Key Environmental Correlates (KEC) of the terrestrial species of the Imnaha subbasin, focus efforts on focal, ESA listed and sensitive species.	Increased understanding of species requirements and improved management	subbasin and surrounding areas	life of management plan
		4	Continue existing and expand research on processes such as fire regimes, hydrology, plant community dynamics etc. that influence the terrestrial communities of the subbasin	Increased understanding of disturbance regimes and habitat requirements	subbasin and surrounding areas	life of management plan

Objective		Strategy		Expected outcomes	Spatial Scale	Project duration
		5	Continue existing and expand research on the biotic interactions and Key Ecological Functions (KEF) of the terrestrial communities of the subbasin (e.g. big game-livestock interactions)	Increased understanding of biotic interactions and KEFs	subbasin and surrounding areas	life of management plan
14B	Restore areas where grasslands have been degraded	1	Research native grassland restoration methods--explore techniques for effectively restoring grassland habitats.	Improved ability to restore degraded grasslands	grassland habitats	until effective techniques are developed
17A	Maintain and enhance the existing quality, quantity and diversity of native plant communities providing habitat to native wildlife species by preventing the introduction, reproduction, and spread of noxious weeds and invasive exotic plants into and within the subbasin.	3	Research innovative techniques for reducing the spread of noxious weeds/invasive plant species and reducing established populations.	Improved ability to combat noxious weeds and invasive plant species	subbasin wide	until effective techniques are developed
18A	Restore the composition, structure, and density of forests to within the historic range of variability (HRV).	3	Continue research into innovative and cost effective techniques for restoring the composition, structure and density of forested habitats to a more natural condition.	Improved ability to manage forest structure and provide habitat to native wildlife	forest habitats	until effective techniques are developed
20A	Restore natural nutrient input cycles and mitigate for damages to aquatic	1	Assess nutrient inputs and cycling in the Imnaha subbasin. Where appropriate, consider carcass additions or other innovative approaches to restore nutrient recycling.	Improved understanding of natural nutrient cycles	areas of reduced anadromous fish run	until effective techniques are developed

Objective		Strategy	Expected outcomes	Spatial Scale	Project duration
and terrestrial populations due to the loss of these nutrients.	2	Research restoration practices--Investigate innovative methods to restore nutrient loading to upland areas similar to those currently used to restore nutrient loads to streams.	More natural nutrient cycles Improved ecosystem function	areas of reduced anadromous fish run	until effective techniques are developed
	3	Research the impacts of fuel load reduction activities on nutrient input and cycling processes.	Improved understanding of fuel load in nutrient cycling processes	Areas where fuel load reducing activities are employed	Until sufficient understanding is achieved

4.3 Terrestrial Data and Information Gaps

The following list(s) include specific data and information gaps defined by the Aquatic and Terrestrial Technical Teams needed for management within the Imnaha subbasin (Table 8). Data and information gaps represent a hindrance to effective management of the fish and wildlife resources of the subbasin. In most cases these gaps are in the basic understanding of species or habitat distribution, condition and trends. While it would be possible and probably worthwhile to develop research projects focused on closing many of these data gaps, in general they do not fit the criteria of a classic research need. For each data gap the technical teams identified potential, generalized methods for collecting data to address data and information gap. Specific methods to be used will necessarily be defined in individual project proposals to account for spatial scales, temporal and monetary restrictions, and specific goals of the proposed work.

Table 8. Data gaps and associated methods and outcomes for terrestrial focal species

Objective		Strategy		Potential Methods[1]	Outcomes
13A	Increase knowledge of terrestrial communities	1	Collect data--develop a survey program and database for terrestrial focal, ESA listed, and sensitive species within the subbasin and surrounding areas	Adhere to established species specific survey protocols and work with experts to develop appropriate survey methodologies when no protocol is available	Improved management and conservation of plant and animal populations
		2	Increase documentation--Support the efforts of the Oregon Natural Heritage Program to document the occurrence of rare species and work toward increased reporting of sightings	Relational databases (e.g. Microsoft Access and GIS); appropriate Oregon Natural Heritage reporting forms	Increased knowledge of the distribution of rare plant and animal species in Oregon and improved management abillity
14A	Maintain grassland quality, condition, and composition	1	Inventory and map the location of grassland communities in a mid-late seral condition.	Field surveys, GIS, satellite imagery and aerial photo interpretation	Increased ability to preserve and study intact grassland habitats and associated species
14B	Restore areas where grasslands have been degraded	2	Prioritize areas for grassland restoration. Consider expected biological response, and cost effectiveness in prioritization process.	GIS, field surveys, patch size, habitat connectivity, cost-benefit considerations	Increased biodiversity and increased habitat available to grassland associated species
15A	Maintain and enhance mature ponderosa pine habitats.	1	Continue efforts to inventory and map existing mature ponderosa pine habitats	Satellite imagery and aerial photo interpretation, field surveys, basal area, canopy cover	Effective management of ponderosa pine habitats and their associated species
16A	Maintain currently functioning wetlands and restore degraded wetlands.	1	Finalize, digitize and ground truth National Wetlands Inventory maps for the subbasin, develop restoration priorities and assess wetland functionality (rely upon work completed by the USFWS, SWCD, NRCS and cooperators).	Hydric soils maps, aerial photos, NWI, PFC ratings	Biodiversity and increased habitat available to wetland associated species
17A	Prevent the introduction, reproduction, and spread of noxious weeds and invasive exotic plants	2	Fund and support efforts to map noxious weed locations and areas with a high risk of invasion.	GIS, satellite imagery and aerial photo interpretation, field surveys, invasive species biology, and sight topography and climate	Increased effectiveness at controlling the spread of invasive plants and protecting important wildlife habitats

18A	Restore the composition, structure, and density of forests to within the historic range of variability.	1	Continue and refine efforts to identify and map the historic range of variability of in the vegetative communities of the subbasin.	Fire scar inventories, historic photos, scientific research on successional and disturbance processes	Increased understanding of historic conditions and disturbance regimes. Improved management ability.
		2	Continue efforts to map and inventory current vegetative conditions including existing old growth and potential old growth areas.		
19A	Reduce the impact of the transportation system on wildlife and fish populations and habitats.	2	Conduct a subbasin wide transportation system analysis of the roads system of the Imnaha subbasin. Recommend for decommissioning, relocation or reconstruction roads not critical for transportation, recreation and land management activities which most negatively impact terrestrial and/or aquatic habitats. Consider relocation, reconstruction or the addition of erosion control structures to necessary roads having negative impacts on fish and wildlife populations. Assess fish passage and make culvert removal or improvement recommendations.	Road use type and rates, road failure rates, erosion rates, wildlife security areas, locations and seasons of vulneable wildlife,fish distibutions, areas of stream confinement, problem culverts…	Reduced impact of roads on fish and wildlife habitats and populations

1 Appropriate methods for data collection are project and site specific and new methods are continually eing developed. These are some currently accepted methods of data collection but method selection should be a part of the project proposal process.

4.4 Monitoring and Evaluation

4.4.1 Aquatic M&E

Aquatic research, monitoring and evaluation (M&E) needs have been identified for the Imnaha subbasin through the input from a wide range of stakeholders and professionals who are most familiar with the logistical needs in their areas.

The information provided in the aquatics M&E section considers taking both a 'bottom-up' and 'top-down' approach. The bottom-up approach is in accordance with the initiative provided two years ago in the *Technical Guidance for Subbasin Planners* (NPCC 2001), and specifically treats M&E at the project scale, for example, in support of individual habitat projects. The top-down approach is recognized to be a critical component of M&E efforts at the regional or programmatic level, as it examines monitoring questions now being asked at large-scale landscape and ecosystem levels and has been called for in the Federal Salmon Recovery Strategy and the Implementation Plan of the Action Agencies addressing the NOAA-Fisheries Biological Opinion (Biological Opinion) on the Federal Columbia River Power System (FCRPS). (Note: the Action Agencies are Bonneville Power Administration, the Army Corps of Engineers, and the Bureau of Reclamation).

The aquatics M&E section follows guidelines provided in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP 2004). The PNAMP represents a group whose mission is to coordinate between project-specific and regional M&E efforts to establish the most effective system design and application needed to accomplish objectives at both levels. Several assumptions are built into the guidance document, which are also applicable to the Imnaha M&E section (PNAMP 2004)

1. Monitoring and evaluation coordination and implementation will be an ongoing activity at the reach, subbasin, and regional levels.

2. Monitoring that is proposed will be more effective if it fits within a broader programmatic network of status monitoring programs and intensively monitored watersheds.

3. It is assumed that local, bottom-up approaches developed within the Imnaha will have higher likelihood for successful funding and meaningful results if they reflect the approaches being developed within the comprehensive state, tribal initiatives, and federal pilot projects (Wenatchee, John Day, and Upper Salmon), and the top-down framework and considerations being developed by PNAMP.

Using a checklist developed for the Council's Independent Scientific Advisory Board (ISAB) and the Independent Scientific Review Panel (ISRP) review of subbasin plans, the PNAMP (2004) suggests planners consider the inclusion of 1) Monitoring Objectives, 2) Monitoring Indicators, 3) Data and Information Archive, 4) Coordination and Implementation, and 5) Evaluation and Adaptive Management in their M&E component. These considerations are presented below.

4.4.1.1 Monitoring and Evaluation Objectives and Indicators

The Imnaha aquatics technical team (IATT) used the subbasin assessment, information provided in Section 5.2.1 of this document (Problems, Objectives, and Strategies), and information provided in the Collaborative Systemwide Monitoring and Evaluation Project (CBFWA 2004) for guidance, but largely structured the following section using information provided in the Monitoring and Evaluation Plan For Northeast Oregon Hatchery Imnaha and Grande Ronde Subbasin Spring Chinook Salmon (Hesse and Harbeck 2004), and information provided in Monitoring and Evaluation Framework for Northeast Oregon Hatchery Imnaha and Grande Ronde Subbasin Steelhead (Hesse et al. 2004 *in review*) to develop a list of measurable objectives and indicators to address subbasin-level questions about factors defining the condition of the watersheds and associated salmon and steelhead populations.

Hesse and Harbeck (2004) and Hesse et al. (*in review*) was used extensively in the development of the Imnaha aquatic M&E objectives and indicators since the work provides a format that (1) is specific to the Imnaha, (2) coordinates an array of monitoring and evaluation activities, (3) fits within a regional framework, and (4) results in information with broad applicability. Hesse and Harbeck (2004) and Hesse et al. (*in review*) also draws from federal, state, tribal, academic and independent sources for monitoring and evaluation recommendations and statistical council.

Limitations of structuring the M&E section by using Hesse and Harbeck (2004) and Hesse et al. (*in review*) include the omission of M&E specific to fall chinook, bull trout, and Pacific lamprey. Also, because Hesse and Harbeck (2004) and Hesse et al. (*in review*) were developed as a part of The Northeast Oregon Hatchery (NEOH) program, their primary intent is to guide evaluation of the NEOH program, give empirical evidence of effects and fill knowledge gaps regarding supplementation and its uncertainty as an enhancement tool.

Despite their focus on only two of the five focal species, the spring/summer chinook and steelhead M&E plans developed by Hesse and Harbeck (2004) and Hesse et al. (*in review*) provide a solid, statistically-based foundation from which additional M&E plans can be derived, represent an M&E effort that is regionally applicable, and have received recent favorable review by the ISRP (2004).

The information presented below represents only a portion of that which is provided in the NEOH M&E plans, but includes that which is pertinent to all five focal species (i.e. fall chinook, bull trout, and Pacific lamprey) and to M&E needs identified in the assessment and Section 5.2.1 of this document (Problems, Objectives, and Strategies). The reader is therefore encouraged to review Hesse and Harbeck (2004) and Hesse et al. (*in review*) for an in-depth review of the NEOH production program, a description of the researchers' approach to monitoring and evaluation, and detailed methodology sections.

The following section is structured as follows:

Monitoring Question
MANAGEMENT OBJECTIVE
Monitoring and Evaluation Objective
Hypotheses or Descriptive Monitoring Attributes

Performance Measures Required
Statistical Tests Applied
Duration/frequency
Spatial Scale of Application

Monitoring Questions:

As suggested in the PNAMP (2004) guidance document, management goals and the measurable monitoring objectives are based on a series of monitoring questions that define specific M&E problems. The monitoring questions address six key variables, including 1) Abundance, 2) Survival/Productivity, 3) Distribution, 4) Genetics, 5) Life History, and 6) Habitat.

1. How is the annual abundance and distribution of Imnaha/Big Sheep spring chinook (IRMAI and IRBSH, respectively), Snake River fall chinook (SNMAI), Imnaha summer steelhead (IRMMT-s), and Imnaha bull trout populations and associated life history stages changing over time within the subbasin?

2. How is freshwater productivity (e.g., smolt/female) and survival (e.g., SAR) of IRMAI, IRBSH, SNMAI, and IRMMT-s fish populations affected by hatchery practices?

3. What is the fraction of potential natural spawners that are of hatchery origin?

4. Is there genetic differentiation between Imnaha fall chinook and Snake River Fall chinook?

5. What is the age-structure of IRMAI, IRBSH, SNMAI, IRMMT-s, and Imnaha bull trout populations?

6. How does habitat condition affect productivity of various life history stages of focal populations?

7. What are the overall impacts of human related activities on freshwater habitat and landscape processes within the subbasin?

Management Objectives and Assumptions:

The following management objectives/assumptions are based on the previous questions, and address the same key variables. For each Management Objective determining whether the assumptions are met (valid) requires expression of the assumption in quantifiable terms.

MANAGEMENT OBJECTIVE 1: UNDERSTAND THE CURRENT STATUS, TRENDS, AND DISTRIBUTION OF IRMAI, IRBSH, SNMAI, IRMMT-s, and IMNAHA BULL TROUT [NATURAL] POPULATIONS IN THE IMNAHA

Assumptions:

A. In-basin habitat is stable and suitable for focal species production
B. We can describe juvenile production in relationship to available habitat in each population and throughout the subbasin.
C. We can describe annual (and 8-year geometric mean) abundance of natural-origin adults relative to management thresholds (minimum spawner abundance and ESA delisting criteria) within prescribed precision targets.
D. Adults utilize all available spawning habitat in each population and throughout the subbasin.
E. The relationships between life history diversity, life stage survival, abundance and habitat are understood.

MANAGEMENT OBJECTIVE 2: ASSESS, MAINTAIN, AND ENHANCE NATURAL PRODUCTION AND SURVIVAL OF FOCAL SALMONID POPULATIONS IN SUPPLEMENTED STREAMS WITHIN THE IMNAHA

Assumptions:

A. Progeny-to-parent ratios for hatchery-produced fish significantly exceeds those of natural-origin fish.
B. Natural reproductive success of endemic hatchery-origin fish must be similar to that of natural-origin fish.
C. Spatial distribution of endemic hatchery-origin spawners in nature is similar to that of natural-origin fish.
D. Abundance and spatial distribution of non-endemic hatchery-origin spawners in nature is limited.
E. Productivity of supplemented populations is similar to productivity of populations if they had not been supplemented.
F. Life stage-specific survival is similar between hatchery and natural-origin population components.

MANAGEMENT OBJECTIVE 3: ASSESS LIFE HISTORY CHARACTERISTICS AND MAINTAIN GENETIC DIVERSITY IN SUPPLEMENTED AND UNSUPPLEMENTED FOCAL POPULATIONS IN THE IMNAHA

Assumptions:

A. Adult life history characteristics in supplemented populations remains similar to pre-supplementation population characteristics.
B. Temporal variability of life history characteristics in supplemented populations remains similar to unsupplemented populations (assumes robust wild population dynamics).
C. Juvenile life history characteristics in supplemented populations remains similar to pre-supplemented population characteristics.
D. Genetic characteristics of the supplemented population remain similar (or improved) to the unsupplemented populations.

MANAGEMENT OBJECTIVE 4: Understand the current status and trends of HABITAT CONDITIONS AS THEY RELATE TO FOCAL SPECIES STATUS in the Imnaha

Assumptions:

A. The relationships between focal species use and habitat are understood

B. In-basin habitat is stable and suitable for focal species production

C. We can describe juvenile production in relationship to available habitat in each population and throughout the subbasin

MANAGEMENT OBJECTIVE 5. ASSESS THE EFFECTIVENESS OF RESTORATION ACTIVITIES AND OTHER HUMAN RELATED ACTIVITIES ON FOCAL SPECIES HABITAT CONDITION

Assumptions:

A. Habitat conditions in wilderness reaches (*e.g.*, Eagle Cap) are representative of an unmanaged system and can be used comparatively between streams sharing similar physical characteristics

B. Determination of restoration activity effectiveness and/or human-related disturbance on aquatic habitats are indicative of biological production potential of a given focal species

Monitoring and Evaluation Objectives:

The management assumptions form the basis of the Monitoring and Evaluation Objectives. Testable hypotheses or descriptive measures are then identified. Key and associated performance measure(s) to be quantified are then described. The KPMs and associated spatial scale, required/desired precision, and sampling frequency/duration are presented in Table 9.

Objectives and strategies, as defined in Section 5.2.1, and pertinent focal species are included in parenthesis in the Monitoring and Evaluation Objective header. To maximize incorporation of the five subbasin focal species, verbiage presented in Hesse and Harbeck (2004) and Hesse et al. (*in review*) has been selectively incorporated, and/or revised.

Table 9. Summary of key performance measures in relation to spatial scale, required precision, frequency of sampling, and linkage to monitoring objectives and objectives/strategies defined in Section 5.2.1.

	Performance Measure	Spatial Scale	Required Precision[1] (CV)	Desired Precision[1] (+/- 95% CI)	Frequency/ Duration	Monitoring Objective Link
Abundance	Adult Escapement to Snake Basin	Subbasin-wide			Annual	
	Fish per Redd	Primary Aggregates			Annual – ongoing	1b, 2a, 2b
	Adult Spawner Abundance	Primary Aggregates			Annual – ongoing	2a
	Index of Spawner Abundance (redd counts)	Subbasin-wide and Primary Aggregates			Annual – ongoing	1b, 2a
	Hatchery Fraction	Primary Aggregates			Annual – ongoing	2a, 2b
	Harvest	Key Areas			Annual	2a
	Index of Juvenile Abundance (Density)	Subbasin-wide			Annual	1a
	Juvenile Emigrant Abundance	Primary Aggregates			Annual	1a, 2c
	Hatchery Production Abundance	Key Areas			Annual	2a
	Smolt Equivalents	Primary Aggregates			Annual	2a, 2c
	Run Prediction	Key Areas			Annual, ongoing	
Survival-Productivity	Smolt-to-Adult Return Rate	Subbasin-wide and Key Areas			Annual	2c
	Parent Progeny Ratio (lambda, adult-to-adult)	Subbasin-wide and Key Areas			Annual for at least 10 years intervals	2a
	Recruit/spawner (smolt per female or redd)	Primary Aggregates			Annual	2a
	Pre-spawn Mortality	Key Areas			Annual	2a
	Juvenile Survival to Lower Granite Dam	Primary Aggregates			Annual	2c
	Juvenile Survival to Mainstem (McNary and Bonneville) Dams	Subbasin-wide			Annual	
	In-hatchery Life Stage Survival	Key Areas			Annual	
	Post-release Survival	Key Areas			Annual	2c
Di	Adult Spawner Spatial Distribution	Subbasin-wide			3-5 year cycle	1c

	Performance Measure	Spatial Scale	Required Precision[1] (CV)	Desired Precision[1] (+/- 95% CI)	Frequency/ Duration	Monitoring Objective Link
	Stray Rate	Key Areas			Annual	
	Juvenile Rearing Distribution	Subbasin-wide			Annual (5 year cycle)	1a
	Disease Frequency	Primary Aggregates			Annual, Event Triggered	
Genetic	Genetic Diversity	Subbasin-wide and Key Areas			Small-scale Study (5 years)	3a
	Reproductive Success (Parentage)	Key Area			Small-scale Study (5 years)	2c
	Gene Conservation (Cryopreservation)	Primary Aggregates			Annual (5 + year cycle)	
Life History	Age–at–Return	Primary Aggregates			Annual - ongoing	2a, 3b
	Age–at-Emigration	Primary Aggregates			Annual	3c
	Size-at-Return	Primary Aggregates			Annual	3b
	Size-at-Emigration	Primary Aggregates			Annual	3c
	Condition of Juveniles at Emigration	Primary Aggregates			Annual – ongoing	3c
	Adult Spawner Sex Ratio	Primary Aggregates			Annual - ongoing	2a, 2b, 3b
	Fecundity	Key Areas			Annual	2b, 3b
	Adult Run-timing	Key Areas			Annual	3b
	Spawn-timing	Key Areas			Annual	2b
	Juvenile Emigration Timing	Primary Aggregates			Annual	3c
	Mainstem Arrival Timing (Lower Granite)	Subbasin-wide			Annual	3c
Habitat	Physical Habitat	Subbasin-wide and Key Areas			Every three years	4a
	Stream Network	Subbasin-wide			10yrs	
	Passage Barriers/Diversions	Subbasin-wide			5 yrs	
	Instream Flow	Subbasin-wide and Key Areas			Continual (5 plus year cycle)	4a
	Water Temperature	Subbasin-wide and Key Areas			Continual (5 year cycles), Event Triggered	4a
	Chemical Water Quality	Subbasin-wide			Continual, 3 years	

	Performance Measure	Spatial Scale	Required Precision[1] (CV)	Desired Precision[1] (+/- 95% CI)	Frequency/ Duration	Monitoring Objective Link
	Macroinvertebrate Assemblage	Subbasin-wide			5 years	
	Fish and Amphibian Assemblage	Subbasin-wide			5 year	

[1] Prescription of the required/desired precision is being developed as part of the final M&E plan Step 3 submittal based on observed annual variability, five year evaluation cycles, and number of replicates associated with each performance measure needed to detect biologically/management significant change. Currently used recommendations generally identify CV's of 15 and 25% (Jordan et al. 2002). However these have been established through EMAP type projects on the bases of the number feasible sample size/replication (i.e. 50 sample site). Required precision is related to ability to detect change, whereas desired precision compares population status with management thresholds.

MANAGEMENT OBJECTIVE 1: UNDERSTAND THE CURRENT STATUS, TRENDS, AND DISTRIBUTION OF NATURAL IRMAI, IRBSH, SNMAI, IRMT-S, AND IMNAHA BULL TROUT POPULATIONS IN THE IMNAHA.

Monitoring and Evaluation Objective 1a. Describe status and trends in juvenile abundance at the population and subbasin scales in the Imnaha (1A,

H_1 - Descriptive: Characterize parr densities over time for the Imnaha subbasin.

H_2 - Descriptive: Characterize smolt production over time in index production areas.

Key performance measures:

- parr densities
- juvenile emigrant abundance

Statistical Tests Applied: Data analysis will involve calculating the percentage of survey sites that contain at least one juvenile fish for each focal species and the percentage of pools per site that contain juvenile fish for each focal species to quantify changes in the relative distribution inter-annually. We will quantify the number of juveniles observed per square meter for use in population trend analysis within and among individual subbasins. Confidence limits for summary estimates will be developed based on quantifying the measurement error in the survey data and site-to-site variability based on a variance estimator developed by the EPA Environmental Monitoring and Assessment Program (EMAP) for this application (*refer to* http://www.epa.gov/nheerl/arm/).

Duration/Frequency: Monitoring of juvenile emigration will occur continually over time by emigrant trapping in key production streams.

Spatial Scale: Subbasin-wide

Monitoring and Evaluation Objective 1b. Describe status and trends in adult abundance and productivity for all focal populations in the Imnaha subbasin (1A2, 1A4, 2A3, 3A, 3A2, 4B, 5A3, 8B3; all focal species except Pacific lamprey).

H_1 - Descriptive: Trend in adult abundance over time.

H_2 - Descriptive: Monitor survival rates and abundance relative to management and conservation thresholds.

Key performance measures:

- adult abundance (weir, mark- recapture, and redd count combinations)
- derived measures of productivity (Lambda; based on annual and 8-year geometric means of minimum spawner escapement thresholds and ESA recovery criteria)

Statistical Tests Applied: We will apply data of time series abundance to the Diffusion Approximation Model (also called a Wiener-Drift process model) to evaluate population viability. The DA model has been recommended for use when analyzing time series data regarding abundance (Dennis et al. 1991, Holmes 2001, Holmes and Fagan 2002).

Spatial Scale: Subbasin-wide and primary aggregates (*e.g.*, IRMAI, IRBSH, SNMAI, IRMMT-s, and Imnaha bull trout populations)

Monitoring and Evaluation Objective 1c. Monitor focal species spawning distributions in the Imnaha subbasin (5A, 4B2, 4E5; all focal species except Pacific lamprey).

H_1 - Descriptive: Spatial distribution of adult spawners over time.

Key performance measure:

- redd distribution

Statistical Tests Applied: The development of an EMAP- type probabilistic sampling scheme for redd counts will complement current survey efforts. Twenty-five random sites outside the traditional survey areas will be selected. Each site will be 1 km in length. Survey style will be based on protocols and methods used during traditional surveys employed in the subbasin.

Frequency/Duration: 3-5 year cycle

Spatial Scale: Subbasin-wide

MANAGEMENT OBJECTIVE 2: ASSESS, MAINTAIN, AND ENHANCE NATURAL PRODUCTION AND SURVIVAL OF FOCAL SALMONID POPULATIONS IN SUPPLEMENTED STREAMS WITHIN THE IMNAHA

Monitoring and Evaluation Objective 2a: Determine and compare the productivity of hatchery-origin fish and natural-origin fish in Imnaha (2A, 2B, 3A, 3A2, 5A3, 8A2, 8B3; all focal species).

Ho_1: Progeny-per-parent ratio of hatchery-origin fish over time is equal to that of natural-origin fish for each stream.

Ha_1: Progeny-per-parent ratio of hatchery-origin fish over time is greater than that of natural-origin fish for each stream.

Ho_2: Progeny-per-parent ratio is equal between streams (or the levels of supplementation intensity) regardless of fish type (hatchery vs. natural-origin fish).

Ha_2: Progeny-per-parent ratio is significantly different between streams (or the levels of supplementation intensity) regardless of fish type (hatchery vs. natural-origin fish).

Ho_3: Progeny-per-parent ratio of hatchery-origin fish is the equal to that of natural-origin fish across streams (or the levels of supplementation intensity).

Ha_3: Progeny-per-parent ratio of hatchery-origin fish is significantly different from that of natural-origin fish across streams (or the levels of supplementation intensity).

Key performance measures:

- progeny-per-parent ratio (P:P). Calculation of P:P relies on annual run reconstructions and requires quantification of adult abundance to tributary (escapement), index of spawner of abundance (redd counts), spawner abundance (spawner), fish per redd, hatchery fraction, age class structure, age-at-return, adult spawner sex ratio, prespawning mortality, and in-tributary harvest. Progeny are quantified through run-reconstruction. Natural fish P:P use two variants of parents; estimated escapement and spawners. Hatchery P:P are generated from the number of parents collected for broodstock by brood year and resulting hatchery returns to the parent stream. P:P ratio will be calculated for total adult contribution (adult-to-adult) and by female contribution (female-to-female).

Statistical Tests Applied: Testing of results for significantly greater rate by hatchery-origin fish applies a pair-wise one-tail t-test comparison of hatchery P:P to natural P:P by brood year (cohort) within each tributary over time. Time (year) plays a role of 'pair'. Characterization of result variability over time within each stream utilizes replication over 5 years periods.

We also desire to test across streams (or the levels of supplementation intensity). In this case, we are interested in testing additional null hypotheses. In testing these hypotheses, we check the main effect of stream, whereas in testing the second hypotheses, we first check the interaction term between stream and fish type. Graphically, the second null hypothesis says that P:P ratio of hatchery fish over streams is parallel to that of naturally produced fish. Years are replicates. To test these hypotheses at the same time, two-factor analysis of variance (ANOVA) is appropriate, where two factors are fish type (hatchery fish vs. naturally produced fish), and stream (or the level of supplementation intensity).

We will test at 5% Type I error (i.e. $\alpha = 0.05$), and show the p-value of test statistic. If the p-value is less than the level of Type I error, we will reject null hypothesis.

Frequency/Duration: Annual – ongoing. Monitoring of P:P ratios is a long-term process which should continue until the program achieves equal or stable performance for two complete generations (assumption of consistent program operations). Changes in hatchery program operations must be accompanied by monitoring of P:P ratios.

Spatial Scale: Primary Aggregates

<u>Monitoring and Evaluation Objective 2b:</u> Determine and compare relative reproductive success of hatchery and naturally produced focal species (3A, 5A4, 4E4; all salmonid focal species**) .**

Ho_1: Reproductive success of naturally spawning hatchery fish is equal to that of naturally produced fish.
Ha_1: Reproductive success of naturally spawning hatchery fish is significantly different than that of naturally produced fish.

Ho_2: Mate choice is random with respect to parentage of individual fish (i.e., wild, conventional and captive brood stock).
Ha_2: Mate choice with respect to parentage of individual fish is selective and is significantly different.

Ho_3: Selection gradients are the same in the hatchery and the wild and do not differ between sexes nor between hatchery- and naturally-produced fish.
Ha_3: Selection gradients are significantly different for hatchery and natural origin fish between sexes.

Ho_4: Interfamily variance in reproductive success is so great that it is not possible to make meaningful conclusions about specific selective factors and the quantitative genetic interactions between hatchery and wild components of these supplemented populations. Preliminary results indicate that although variance is large, effect sizes can also be large.
Ha_4: Interfamily variance can be accounted for relative to effect size.

<u>Key performance measures:</u>

- The relative proportion of offspring produced per parent by origin.
- Supporting performance measures include adult abundance to tributary, hatchery fraction, age-at-return, adult spawner sex ratio, fecundity (by age and size), and spawn-timing (by origin).

<u>Statistical Tests Applied:</u> Probabilistic approaches that explore the likelihood of each possible parentage assignment and establish statistical criteria for accepting the true parent (*e.g.*, Cervus 2.0, Marshall et al. 1998).

<u>Frequency/Duration:</u> Annual – ongoing. Performance should be monitored for at least two complete generations and replicated annually three to five year.

<u>Spatial Scale:</u> Primary aggregates.

<u>Monitoring and Evaluation Objective 2c:</u> Determine and compare life-stage specific survival rates for hatchery and natural fish in the Imnaha (2A, 2A3, 2B, 4E5, 5A3, 8A2, 8B3; all focal species**)**

Ho_1: There is no difference in survival rate of smolts from the tributary to Lower Granite Dam between hatchery produced fish and naturally produced fish over time for each stream.

Ha_1: There is a significant difference in survival rate of smolts from the tributary to Lower Granite Dam between hatchery produced fish and naturally produced fish over time for each stream.

Ho_2: There is no difference in smolt-to-adult return rate between hatchery fish and naturally produced fish over time for each stream.

Ha_2: There is a significant difference in smolt-to-adult return rate between hatchery fish and naturally produced fish over time for each stream.

Descriptive: Base line monitoring of life stage specific survival for trends over time.

Key performance measures:

- juvenile emigrant survival to Lower Granite Dam
- smolt-to-adult return rate (SAR) for natural-origin fish and hatchery produced fish within each tributary.

Statistical Tests Applied: Testing of results for significant differences in survival rates between hatchery and natural production within streams/subbasin annually and over five year periods. Juvenile survival estimates generated by the SURPH.2 model include a point estimate and associated variance. SAR estimates will be point estimates with no associated variance descriptor. When we compare two samples by year, the paired t-test is appropriate.

A χ^2 contingency table analysis is performed to test the null hypothesis that detection rates are the same for all populations (Zar 1984, equation 6.1). If detection rates differ, a Tukey-type multiple comparison on transformed proportions is used to determine which populations differ (Zar 1984, equation 22.13). Survival probabilities are compared between populations using the modeling and hypothesis testing capabilities of SURPH 2.1. Candidate models are compared by the likelihood ratio test, and Akaike's information Criterion (AIC).

We will test at 5% Type I error (i.e. $\alpha = 0.05$), and show p-value of test statistic. If the p-value is less than the level of Type I error, we will reject null hypothesis.

Frequency/Duration: Annual

Spatial Scale: Primary Aggregates

MANAGEMENT OBJECTIVE 3: ASSESS LIFE HISTORY CHARACTERISTICS AND GENETIC DIVERSITY IN SUPPLEMENTED AND UNSUPPLEMENTED FOCAL POPULATIONS IN THE IMNAHA

Monitoring and Evaluation Objective 3a. Determine and compare genetic characteristics of hatchery and natural fish in the Imnaha subbasin (2B1, 2B2, 3A, 4E, 4E1, 5A, 5A1, 5A3, 5A4, 5B3; all salmonid focal species)

Ho_1: There are no genetic differences between hatchery populations and natural populations they were derived from.
Ha_1: Significant genetic differences exist between hatchery and natural population segments they were derived from.

Ho_2: Populations that have been supplemented show the same magnitude of genetic change over time as unsupplemented populations.
Ha_2: The magnitude of genetic change over time has been altered in supplemented populations.

Ho_3: The relationship between N_e and N is the same in hatchery and natural populations.
Ha_3: The relationship between N_e and N is significantly reduced for hatchery and natural populations.

Ho_4: Non-target wild populations have not been genetically affected by hatchery strays.
Ha_4: Non-target wild populations have been genetically altered by hatchery strays.

Key performance measures:

- Measure levels of genetic variability in each population: Genetic variability within populations will be evaluated in a number of different ways. Comparisons of variability in hatchery, natural, and wild populations will be made and changes in levels of variability will be evaluated through time. Observed variability will also be compared.
- Estimate effective population size (N_e) and the ratio N_e/N for each population--Fixation indices and gametic disequilibrium will be used to estimate and evaluate the relationship between effective population size and census size (N) estimated from redd counts, spawner surveys, and population enumeration.
- Evaluate population genetic structure of natural and wild populations--Fixation indices and hierarchical gene diversity analyses will be used to partition genetic variation into spatial and temporal components. These relationships will be used to estimate levels of gene flow among populations.
- Document selective forces and genetic effects of supplementation on target and non-target populations--Indices of genetic differentiation will be calculated between hatchery and natural, and hatchery and wild populations. Patterns of genetic change will be examined through time in the three classes of populations.

Statistical Tests Applied: Electrophoretic phenotypes visualized on starch gels are interpreted as genotypes according to guidelines discussed by Utter et al. (1987). A chi-square test is used to compare genotypic frequencies at each variable locus in each population with frequencies expected under Hardy-Weinberg equilibrium. This test can be useful in detecting artifactual (nongenetic) variation. The method of Waples (1988) is used to evaluate genotypes and estimate allele frequencies at isoloci (duplicated gene loci). A variety of standard statistical analyses are routinely applied to the data (e.g., computing heterozygosity, gene diversity, number of alleles per locus, genetic distances, and *F*-statistics; testing for heterogeneity of allele frequencies among populations).

In addition to these analyses, a number of more specialized analyses are used to estimate effective population size. As the primary goal of this project is to study genetic changes over time in natural and wild populations resulting from supplementation, it is necessary to consider factors other than hatchery-wild genetic interactions that can lead to genetic change. Because supplementation is typically considered only when natural abundance is low, the effects of random genetic drift due to finite population size must be considered in evaluating observed genetic changes. Our methods for estimating effective population size include the following:

Quantifying allele frequency change. The statistic used to measure the magnitude of genetic change is $\hat{F} = (P_1 - P_2)^2 / [(\bar{P}(1 - \bar{P})]$, where P_1 and P_2 are allele frequencies in samples taken at two different times and is the mean of P_1 and P_2. $\hat{F}$ is computed for each gene locus surveyed, and a mean $\hat{F}$ over all loci in a comparison of temporally spaced samples is also computed.

Testing for selection. Although there is a body of evidence suggesting that the enzymatic gene loci sampled by electrophoresis in general are largely unaffected by natural selection, it is important to evaluate this assumption because strong selection would complicate the interpretation of changes within populations and interactions between populations. If the loci used are effectively neutral, they all should be affected by genetic drift to approximately the same degree. The method of Lewontin and Krakauer (1973) will be used to test the hypothesis that the variance of single locus values is no larger than expected from random sampling error. DNA sequence data will be subjected to additional tests of neutrality, including non-synonymous to synonymous substitution rates and others (reviewed by Ford 2002).

Measuring gametic disequilibrium. The statistic r^2, the squared correlation of alleles at different gene loci, are computed for each pair of loci in each sample. The overall mean r^2 value is a measure of gametic disequilibrium, or non-random associations across loci.

Estimating N_b. After omitting any loci identified by the test for selection, the mean value (computed as in #1) is used to estimate N_b, the effective number of breeders each year. The procedure follows the "temporal method" for estimating effective population size (Krimbas and Tsakas 1971; Nei and Tajima 1981; Waples 1989), as modified specifically for Pacific salmon (Waples 1990).

Because $\hat{F}$ is known to be distributed approximately as chi-square, confidence limits can be placed on the estimate of N_b. The mean value of r^2 provides an independent method for estimating N_b, based on the method developed by Hill (1981), and confidence limits can also be placed on this estimate.

Frequency/Duration: Annual (5-year cycle)

Spatial Scale: Primary aggregates; Subbasin-wide; Key areas

Monitoring and Evaluation Objective 3b. Determine and compare adult life history characteristics between hatchery and natural fish in the Imnaha subbasin (3A2, 4E4, 8A2; all focal species)

Ho_1: There is no difference in adult age-at-return structure over time between hatchery and natural fish within each supplemented population.

Ha_1: There is a significant difference over time in adult age-at-return structure between hatchery and natural fish within each supplemented population.

Ho_2: There is no difference in adult size-at-age over time between hatchery and natural fish within each supplemented population.

Ha_2: There is a significant difference over time in adult size-at-return between hatchery and natural fish within each supplemented population.

Ho_3: There is no difference in adult spawner sex ratio over time between hatchery and natural fish within each supplemented population.

Ha_3: There is a significant difference over time in adult spawner sex ratio between hatchery and natural fish within each supplemented population.

Ho_4: There is no difference in adult run-timing over time between hatchery and natural fish within each supplemented population.

Ha_4: There is a significant difference over time in adult run-timing between hatchery and natural fish within each supplemented population.

Ho_5: There is no difference in fecundity over time between hatchery and natural fish within each supplemented population.

Ha_5: There is a significant difference over time fecundity between hatchery and natural fish within each supplemented population.

Ho_6: There is no difference in egg size over time between hatchery and natural fish within each supplemented population.

Ha_6: There is a significant difference over time in egg size between hatchery and natural fish within each supplemented population.

Key performance measures:

- age-at-return structure (with out jacks)
- size-at-return
- sex ratios
- fecundity
- adult run-timing

Statistical Tests Applied: A simple t-test is appropriate because we compare two population segments (hatchery origin and natural-origin) directly for each adult life history characteristics over time. Years are replicates.

We determine whether migration timing (frequency distributions) differs between populations using a Kruskal-Wallis one-way analysis of variance on ranked dates of detection, expressed as day of the year, of expanded fish numbers. When significant differences are found, we use Dunn's pair-wise multiple-comparison procedure ($\alpha = 0.05$) to further analyze the data (SPSS Inc. 1992–1997).

ANOVA analysis can also be used to characterization of trends (population description) over time by considering time (year) as an explanatory variable not as replicates.

We will test at 5% Type I error (i.e. $\alpha = 0.05$), and show p-value of test statistic. If the p-value is less than the level of Type I error, we will reject null hypothesis.

Frequency/Duration: Annually. Monitoring of adult life history characteristics will occur annually for the duration of the program operations. Testing for change will occur in 5-year intervals.

Spatial Scale: Primary Aggregates and other key areas.

Monitoring and Evaluation Objective 3c. Determine and compare smolt migration characteristics between natural and hatchery smolts in the Imnaha (1A, 4B3; all salmonid focal species)

Ho_1: There is no difference in juvenile age-at-emigration over time between hatchery and natural fish within each supplemented population.

Ha_1: There is a significant difference over time in juvenile age-at-emigration between hatchery and natural fish within each supplemented population.

Ho_2: There is no difference in size-at-emigration over time between hatchery and natural fish within each supplemented population.

Ha_2: There is a significant difference over time in size-at-emigration between hatchery and natural fish within each supplemented population.

Ho_3: There is no difference in juvenile emigration-timing over time between hatchery and natural fish within each supplemented population.

Ha_3: There is a significant difference over time in juvenile emigration-timing between hatchery and natural fish within each supplemented population.

Key performance measures:

- age-at-emigration
- size-at-emigration
- emigration timing

Statistical Tests Applied: A simple t-test is appropriate because we compare two population segments (hatchery origin and natural-origin) directly for each juvenile life history characteristics over time. Years are replicates.

We determine whether migration timing (frequency distributions) differs between populations using a Kruskal-Wallis one-way analysis of variance on ranked dates of detection, expressed as day of the year, of expanded fish numbers. When significant differences are found, we use Dunn's pair-wise multiple-comparison procedure (α = 0.05) to further analyze the data (SPSS Inc. 1992–1997).

ANOVA analysis can also be used to characterization of trends (population description) over time by considering time (year) as an explanatory variable not as replicates.

We will test at 5% Type I error (i.e. $\alpha = 0.05$), and show p-value of test statistic. If the p-value is less than the level of Type I error, we will reject null hypothesis.

Frequency/Duration: Annual. Monitoring of juvenile life history characteristics will occur annually for the duration of the program operations. Testing for change will occur in 5-year intervals.

Spatial Scale: Primary aggregates; subbasin-wide

MANAGEMENT OBJECTIVE 4: UNDERSTAND THE CURRENT STATUS AND TRENDS OF HABITAT CONDITIONS AS THEY RELATE TO FOCAL SPECIES STATUS IN THE IMNAHA

Monitoring and Evaluation Objective 4a. Determine status and trends of focal species habitat in the Imnaha (2A, 2A2, 2A5, 4B, 4B1, 4B2, 5B3, 8A1, all focal species habitat**)**

H_1 - Descriptive: Characterization of physical habitat condition throughout each subbasin and trend over time.

H_2 - Descriptive: Characterization of water temperature profiles for each watershed and key areas within each treatment and reference stream (including in-hatchery temperatures).

H_3 - Descriptive: Characterization of stream flow profiles for each subbasin and key areas within each treatment and reference stream (including stream reaches impacted by hatchery facilities).

Key performance measures: N/A

Statistical Tests Applied: We will implement the Environmental Monitoring and Assessment Program (EMAP) sampling framework, a statistically based and spatially explicit sampling design to quantify status and trends in stream and riparian habitats.

Frequency/Duration: Annually (late June through September).

Spatial Scale: Fifty spatially balanced, randomly selected reaches will be sampled for juvenile salmonids and stream and riparian condition in the Imnaha subbasin.

MANAGEMENT OBJECTIVE 5. ASSESS THE EFFECTIVENESS OF RESTORATION ACTIVITIES AND OTHER HUMAN RELATED ACTIVITIES ON FOCAL SPECIES HABITAT CONDITION

Monitoring and Evaluation Objective 5a. (*refer to research needs section*)

4.4.1.2 Data Information Archive

The ability for all resource managers to access monitoring and evaluation information is paramount in their ability to report recovery success. This depends upon consistent data management standards. The PNAMP data management goal is to: develop or adopt fish and habitat data collection protocols, sampling protocols, and analytical methods, and to ensure that data arising from these protocols can be managed, shared, and used.

To facilitate the PNAMP data management goal, data management systems will follow a consistent methodology that breaks the tasks into distinct steps (from PNAMP 2004):

1. Assessing needs and gathering requirements. Understanding the necessary data products, the people who are involved, and when products are needed.
2. Developing a detailed Data Management Coordination Project Plan following forthcoming guidance from PNAMP. Set out the time frame for deliverables, who will do what and when and cost and cost share.
3. Analyzing the requirements. The requirements need to be described in data management terms.
4. To the degree possible, utilize existing database projects and systems.
5. Designing, developing and testing solutions.
6. Transition and training.
7. Deployment.
8. Maintenance.

9. Independent validation and verification.

Coordination of data management will be most successful if standard M&E protocols are adhered to by planners. Examples of data definitions (*e.g.*, definitions of KPMs) are provided in Appendix B, Appendix Table 2.

4.4.1.3 Coordination and Implementation

As previously discussed, the mission of the PNAMP is to coordinate between project-specific and regional M&E efforts to establish the most effective system design and application needed to accomplish objectives at both levels. The Imnaha aquatics technical team welcomes this assistance, as well as that provided through the Council in order to establish a meaningful and replicable M&E program.

4.4.1.4 RME Logic Path (Evaluation and Adaptive Management)

The Imnaha aquatics M&E program is predicated upon achieving the desired future condition of the subbasin (Biological Vision Statement – Section 4.1 of this document). The vision statement provides guidance for implementing actions in the future and frames the biological objectives and strategies for the subbasin. Direct ties between the proposed M&E program and the guiding principles used to implement the vision statement are illustrated in Table 10.

The Imnaha aquatics M&E program is also designed to fit within 'top down' regional RM&E efforts, such as those currently being coordinated by the PNAMP and the CSMEP, both of which draw from the federal Action Agencies and NOAA Fisheries in their "Draft Research, Monitoring and Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion" (The Research, Monitoring and Evaluation Plan, http://www.efw.bpa.gov/cgi-bin/FW/welcome.cgi).

Because of the M&E efforts already underway in the Imnaha (*e.g.*, NPT NEOH M&E program and CSMEP), a template for cataloging data, similar to that currently being used in the other federal pilot programs (*e.g.*,Wenatchee, John Day, and Upper Salmon), is currently available for application. The template includes consideration of Tier 1, 2, and 3 variables, which are consistent with the FCRPS BiOp.

Additional relationships between the proposed M&E and other existing programs are discussed in Section 5 of this document.

Table 10. Ties between the proposed Imnaha M&E program and the guiding principles of the Imnaha vision statement (linkage is shown with an 'X')

M&E Program	Process Principles	Outcome Principles
	Respect, recognize, and honor the legal authority, jurisdiction, treaty-reserved rights, and legal rights of all parties	Provide_ridgetop-to-ridgetop stewardship of natural resources, recognizing all components of the ecosystem, including the human component
X	Coordinate efforts to implement the Pacific Northwest Electric Power Planning and Conservation Act; the Endangered Species Act; the Clean Water Act; tribal treaties; and other local, state, federal, and tribal programs, obligations, and authorities	
X	Promote and enhance local participation in, and contribution to, natural resource problem solving and subbasinwide conservation efforts	Provide opportunities for natural resource-based economies to recover in concert with aquatic and terrestrial species
X	Develop a scientific foundation that incorporates local knowledge for prioritizing projects and for monitoring and evaluation	
X	Promote understanding and appreciation of the need to maintain, protect, enhance, and/or restore a healthy and properly functioning ecosystem	Maintain, enhance, and/or restore habitats to sustain and recover aquatic and terrestrial species diversity

4.4.2 Terrestrial Monitoring and Evaluation

Implementation or ‘action’ strategies identified in this plan that may require monitoring and evaluation components are summarized in . The focus is on the strategy level, not on the project level. The (Monitoring and Evaluation) M&E actions described below are not intended to be a field-ready program; rather, they represent a first step in program development. Current or ongoing M&E programs (as described in the Inventory) incorporate many of the M&E needs identified in this section. Development of new projects in the subbasin will therefore be coordinated with existing programs to maximize effectiveness, reduce redundancy and enhance spatial and temporal data comparability.

An overview of potential short (environmental) and long (biological) term indicators of success around which monitoring strategies may be based is presented for each implementation or ‘action’ strategy identified in this plan (Table 11). Similarly to information presented in the prior section, the broad nature of identified strategies will likely result in the delineation of multiple focused restoration or implementation projects which, when results are combined, will address the overall need. For this reason, short and long term indicators of success described in Table 11 should be consider as guidance for future project development rather than as rigidly defined indicators to be used in M&E project components. Future projects should delineate M&E strategies and indicators appropriate to the scale and intent of the individual project while considering the overall guidance/direction provided here to ensure that small scale project goals and outcomes are consistent with broader scale (subbasin or basin-wide) goals and direction.

Table 11. Monitoring and evaluation identified for terrestrial focal species in the Imnaha subbasin

Objective		Strategy		Potential indicators to monitor	Planned outcome of strategy implementation
14A	Maintain grassland quality, condition, and composition	2	Manage for the persistence and enhancement of large mid-late seral grassland areas, through the implementation of BMPs.	Acres of high quality grassland habitat Vegetative composition Grassland habitat connectivity	Increased grassland habitat quality and increasing population trend for native grassland dependent species
		3	Maintain and enhance rare plant population through proper management, conservation easements, land acquisitions, incentive programs and other tools.	Number of populations and size of rare plant populations Plant populations in protected status	Viable rare plant populations
		4	Develop grazing management plans to limit adverse impacts to areas of intact grasslands.	Percent of native vegetation in grassland habitats Grassland seral stage Grassland habitat connectivity	Increased grassland habitat quality and increasing population trend for native grassland dependent species
14B	Restore areas where grasslands have been degraded	1	Maintain coordination between the Wallowa County Natural Resource Advisory Committee (NRAC), Wallowa County Soil and Water Conservation District (SWCD) the Natural Resource Conservation Service, the U.S. Forest Service and other interested landowners, agencies and organizations.	Cooperation and productivity levels	Most cost effective and biologically beneficial restoration for the resources
		3	Actively improve or create native grassland habitats through noxious weed control, management practices and seeding. Use native species, or if necessary for effective restoration non-invasive, non-native species in existing state, federal, and tribal habitat programs.	Prevalence of invasive vegetation species	Increased grassland habitat quality and increasing population trend for native grassland dependent species. Reduced incidence of invasive vegetation

Objective		Strategy		Potential indicators to monitor	Planned outcome of strategy implementation
15A	Maintain and enhance mature ponderosa pine habitats.	2	Maintain existing mature ponderosa pine communities through conservation easements, land acquisition, land exchanges or other strategies. Give priority to larger remnants and those with highest potential to be lost.	Acres of ponderosa pine habitatStructural stage of ponderosa pine habitatPatch size of ponderosa pine habitat	Increased or stable avaliability of mature ponderosa pine habitats and population trend for ponderosa pine dependent species.
		3	Manage for the persistence of ponderosa pine communities--where appropriate to the habitat type, use understory removal followed by early spring burning to protect mature stands from stand-replacing fire events.	Acres of ponderosa pine habitat Structural stage of ponderosa pine habitat Understory composition of ponderosa pine habitat	Increased or stable avaliability of mature ponderosa pine habitats and population trend for ponderosa pine dependent species.
		4	Use selective thinning and early spring burning to encourage succession and the establishment of mature ponderosa pine communities on appropriate habitat types.	Acres of ponderosa pine habitat Structural stage of ponderosa pine habitat	Increased or stable avaliability of mature ponderosa pine habitats and population trend for ponderosa pine dependent species.
		5	Encourage the planting of ponderosa pine on appropriate habitat types in existing state, federal and tribal reforestation efforts.	Acres of ponderosa pine planted	Increased or stable avaliability of mature ponderosa pine habitats and population trend for ponderosa pine dependent species.
16A	Maintain currently functioning wetlands and restore degraded wetlands.	2	Maintain high quality wetland habitats, through conservation easements, land acquisition, public education, promotion of BMPs, incentive programs, continued use of alternative grazing strategies and additional installation of alternative forms of water for livestock. Adjust seasonal timing of livestock grazing to minimize soil compaction, erosion and noxious weed propagation.	BMP implementation ratesChanges in management practicesVegetation composition, structure and diversityWater qualitySoil compactionErosion ratesPrevalence of invasive plants	Increased or stable avaliability of high quality wetland habitats and population trends for wetland dependent species.

Objective			Strategy	Potential indicators to monitor	Planned outcome of strategy implementation
		3	Continue existing programs such as CREP, and WHIP and develop new programs that work to restore wetland habitats.	Number of effective wetland conservation programs	Increased wetland habitat quality and upward population trends for wetland dependent species.
16B	Maintain currently functioning riparian areas and restore degraded riparian areas.	1	Maintain and enhance riparian communities through conservation easements, land acquisition, promotion of BMPs, land stewardship, continued use of alternative grazing strategies, installation of additional alternative forms of water for livestock and increased enrollment by landowners in the Continuous Conservation Reserve Program (CCRP) and the Conservation Reserve Enhancement Program (CREP).	BMP implementation rates Changes in management practices Vegetation composition, structure and diversity Water quality Soil compaction Erosion rates Prevalence of invasive plants	Increased riparian habitat quality and upward population trends for riparian dependent species.
		2	Increase understanding of the importance of riparian habitat through education programs for both the general public and road maintenance personnel.	Increases in understanding of and respect for riparian habitats	Better riparian management and increased riparian habitat quality
		3	Restore the structural diversity and species composition of overstory and understory riparian vegetation. Maintain and improve the availability and distribution of KECs.	Riparian structure Canopy cover Species composition Prevalence of downed wood, snags and other important KECs	Increased riparian habitat quality and upward population trends for riparian dependent species.
		4	Identify winter feeding operations not already covered under Confined Animal Feeding Operation (CAFO) regulations that are impacting water quality, and design management actions to minimize sediment and nutrient inputs to streams.	Sediment and nutrient levels	Improved water quality
		5	Fund existing programs and develop new programs that restore riparian habitats.	Effective riparian restoration programs	Increased riparian habitat quality and upward population trends for riparian dependent species.

Objective		Strategy		Potential indicators to monitor	Planned outcome of strategy implementation
17A	Preventing the introduction, reproduction, and spread of noxious weeds and invasive exotic plants	1	Use the Wallowa County Noxious Weed List to prioritize noxious weed eradication, containment or control efforts in the subbasin.	Rates of noxious weed infestation and spreadIncidence of new invasive species	Most cost effective and biologically beneficial noxious weed eradication and control efforts for the resources
		3	Minimize establishment of new invaders by supporting early detection and eradication programs.	Incidence of new invasive species	Reduced invasion rates and maintenance of existing habitat quality
		4	Develop and implement programs and policies designed to limit the transportation of weed seeds by vehicles and livestock	Number of effective programs and policies Rates of invasive plant infestation and spread	Reduced invasion rates and maintenance of existing habitat quality
		5	Minimize the potential for livestock to facilitate the spread of noxious weeds through weed-free hay programs, quarantine requirements, and other actions. Support the Wallowa County certified hay program. Adjust seasonal timing of livestock grazing to minimize soil compaction, erosion and noxious weed propagation.	Rates of invasive plant infestation and spread Tons of certified hay produced	Reduced invasion rates and maintenance of existing habitat quality
		6	Use integrated pest management principles to eradicate noxious weed populations when possible and to contain or control the spread of noxious weed populations when eradication is not feasible. Coordinate with existing efforts including those of the Tri-County Cooperative Weed Management Area, Tri-State Weed Management Area and the Wallowa County Weed Board.	Rates of invasive plant infestation and spread Cooperation and productivity levels	Reduced invasion rates and maintenance or improvement in existing habitat quality
		7	After treatment, rehabilitate infested sites with desirable plant species.	Area of invasive vegetation Area of native and other desirable plant species	Increase in the availability of high quality habitat

Objective		Strategy		Potential indicators to monitor	Planned outcome of strategy implementation
		8	Increase public participation--develop education and awareness programs in noxious weed identification, spread prevention and treatment.	Public awareness of noxious weed problem Rates of invasive plant infestation and spread	Reduced invasion rates and maintenance or improvement in existing habitat quality
18A	Restore the composition, structure, and density of forests to within the historic range of variability (HRV).	2	Restore the species composition of the forested habitats of the Imnaha subbasin to within the HRV using a combination of precommercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions. Focus efforts on restoring ponderosa pine and western larch communities, and enhancing shrub/forb layer diversity.	Vegetative composition of forest habitats Prominence of ponderosa pine and western larch Incidence of disturbance by fire, insects and disease	More natural species composition in forested habitats. Improved habitat quality for species adapted to native forest composition. More natural disturbance processes (fire, insects, disease).
		3	Restore the structural composition of the forested habitats of the Imnaha subbasin to within the HRV using a combination of precommercial and commercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions. Maintain and enhance existing late seral habitats and associated KECs.	Structural composition of forest habitats Prominence of late seral habitats and associated KECs Incidence of disturbance by fire, insects and disease	More natural structural composition in forested habitats. Improved habitat quality for species adapted to native forest structure patterns. More natural disturbance processes (fire, insects, disease).
		4	Reduce densities in forest areas that exceed the HRV to reduce the potential for insect and disease outbreaks and lethal fires. Use a combination of precommercial and commercial thinning, mechanical treatment, underburn, single-tree selection and/or prescribed fire as appropriate to site conditions.	Density of forest habitats Incidence of disturbance by fire, insects and disease	More natural forest densities. Improved habitat quality for species adapted to native forest structure patterns. More natural disturbance processes (fire, insects, disease).

Objective			Strategy	Potential indicators to monitor	Planned outcome of strategy implementation
19A	Reduce the impact of the transportation system on wildlife and fish populations and habitats	1	Implement the recommendations of the HCNRA CMP and other Forest Service documents for the public lands of the subbasin	Road densitiesRoad failures and landslidesErosion ratesDirect wildlife mortalitiesWildlife migration patternsStream channel conditionRunoff and flow patternsBarrier impactsWildlife security areas	Reduced impact of the transportation system on aquatic and terrestrial ecosystems and populations
		2	Implement the recommendations of the transportation system analysis when completed.	Road densities Road failures and landslides Erosion rates Direct wildlife mortalities Wildlife migration patterns Stream channel condition Runoff and flow patterns Barrier impacts Wildlife security areas	Reduced impact of the transportation system on aquatic and terrestrial ecosystems and populations

5 Coordination with Existing Programs

For a subbasin plan to be adopted by the NPCC, the plan must conform to existing federal guidelines of the Endangered Species Act (ESA) and Clean Water Act (CWA). The status of listed species and of water quality conditions are discussed in Assessment Section 1.2.1.1: Species Designated as Threatened or Endangered and Assessment Section 1.1.2.3. Water Quality. Planning must be reflective of, and integrated with, recovery plans for listed species within the subbasins, performance measures described in the Federal Columbia River Power System Biological Opinion, and the Water Quality Management Plan of the state (NPCC 2001). Following is a description of ESA and CWA considerations and of how recommended objectives and strategies conform to these federal guidelines.

5.1 Endangered Species Act Considerations

The Imnaha subbasin contains species listed as threatened or endangered under the Endangered Species Act (ESA) (16 U.S.C. §§ 1531–1544). The ESA, amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Fisheries Service (NOAA Fisheries), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitats.

Section 7 of the ESA also makes it clear that all federal agencies should participate in the coordination of programs that involve endangered species. Under this provision, federal agencies often enter into partnerships and memoranda of understanding with the USFWS for implementing and funding conservation agreements, management plans, and recovery plans developed for listed species. The development of these partnerships is encouraged as such planning efforts enable proactive approaches for managing listed species.

USFWS has developed, and is in the process of developing, recovery plans for species listed under the ESA in the Imnaha subbasins. Actions called for in the *Imnaha Subbasins Management Plan* should be coordinated, consistent, and integrated with these recovery plans as well any applicable performance measures from the Federal Columbia River Power System Biological Opinion (BiOp) (NPCC 2001).

5.1.1 Consistency with applicable performance measures in BiOp.

The *Imnaha Subbasin Plan* should be coordinated with habitat actions and ecological objectives in the Federal BiOp (N. Berwick, NOAA Fisheries, personal communication, April 4, 2004). Habitat actions described in the BiOp are intended to accelerate efforts to improve survival in priority areas in the short term, while laying a foundation for long-term strategies through subbasin assessment and planning (NMFS 2000). The long term habitat strategy in the BiOp has three overarching objectives: 1) protect existing high quality habitat, 2) restore degraded habitats on a priority basis and connect them to other functioning habitats, and 3) prevent further degradation of tributary habitats and water quality. These are consistent with rules developed by technical team members during subbasin planning prioritization exercises (*refer to* Section 6.1) as well as objectives for focal habitats in the Imnaha subbasins (*refer to* Section 3).

The following objectives were more specifically described in the BiOp (NMFS 2000) as necessary for tributary habitat improvement efforts benefiting the Technical Recovery Team (TRT)-defined populations residing in the Imnaha (spring/summer chinook (IRMAI), Big Sheep Creek (IRBSH) watersheds, the fall chinook population (SNMAI), and the summer steelhead population (IRMMT-s). Related objectives and associated strategies in this plan include:

- Water quantity--increase tributary water flow to improve fish spawning, rearing, and migration (*refer to* Aquatic Objectives 8A and 8B).

- Water quality--comply with water quality standards, first in spawning and rearing areas, then in migratory corridors (*refer to* Aquatic Objectives 7A and 12A).

- Passage and diversion improvements—address in-stream obstructions and diversions that interfere with or harm listed species (*refer to* Aquatic Objective 10A).

- Watershed health—manage both riparian and upland habitat, consistent with the needs of the species (*refer to* Aquatic Objectives 7A, 9A, and 9B).

- Mainstem habitat—improve mainstem habitat on an experimental basis and evaluate the results (*refer to* Aquatic Objective 11A).

In the long term, habitat recovery and watershed restoration for non-Federal public, Tribal, and private lands require state and local stewardship. An overall framework for this stewardship can be created through subbasin plans and recovery plans which establish goals, objectives, and priority actions that are coordinated across Federal and non-Federal ownerships and programs (NMFS 2000). The *Imnaha Subbasin Plan* provides an important context for classifying and prioritizing areas for protection and restoration. The Plan also provides a foundation for ESA recovery planning.

Performance standards and measures are described in the "All H Strategy" (Habitat, Hatcheries, Harvest, Hydropower), which is the "umbrella" under which the BiOp falls (Federal Caucus 2000), and in the aquatics RM&E section (Appendix Table 2). Of the 4 H's, coordination with habitat standards and measures in the BiOp is of primary importance as development of strategies to address habitat concerns is a major objective of subbasin planning (NPCC 2000). <u>Habitat performance standards</u> are: 1) prevent habitat degradation, 2) restore high quality habitat, and 3) restore/increase habitat complexity (Federal Caucus 2000). Associated <u>performance measures</u> as described in the "All H Strategy" include (and are presented in the aquatics RM&E section in this document):

• Increased stream miles meeting water quality standards (temperature and sediments) (*refer to* Aquatic Objectives 7A and 12A and Aquatics Environmental Monitoring Objective 4a).

• Increased stream miles with adequate instream flows (*refer to* Aquatic Environmental Objectives 8A and 8B and Aquatics Monitoring Objective 4a).

• Increased stream miles opened to fish access (*refer to* Aquatic Environmental Objective 10A, and Aquatics Monitoring Objectives 1a, 1c).

• Increased number of diversion areas screened (*refer to* Aquatic Environmental Objective 10A, Aquatic Monitoring Objectives 1a, 1c).

• Increased acres and/or stream miles of habitat protected or restored (*refer to* Aquatic Environmental Objectives 7A, 8A, 8B, 9B, 10A, 11A and Aquatic Monitoring Objective 4a).

The ultimate performance standard for habitat is fish productivity (Federal Caucus 2000). However, this will be difficult to establish as survival improvements from habitat actions cannot be measured in the short term. Even in the long term, measuring progress toward a biologically based standard will be challenging and expensive. Based on our current understanding of the associations between ecosystem processes and salmonid populations, four habitat factors will influence performance measures throughout the basin (Federal Caucus 2000):

- In-stream flows;
- Amount and timing of sediment inputs to streams;
- Riparian conditions that determine water temperature, bank integrity, wood input, maintenance of channel complexity; and
- Habitat access

The *Imnaha Subbasin Management Plan* addresses each of these measures with detailed objectives and strategies (Aquatic Ecosystem Section 3.2.1 and Terrestrial Ecosystem Section 3.2.2) as well as a research, monitoring, and evaluation plan (Plan Section 4).

5.1.2 Consistency with existing recovery plans

Bull trout (*Salvelinus confluentus*), Chinook salmon (*Oncorhynchus tshawytscha*), and Steelhead (*Oncorhynchus mykiss*) are fish species listed under the Endangered Species Act (ESA) currently present in the Imnaha subbasin. Other threatened or endangered species in the subbasins include the bald eagle (*Haliaeetus leucocephalus*), lynx (*Lynx lynx*), Spalding's silene (*Silene spaldingii),* and MacFarlane's four o' clock (*Mirabilis macfarlanei*) (Assessment Section 1.2.1.1: Species designated as threatened or endangered, Table 30). Wolves (*Canis lupis*) have not been documented in the subbasin; however, with continual expansion of the wolf population in Idaho, resident wolves may become established in the near future. The status of wolves in Oregon was recently changed from endangered to threatened under the ESA (Assessment Section 1.2.1.1: Species designated as threatened or endangered). The Columbia spotted frog (*Rana luteiventris*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and Slender moonwort (*Botrychium lineare*) are currently candidate species under ESA (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

Of the focal species in the Imnaha subbasins, three aquatic species, bull trout, chinook salmon, steelhead and one terrestrial species, bald eagle, are listed as “Threatened” or “Endangered” under the ESA (Assessment Section 1.2.1.1: Species designated as threatened or endangered). The remaining species listed under ESA in Table 30 were not included as focal species for the priority habitat types, but are included in the assessment (Assessment Section 1.2.1.1: Species designated as threatened or endangered) as they effect future management actions or projects. In addition to the federally listed threatened or endangered species, there are species designated by ODFW (Table 33) and USFS Region 6 (Table 34) as sensitive in the Imnaha subbasin (Assessment Section 1.2.1.2: Species recognized as rare or significant to the local area). These species could be future candidates for listing, and as such, it is important to document their status. The following ESA species have recovery plans (or a conservation strategy) that are existing or in development:

5.1.2.1 Bull trout (Salvelinus confluentus)

Bull trout were listed under ESA as threatened on November 1, 1999 (64 FR 58910). The Bull Trout Recovery Team (BTRT) developed a draft recovery plan that provided a framework for implementing recovery actions for the species (USFWS 2002). The bull trout draft recovery plan was also used as the principal basis for identifying critical habitat for the species. The proposed designation of critical habitat was published on November 29, 2002 (67 FR 71236) (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

Bull trout occurring in the Imnaha subbasin belong to the Imnaha-Snake Rivers Recovery Unit. The USFWS identified four subpopulations in the Imnaha subbasins. These subpopulations are the Imnaha River, Big Sheep Creek, Little Sheep Creek, and McCully Creek. Bull trout have also been found throughout the Wallowa Valley Improvement Canal. As resident fish found within the canal do not have downstream passage opportunities, and could originate from the Big Sheep, Little Sheep, or McCully creek subpopulations, bull trout found here have not been recognized as a distinct subpopulation (Assessment Section 1.2.6: Bull trout population delineation and characterization).

The Imnaha bull trout recovery unit team suspects that the Imnaha/Snake Recovery Unit contains up to two core areas, but for the purposes of recovery should be considered as one core area. These areas include the Imnaha Core Area, which is comprised of all tributaries containing local populations (both current and potential as identified by the recovery unit team), and the mainstem Imnaha River from the headwaters downstream to the confluence with the Snake River. Populations occurring in Snake River tributaries such as Sheep and Granite Creek likely represent a separate core area (Assessment Section 1.2.6: Bull trout population delineation and characterization).

Additional populations exist in major tributaries to the Snake River, including the Bruneau, Boise, Weiser, Malheur, Payette, Powder, Grand Ronde, Salmon, and Clearwater Rivers.

Historic and current interaction among these populations is unknown, although presumably all historic bull trout populations periodically interacted with other populations in the Snake River basin. Currently, interaction is difficult or impossible as most populations are isolated by fish barriers, primarily dams (USFWS 2002).

The status of the bull trout was first assessed in 1991 and all subpopulations within the Imnaha subbasin except the Imnaha River were rated of “special concern” because of passage barriers, downstream losses of migrants, and in Big Sheep and Little Sheep creeks, habitat degradation (Assessment Section 1.2.6: Bull trout population delineation and characterization). The Imnaha River subpopulation was rated at “low risk”. Additional monitoring led to a downgrading of the Little Sheep Creek subpopulation to “high risk of extinction”. McCully Creek was downgraded to “moderate risk of extinction” because of the isolation of this population caused by the canal (Assessment Section 1.2.6: Bull trout population delineation and characterization).

Bull trout have more specific habitat requirements than most other salmonids. Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, substrate for spawning and rearing, and migratory corridors (USFWS 2002). The *Imnaha Subbasin Plan* provides mechanisms to reduce factors limiting bull trout. Environmental Objectives 6A and 10A (Plan Section 3.2.1.2: Environmental Components) is to reduce the number of artificially blocked stream miles to increase population connectivity. Additional Environmental Objectives are to achieve adequate temperatures (Environmental Objective 7A), and habitat complexity (Environmental Objective 11A) for bull trout and other listed or focal species.

5.1.2.2 Bald eagle (Haliaeetus leucocephalus)

Bald eagles were listed under ESA as threatened July 12, 1995 (60 FR 35999), but are being considered for de-listing by USFWS as of July 4, 1999 (64 FR 128). Their population status is described as in recovery, with the breeding population doubling every 6-7 years (USFWS 1986). Bald eagles have other status designations by state and federal agencies (Assessment Section 1.2.1.2: Species recognized as rare or significant to the local area , Table 34). In Oregon, historic bald eagle nests have been documented in 32 of 36 counties. Those counties where historic breeding records did not occur include Sherman, Gilliam, Morrow, and Malheur counties. The current range in the lower 48 states has been divided into five recovery areas: Chesapeake Bay, Pacific, Southeastern, Northern States, and Southwestern. The Imnaha Subbasin lies within the Pacific recovery area (Assessment Section 1.2.9: Terrestrial focal species habitat use and population status characterization).

The Pacific recovery area was divided into zones, and the Imnaha subbasin is part of the Snake River zone. Recovery goals for the Snake River zone are to: 1) locate, monitor, and protect nesting, roosting, and feeding areas, 2) develop nest site plans for nesting and roost areas, 3) monitor productivity, 4) prevent significant habitat disturbance and direct human interference at nest sites and feeding areas, and 5) re-establish six breeding pairs (Assessment Section 1.2.9: Terrestrial focal species habitat use and population status characterization; Terrestrial Objective 13A).

Bald eagles nest in forested areas near the ocean, along rivers, and at estuaries, lakes, and reservoirs. Eagles usually nest in mature conifers with gnarled limbs that provide ideal platforms for nests. Ponderosa pine, Douglas fir, and black cottonwood are preferred nest trees in the Pacific recovery area (Assessment Section 1.2.9: Terrestrial focal species habitat use and population status characterization). Loss of habitat, loss of prey, and human disturbance are the greatest current threats to bald eagle populations. Actions identified by the Wallowa-Whitman National Forest are currently being implemented in portions of the subbasin that should result in continued improvement in bald eagle habitat including: implementation of management standards for livestock grazing to improve riparian conditions, snag maintenance to provide perches and/or nest trees, restoration of fire regimes to maintain large tree species preferred by bald eagles (ponderosa pine and Douglas fir respond to periodic burns), and efforts to protect and restore anadromous fish runs (Assessment Section 1.2.9: Terrestrial focal species habitat use and population status characterization).

Similar objectives have been defined in this subbasin management plan. Environmental Objectives 7A, 10A, and 10B aim to protect and restore riparian and wetland habitats. Objective 16A, Strategy 2 provides recommendations to minimize the impact of grazing on riparian habitats. Terrestrial Objective 15A is to protect and manage for mature, old growth stands of ponderosa pine, consistent with bald eagle needs. Terrestrial Objective 15A, Strategy 3 and Objective 18A, Strategies 4, 5, and 6 are to manage for a natural fire regime. Objectives to support anadromous fish population (Objectives 1A, 2A, and 2B) will also support the prey base for bald eagles.

5.1.2.3 Lynx (Lynx lynx)

On March 24, 2000, the North American lynx (*Lynx lynx*) was federally listed as threatened (65 FR 16051) under ESA. Critical habitat has not been designated as no recovery plan currently exists for lynx. However, the Canada Lynx Assessment and Strategy (Ruediger et al. 2000) describes conservation measures and objectives (M. Hemker, USFWS, personal communication, April 6, 2004). In accordance with this interagency strategy, the USFWS, BLM, and USFS have cooperated to identify lynx analysis units (LAUs). Three LAUs have been delineated in the Imnaha subbasin; these LAUs follow the boundaries of the three major watersheds: lower Imnaha, upper Imnaha, and Big Sheep Creek. Collectively, the LAUs encompass the entire Imnaha subbasin (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

In the western mountains, lynx are associated with coniferous forests and upper elevations using early successional forest stands for foraging and mature forest stands containing large woody debris for denning. Lynx can be managed by managing for snowshoe hare (*Lepus americanus*), as they comprise up to 83% of the lynx diet. Hare populations increase dramatically following disturbance, particularly fire that creates hare cover and food, generally benefiting lynx (Ruediger et al. 2000).

Restoring fire as an ecological process was listed in the Canada Lynx Assessment and Strategy as a conservation measure addressing risk factors affecting lynx productivity. It was suggested that fire be used to move toward landscape patterns consistent with historical succession and disturbance regimes using mechanical pre-treatment and management ignitions as necessary. Terrestrial Objective 15A, Strategy 3 and Objective 18A, Strategies 4, 5, and 6 are those designed to manage fire on the landscape that would allow for natural ecosystem processes and succession and are consistent with conservation measures.

Timber management modifies the vegetation structure and mosaic of forested landscapes and can be used as a disturbance process to create and maintain lynx habitat, and that of their prey (red squirrel and snowshoe hare). Greater emphasis has been placed on retention of live and dead trees and coarse woody debris, important habitat components (Ruediger et al. 2000). Dense horizontal cover of conifers, just above the snow level in winter, is critical for snowshoe hare habitat. This structure may occur either in regenerating seedling/sapling stands, or as an understory layer in older stands. Relatively few snowshoe hares are found in large openings, and thus lynx do not spend much time hunting in open areas, especially in winter. Clearcuts, shelterwood cuts, seed tree cuts, and diameter-limit prescriptions that result in distance to cover greater than 100 m (325 feet) may restrict lynx movement and use patterns until forest regeneration occurs. It may take approximately 15 to 30 years following forest management practices or fire for conifers and/or brush species to regenerate to heights sufficient to extend above average winter snow levels and create high quality habitat for snowshoe hare (Ruediger et al. 2000). Terrestrial Objectives 15A and 17A and associated strategies to protect pine/fir forest habitats and promote ecological processes leading to late seral stages support needs for lynx. Unless other information becomes available, actions should remain consistent with standards and guidelines in Canada Lynx Assessment and Strategy (M. Robertson, USFWS, personal communication, May 14, 2004). As most habitat is in headwater systems, management should also be consistent with recommendations in the Sawtooth National Forest Land Management Plan (USFS 2003b) (M. Robertson, USFWS, personal communication, May 14, 2004).

The main sources of lynx mortality are starvation (prey scarcity) and harvest by humans, which is no longer legal. It is also speculated that habitat fragmentation facilitating access by interspecific competitors may affect the structure and function of lynx populations. Plowed roads and groomed over-the-snow routes may allow competing carnivores such as coyotes and mountain lions to access lynx habitat in the winter, increasing competition for prey. Planning objectives in the Canada Lynx Assessment and Strategy (Ruediger et al. 2000) suggest the following to manage for recreational activities while protecting the integrity of lynx habitat:

a) Maintain the natural competitive advantage of lynx in deep snow conditions by minimizing snow compaction in lynx habitat.
b) Concentrate recreational activities within existing developed areas, rather than developing new recreational areas in lynx habitat.
c) On federal lands, ensure that development or expansion of developed recreation sites or ski areas and adjacent lands address landscape connectivity and lynx habitat needs.

Terrestrial Objective 19A includes verbiage to minimize the negative impact of current and future development, including roads, on the native terrestrial species of the subbasins. Strategies include the identification, mapping, and prioritization focal habitats and travel corridors important to aquatic and terrestrial species for protection and to provide such information to regional planners and natural resource managers. In addition, Terrestrial Objective 19A is to regulate and enforce off-road vehicle restrictions (OHV) and educate to minimize impacts of recreation. Each of these strategies will support the needs of lynx.

5.1.2.4 Spalding's catchfly (Silene spaldingii)

Spalding's catchfly (sometimes called Spalding's silene), a member of the pink or carnation family, was listed as a Threatened species on 10 October 2001 (66 FR 51598) (Hill and Gray 2004). A recovery plan is in early stages of development and has not yet been released. The 2004 Conservation Strategy for Spalding's catchfly (*Silene spaldingii* Wats.) (Hill and Gray 2004) is a useful interim guide for describing limiting factors, protection and restoration priorities, and additional survey needs (M. Hemker, USFWS, personal communication, April 6, 2004).

Twelve observations of Spalding'scatchfly have been documented in the subbasin by the Oregon Natural Heritage Program. These sightings all occur within the Little Sheep Creek drainage. The largest populations are protected on land recently purchased by The Nature Conservancy in the Camp Creek drainage, but five are on private land and one is located on land administered by the BLM. Another population of Spalding's catchfly is reported by the USFWS to occur in the upper Imnaha River watershed (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

Spalding's catchfly prefers open native grassland habitats and is associated with Idaho fescue (*Festuca idahoensis*), rough fescue (*F. scabrella*), or bluebunch wheatgrass (*Pseudoroegneria spicata*, formerly called *Agropyron spicatum*). Scattered individuals of ponderosa pine may also be found in or adjacent to Spalding's silene (Hill and Gray 2004). As 275,555 acres of grasslands exist in the Imnaha subbasins (Assessment Section 1.1.9: Land Cover, Figure 14: Current wildlife habitat types (WHTs) of the Imnaha subbasin), additional surveys may result in additional documented occurrences of Spalding's catchflyin the subbasin. Therefore, objectives and strategies recommended in this subbasins management plan shall be consistent with Spalding'catchfly needs.

Weed invasion is the major cause of Spalding's catchfly habitat degradation. Disturbances to soil and vegetation, both natural (fire, soil slumps, animal burrowing and trailing, etc.) and anthropogenic (livestock grazing and trampling, cultivation, road-building, fire suppression activities, off-road recreational use, etc.) are also major contributing factors (Hill and Gray 2004). Terrestrial Objective 17A is to protect the existing quality, quantity, and diversity of native habitats. Terrestrial Objective 17A supports this effort by recommending strategies to reduce the extent and density of established noxious weeds and invasive exotics and restore native habitats.

Livestock grazing has major negative effects on Spalding's catchfly and its habitat (Hill and Gray 2004). Prolonged heavy grazing pressure from domestic livestock in some areas has resulted in major alterations of the structure, function and composition of the fescue bunchgrass communities that support Spalding's catchfly and has also promoted weed invasion. Terrestrial

Objective 16A, Strategy 2 to manage grazing to reduce impacts on the aquatic and terrestrial communities in the subbasins will support Spalding's catchfly needs.

Life histories of native plant species are often fine-tuned to a particular regime of fire frequency, intensity and seasonal distribution (Hill and Gray 2004). Alterations of fire regimes, including fire suppression, increasing fire severities and frequencies, and out-of-season fires, have potential to degrade Spalding's catchfly habitat. Terrestrial Objective 15A, Strategy 3 and Objective 18A, Strategies 4, 5, and 6 are to manage fire on the landscape in a manner that would allow for natural ecosystem processes and succession are consistent with Spalding's catchfly needs.

Fifty-two percent of Spalding's catchfly populations occur on private lands; not including the 12% of populations in which a private individual or corporation is a part-owner (Hill and Gray 2004). As a result, integration of Socioeconomic Objectives and associated strategies in Plan Section 3.2.3 are necessary for successful implementation of Spalding's catchfly protection and restoration activities.

The conservation recommendations for Spalding's catchfly focus on protection of existing populations and habitat, and maintenance of potential habitat (Hill and Gray 2004). The following recommendations were summarized by Hill and Gray (2004) to reduce the most imminent and pervasive threats to Spalding's catchfly and its habitat. In order of priority, recommendations address the following issues (additional details can be found in Hill and Gray 2004): 1) habitat degradation from non-native invasive plants, and major contributing disturbance factors, livestock grazing and fire (see additional guidelines for effective weed, livestock, fire management, and habitat restoration), 2) inventory of potential unsurveyed habitat (specific recommendations identify areas with immediate survey needs), 3) habitat fragmentation (specific recommendations are given to help protect pollinators, reduce further habitat fragmentation, protect small populations on isolated habitat fragments, retain genetic diversity of threatened small populations, and suggest areas that would allow protection of groups of small populations), 4) monitoring (recommendations identify priority monitoring needs and provide suggestions of appropriate monitoring methodology), and 5) reporting and record-keeping (recommendations are made to help standardize and improve reporting and record-keeping across the four-state region of Spalding's catchfly known distribution). Aquatic and Terrestrial priorities (Plan Section 6.1) in the Imnaha subbasin are to protect existing habitat and build from strength, consistent with recommendation's for Spalding's catchfly conservation.

5.1.2.5 MacFarlane's four o' clock (Mirabilis macfarlanei)

MacFarlane's four o'clock was originally listed as endangered in 1979 (44 FR 61912). Due to the discovery of additional populations and ongoing recovery efforts, the species was downlisted to threatened in March 1996. MacFarlane's four o'clock is endemic to the low-elevation grassland habitats in the Imnaha, Snake and Salmon river canyons of Wallowa County, Oregon, and Idaho County, Idaho. It is currently found in 11 populations in Idaho and Oregon. Two of the 11 known populations of MacFarlane's four o'clock occur along the lower Imnaha River (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

MacFarlane's four o'clock and its habitat have been and continue to be threatened by a number of factors, including herbicide and pesticide spraying, landslide and flood damage, disease and insect damage, exotic plants, livestock grazing, off-road vehicles, and possibly road and trail construction and maintenance (USFWS 2000). Care should be taken to protect MacFarlane's four o' clock during noxious weed or other invasive exotic treatments (Terrestrial Objective 17A).

5.1.2.6 Wolf (Canis lupus)

The gray wolf (*Canis lupus*) was listed as endangered under ESA on March 9, 1978 (43 FR 9607). On November 22, 1994, areas in Idaho, Montana and Wyoming were designated as non-essential experimental populations in order to initiate gray wolf reintroduction projects in central Idaho and the Greater Yellowstone Area (59 FR 60252, 59 FR 60266). Special regulations for the experimental populations allow flexible management of wolves, including authorization for private citizens to take wolves in the act of attacking livestock on private land (USFWS 1987). Recovery criteria for wolves in the Central Idaho Recovery Area is a minimum of 10 breeding pairs (or about 100 wolves) for a minimum of three successive years (USFWS 1987).

Wolves reintroduced in Oregon traveled widely and generally northward, but most remained on public land within the core reintroduction area (Bangs and Fritts 1996). Numerous recent wolf sightings have been reported in Oregon; however, only three of these reports have been verified. These wolves were either killed (one was illegally shot, the other hit by a car) or returned to Idaho. The subbasin contains healthy ungulate populations and a large wilderness, both of which provide requirements sufficient for wolf habitation. It is anticipated that, with continual expansion of the wolf population in Idaho, resident wolves may become established in the area in the near future. The status of wolves in Oregon was recently changed from endangered to threatened under the ESA (Assessment Section 1.2.1.1: Species designated as threatened or endangered).

Terrestrial Objective 13A aims to increase understanding of the composition, population and habitat trends, and habitat requirements of the terrestrial communities of the Imnaha subbasin. This objective and associated strategies support the actions or "tasks" needed to recover the Northern Rocky Mountain Wolf (USFWS 1987). Recommended actions are to determine the present status and distribution of gray wolves in the Northern Rocky Mountains and devise a systematic approach for compiling observations and other data on the wolf (USFWS 1987), which is consistent with Strategies 13A1, 2, 5, and 6 in this subbasins plan. Specific tasks that should be considered are to: 1) determine the size of home range for packs, pairs, and lone wolves, 2) estimate the numbers of packs, pairs, and individuals in each area, 3) estimate pup/adult ratios, 4) estimate numbers of litters and litter sizes, 5) determine population trends over time, and 7) further understanding of wolf ecology by evaluating prey requirements, habitat requirements, and interactions with other carnivores (USFWS 1987). It is likely that general habitat management actions in this plan (weeds, fire, etc.) will have little effect on wolves themselves. Effects on their main prey source, elk and deer, should be considered (M. Robertson, USFWS, personal communication, May 14, 2004).

5.2 Clean Water Act Considerations

Formed in 1970, the U.S. Environmental Protection Agency (USEPA) administers the federal Clean Water Act (CWA), requiring enforcement of water quality standards by states. These standards are segregated into *point* and *nonpoint* source water pollution, with point sources requiring permitting. Although controversial, this segregation means that most farming, ranching, and forestry practices are considered nonpoint sources and thus do not require permitting by the USEPA. A TMDL, or Total Maximum Daily Load, is a tool for implementing water quality standards where impairment of beneficial uses exists (Plan Section 5.2.2: TMDLs in the Imnaha subbasin) (USEPA 2004). The USEPA provides funding through Section 319 of the CWA for TMDL implementation projects. Section 319 funds are administered by ODEQ in Oregon (USEPA 2004).

In satisfaction of the nonpoint source pollution (NPS) control program update mandate, generally referred to as Section 319 of the CWA, the state of Oregon completed the Oregon Nonpoint Source Control Program Plan. The document represents a unified approach reflecting the State's intention to continue to plan, implement and prioritize actions to address NPS problems on a statewide basis, while avoiding undue duplication of effort (ODEQ 2000).

The Oregon Nonpoint Source Control Program Plan is an "umbrella" under which all CWA activities in Oregon are consistent. Objectives and strategies in the *Imnaha Subbasin Plan* shall be consistent and integrated with the water quality management plans in the state (NPCC 2001).

5.2.1 Consistency with Oregon State's Water Quality Management Plan

The updated Oregon Nonpoint Source Control Program Plan outlines the state's strategy to meet the EPA's revised Clean Water Act 319 program guidance dealing with nonpoint source pollution (ODEQ 2004). The primary purpose of the Nonpoint Source Assessments and Management Programs is to provide the states and tribes with a new blueprint for implementing programs to address priority nonpoint source water quality problems. The focus is needed in order to identify innovative funding opportunities and to effectively direct limited resources toward the highest priority issues and waterbodies. Subbasin planning efforts should be consistent and coordinated with the State's Water Quality Management Plan (NPCC 2001).

The Oregon Nonpoint Source Control Program shares the mission of *The Oregon Plan for Salmon and Watersheds* (Oregon Watershed Enhancement Board 2003) to restore Oregon's native fish populations—and the aquatic systems that support them—to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits. Protection and recovery of natural processes in watersheds is the aim (ODEQ 2000).

The Oregon Nonpoint Source Control Program Plan seeks to incorporate nine elements identified as necessary components for nonpoint source programs (ODEQ 2000):

1. Explicit short and long-term goals, objectives and strategies to protect surface and groundwater.

2. Strong working partnerships and collaboration with appropriate state, tribal, regional, and local entities, private sector groups, citizens' groups, and federal agencies.

3. A balanced approach that emphasized both statewide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

4. The program (a) abates known water quality impairments resulting from non-point source pollution, and (b) prevents significant threats to water quality from present and future activities.

5. An identification of waters and watersheds impaired or threatened by nonpoint source pollution and a process to progressively address these waters.

6. The State reviews, upgrades, and implements all program components required by §319 of the Clean Water Act and establishes flexible, targeted, interactive approaches to achieve and maintain beneficial uses of waters as expeditiously as practicable.

7. Identification of Federal lands and objectives which are not managed consistently with State program objectives.

8. Efficient and effective management and implementation of the State's nonpoint source program, including necessary financial management.

9. A feedback loop whereby the State reviews, evaluates, and revises its nonpoint source assessment and its management program at least every five years.

In the short term, the emphasis of the program is placed on restoration, that is reducing the level of existing pollution preventing the aquatic environment from realizing its proper functionality and biological diversity. The long-term strategy relies more on prevention to ensure that future waterways do not become impaired in the first place (ODEQ 2000).

The Vision and Guiding Principals (Plan Sections 2.1 and 2.2), Objectives (Plan Section 3: Aquatic/Terrestrial Ecosystems), and Socioeconomic Objectives (Plan Section 3.2.3) in the *Imnaha Subbasin Management Plan* are consistent and integrated with the key elements of the Oregon Nonpoint Source Control Program Plan. Long and short-term goals have been established. Monitoring and evaluation activities (Plan Section 4: M&E) describe measurable short-term outcomes and expected biological response of implementation strategies. Working partnerships and collaborative efforts have been developed during subbasin planning and public involvement meetings (Section 1). Local involvement during activities in impaired watersheds has been recommended (Plan Section 3.2.3: Socioeconomic objectives). Data gaps, research needs and monitoring activities are recommended and a feedback loop for adaptive management described (Plan Section 4: Research, monitoring, and evaluation).

5.2.1.1 303(d) Listed Segments

Section 303(d) of the CWA requires that water bodies violating state or tribal water quality standards be identified and placed on a 303(d) list. Water bodies that do not meet water quality standards with implementation of existing management measures are listed as impaired under §303(d) of the CWA. It is each state's responsibility to develop its respective 303(d) list and establish a TMDL for the parameter(s) causing water body impairment (USEPA 2004).

The entire Imnaha mainstem, and many reaches in key tributaries, are listed for temperature (Assessment Section 1.1.2.3: Water Quality, Figure 25: Streams in the Imnaha subbasin listed on

Oregon's 2002 §303(d) list). A complete list of streams listed under § 303(d) is provided in Assessment Section 1.1.2.3: Water Quality, Table 11: Imnaha River watershed §303(d) listings. Cultivation, farming, and settlement have reduced the occurrence of riparian species in certain areas, and are believed to be primary contributors to stream temperature increases (Assessment section 1.1.2.3: Water Quality). Environmental Objective 7A and 12A and Aquatics Environmental Monitoring Objective 4a regarding temperature reduction actions to improve water quality and reduce the number of stream miles listed as 303 (d) impaired.

5.2.2 TMDLs in Imnaha subbasin

A TMDL, or Total Maximum Daily Load, is a tool for implementing water quality standards and is based on the relationship between pollution sources and in-stream water quality conditions. The TMDL establishes the allowable loadings or other quantifiable parameters for a waterbody and thereby provides the basis to establish water quality-based controls. These controls should provide the pollution reduction necessary for a waterbody to meet water quality standards (USEPA 2004). A TMDL for temperature is being developed for the Imnaha (Assessment Section 1.1.2.3: Water Quality) and is expected to be completed by the end of 2004. (Paul Daneillo, ODEQ, Personal Communication, May 15, 2004). The TMDL for the Imnaha Subbasin will be published as part of a larger report on water bodies in Wallowa County.

6 Conclusions and Recommendations

6.1 Prioritization

6.1.1 Aquatics

A final synthesis component is presented in Table 12, Table 13, and in Figure 2. The multi-species prioritization is based on the previous, species-specific QHA information (refer to Section 1.5.1.5 in the assessment), but identifies priority areas only in HUCs where species overlap occurs, and where there are common management prescriptions (*e.g.*, restoration *vs.* protection *vs.* protection/restoration actions). The overlap of habitat use by the four focal species (Table 12) was ranked based on the number of life history stages occurring in the specific HUC (Table 13).

An inherent problem associated with this type of prioritization is the different distributions of the focal species. For example, resident bull trout tend to inhabit headwater reaches, compared to fall chinook that occur in the lower mainstem. Prioritizing areas according to species overlap therefore becomes bias towards those species with the widest distribution (*e.g.*, spring/summer chinook and summer steelhead).

Based on the previous limiting factors analysis (refer to Section 1.5.1.5 in the assessment) and the multi-species matrix, several common denominators emerge. First, when considering where and which management actions would prove most beneficial to multiple focal species, the upper Imnaha mainstem and headwater reaches of Big Sheep Creek emerge as areas with a comparatively high degree of species overlap and as areas within which protection is a common theme. The occurrence of multiple species in these portions of the subbasin should not be surprising, as they represent areas characterized by comparatively cooler water temperatures, sufficient flows (due to higher mean annual precipitation), and a moderate degree of protection from land use influences (Eagle Cap Wilderness occurs in HUCs 07R, 09P, 09O, and 09N).

Table 12. Sixth-field HUCs within which spring chinook (SC), fall chinook (FC), steelhead (SS), and bull trout (BT) co-occur and within which common restoration, protection, or protection/restoration activities have been defined. HUCs shown are not ranked in order of activity priority. A lack of species combinations indicates a lack of common activities.

	All Species	SC, FC, SS	SC, SS, BT	SC, SS	SC, BT	SS, BT
Priority: Restoration		08B Imnaha River 1	07P Big Sheep Creek 3	07K Big Sheep Creek 1 09A Imnaha River 08D Imnaha River 3 (town) 07M Big Sheep Creek 07D Little Sheep Creek 1		07H Little Sheep Creek 2 07J Little Sheep Creek 3 (Redmont, Ferg., Canal)
Priority: Protection			09M Imnaha River 9 09L Imnaha River 09N Imnaha River 09J Imnaha River		09P South Fork Imnaha River 07R Big Sheep Creek Headwaters	
Priority: Protection/Restoration	08C Imnaha River 2		09J Imnaha River	08H Lightning Creek 07Q Lick Creek 08E Horse Creek		09G Imnaha River 6 09G Imnaha River 6

Table 13. Multi-species prioritization of restoration, protection, and protection/restoration activities in the Imnaha subbasin. HUC rankings are based on the revised QHA restoration values and QHA protection scores (presented above), and are further stratified based on the number of life history stages[1] defined in the HUC. HUCs are prioritized based on the highest rank assigned. This prioritization effort should be used in combination with individual species prioritization (presented above).

	HUC_6	Spring Chinook				Fall Chinook				Steelhead				Bull Trout				Final Rank
		S/I	SR	WR	M	S/I	SR	WR	M	S/I	SR	WR	M	S/I	SR	WR	M	
Priority: Restoration	08B Imnaha River 1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	12
	07P Big Sheep Creek 3	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	08D Imnaha River 3 (town)	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	12
	07K Big Sheep Creek 1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	1	9
	07M Big Sheep Creek	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	1	9
	07D Little Sheep Creek 1	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	1	8
	07J Little Sheep Creek 3 (Redmont, Ferg., Canal)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	8
	09A Imnaha River	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	1	8
	07H Little Sheep Creek 2	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	5
Priority: Protection	07R Big Sheep Creek Headwaters	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	09J Imnaha River*[2]	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	09L Imnaha River	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	09M Imnaha River 9	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	09N Imnaha River	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	09P South Fork Imnaha River	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
Priority: Protect/Restore	09J Imnaha River*	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	12
	08C Imnaha River 2	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	12
	07Q Lick Creek	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	0	11
	09G Imnaha River 6	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	1	10
	08E Horse Creek	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	7
	08H Lightning Creek	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	7

[1]/ Life history stages include spawning/incubation (S/I), summer rearing (SR), winter rearing (WR), and migration (M)
[2]/ Asterisk (*) signifies that the HUC is defined for multiple management actions (*e.g.*, protection and protection/restoration)

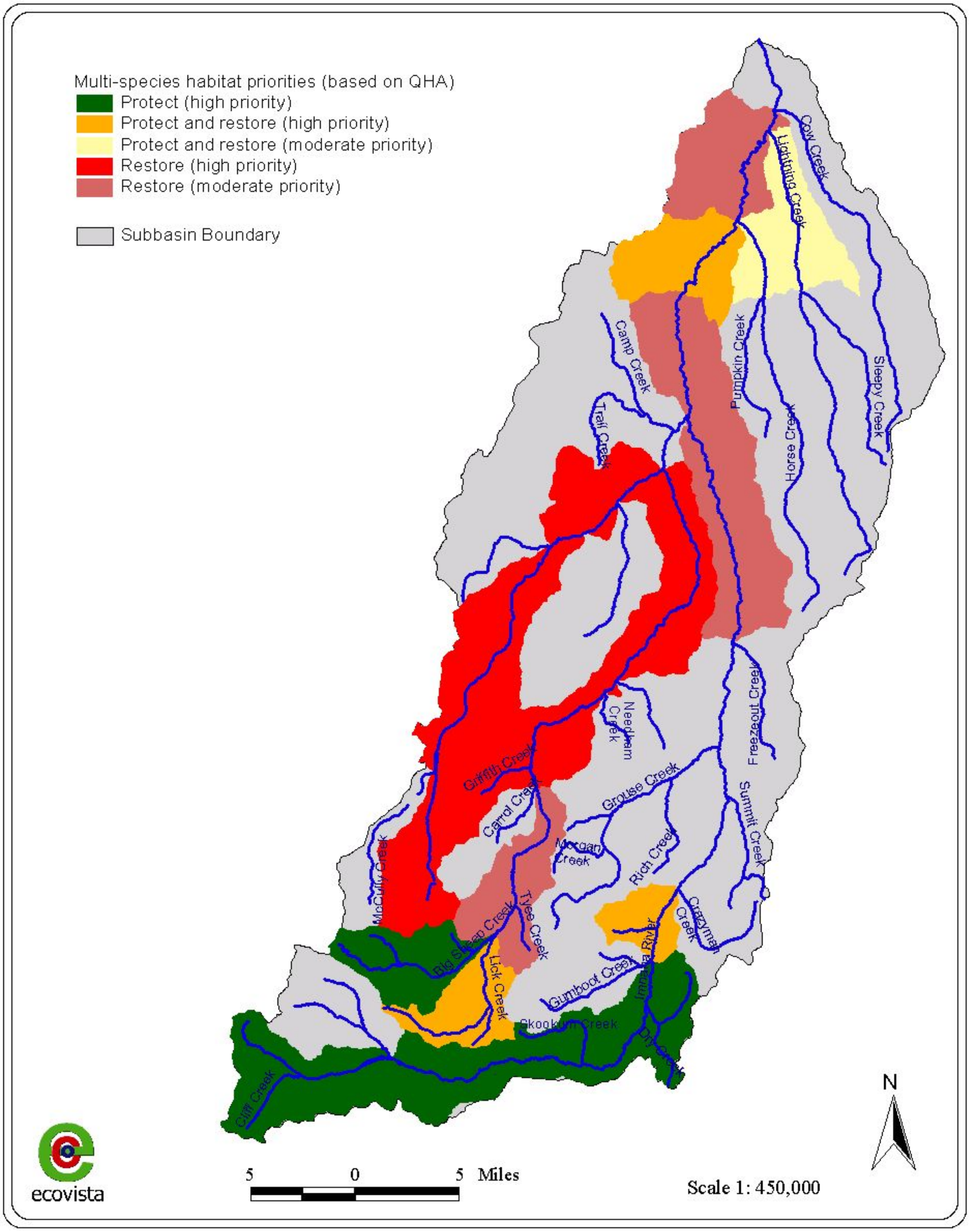

Figure 2. Multi-species representation of restoration, protection, and protection/restoration areas in the Imnaha subbasin. Not shown are Grouse Creek and Gumboot Creek, which are considered by ODFW to represent 'Moderate Priority' restoration areas (B. Knox, ODFW, personal communication, May, 2004).

The management prescription of ‘protection’ is similarly logical, as the upper Imnaha and Big Sheep watersheds contain core populations of bull trout, core spring/summer chinook spawning and rearing areas (upper Imnaha), and critical steelhead habitat. Protection of the core areas in these areas is consistent with underlying themes of conservation biology (*e.g.,* Doppelt et al. 1993) and metapopulation theory (*e.g.,* Rieman and Dunham 1999), especially when considering bull trout.

The Big Sheep Creek watershed (including Little Sheep Creek) represents the area in the subbasin where restoration activities would be most beneficial to multiple focal species. Lower mainstem reaches of Big and Little Sheep Creeks, starting at the confluence of Big and Little Sheep Creek, are inhabited by spring/summer chinook and summer steelhead (07D, 07K, 07M), while mid- upper-elevation reaches of Little Sheep Creek are used by summer steelhead and bull trout (07H, 07J). Species residing in these areas, as discussed in the limiting factors section of the assessment (refer to Section 1.5.1.5), are all limited by excessive stream temperatures and low flows. It is therefore reasonable to assume that riparian improvement actions would be a common restoration activity that would benefit multiple species in the Big Sheep Creek watershed. In the mid- upper-elevation reaches of Little Sheep Creek (HUCs 07H, 07J) steelhead and bull trout would benefit through restoration of connectivity (*e.g.,* addressing structural barriers).

Restoration of lower- and middile-mainstem habitats in the Imnaha (*e.g.*, HUCs 08B, 08D and 09A) is identified as a moderate priority, based on multiple species occurrence and life history needs. Common problems affecting the species (*e.g.,* spring/summer chinook, fall chinook, summer steelhead) that occur in these reaches include channel stability, low flows, high stream temperatures, and excessive sedimentation. Because of the size and location of the river, treatment of problems such as high temperatures, low flows, and sediment will be most effective if they were to occur in upstream areas (*e.g.*, Horse, Cow and Lightning Creeks). Efforts to address channel stability would be most effective in these areas. According to ODFW, Grouse and Gumboot Creeks should also be included in the category of moderate restoration priorities (B. Knox, ODFW, personal communication, May, 2004), however they did not emerge as such in the multi-species analysis. Spring/summer chinook occur in only the lower portion of Grouse Creek, while steelhead are well distributed throughout both Grouse and Gumboot Creeks. Common problems in both drainages include low flows and high temperatures. In Grouse Creek, a diversion near the confluence acts as a barrier to spring chinook.

Several areas are defined for both protection and restoration management activities (*e.g.*, HUCs 07Q, 08C, and 09J). As discussed in the assessment, the recommendation of ‘protect and restore’ is based on the fact that the HUC in question was ranked equally for both protection and restoration needs through the QHA modeling process. The ‘protect and restore’ recommendation for a HUC means that the habitat in question is currently providing an important function for a given focal species, but that it could potentially provide more functions given restoration actions occur. For example, in the case of HUC 07Q (Lick Creek), the habitat is suitable for a bull trout CHSU designation, it represents a core spring/summer chinook spawning area, and supports comparatively high densities of summer steelhead. The condition of habitat in Lick Creek is obviously suitable to support these species, and thereby warrants protection consideration, however, it could potentially improve given improvements in riparian vegetation, bank stability, and connectivity (*e.g.,* culverts acting as barriers to juvenile fish movement).

6.1.2 Terrestrial

6.1.2.1 Top terrestrial priorities

Objectives and strategies for improving the primary limiting factors to terrestrial species in the subbasin are contained in section 3.2.2. Projects that work to implement the strategies and meet the objective developed in this section will benefit the wildlife, plants and terrestrial communities of the subbasin and are priorities. However, during technical team discussions of protection and restoration priorities for the subbasin five items emerged as the top priority terrestrial issues for the subbasin. Reasons for selection as a top priority issue included potential for severe irreversible damage to the ecosystem as a result of inaction or disproportionate importance of the habitat affected.

- **Reduce the risk of catastrophic fire**
  Altered fire regimes and other disturbance processes have changed the stand density, and vegetative composition of the subbasins forests. Fuel loads have accumulated and more of the subbasins forests exhibit fuel model 9 or 10 characteristics than did historically. Fires burning in these fuel models can have much higher intensities, are more difficult to suppress, and have longer and more severe ecological impacts than other fires. For example, numerous negative effects were documented after the 1989 Canal Creek fire, including a reduction in shade-providing riparian vegetation, accelerated sheet, rill and gully erosion hazards and reduced hydrologic storage capacity. The fire burned more than 9,000 acres in the Upper Big Sheep Creek Watershed most with a high fire intensity (USFS 1995). This has reduced the structural diversity of forest habitat in the area and created very large habitat patches of early seral trees. Dense hardwoods have begun to establisn in the area, these trees are broviding stream shading and other habitat benefits. Conifers have not yet reestablished in the area (T. Schommer wildlife biologist USFS, personal communication May 2004).

  The Imanha Subbasin terrestrial technical team identified two areas where the risk of catastrophic fire in the subbasin is very high due to forest structural conditions, the Lick Creek (O7Q) and Gumboot (09K) subwatersheds. Large intense fires in these areas could have serious impacts on both wildlife and fish species in the subbasin. Reducing the potential for catastrophic fire in these areas should be a priority, potential methods for achieving this include precommercial thinning, mechanical treatment, underburn, and prescribed fire.

- **Reduce the risk of noxious weed invasion into grassland habitats**
  The grassland habitats of the Imnaha subbasin are still in relatively good condition relative to other grassland habitats in the Columbia Basin. Preventing the further establishment and spread of noxious weeds into these habitats is a priority for maintaining these high quality areas. Focus noxious weed efforts based on the priorities set by Wallowa County (see assessment section 1.5.2)

- **Restore degraded riparian areas**
  Riparian areas are very important to both the aquatic and terrestrial wildlife populations of the Imnaha subbasin. The Imnaha subbasin Multi-species Biological Assessment

(USFS 2003d) identified 17 subwatershed in the subbasin where riparian conditions are functioning at risk (7A,7D,7E,7H,7J,7K,7M,7O,7P,7Q, 8D, 9A,9D,9E,9F,9H,9K; see Appendix C for locations). Maintaining and enhancing riparian conditions should improve habitat for fish and riparian dependent wildlife and improve connectivity between habitats and populations. Other finer scale areas of the subbasin may be identified as needing riparian restoration in the future.

- **Increase baseline data collection and monitoring**
  Increased information on terrestrial populations in the subbasin, their interactions and ecosystem function is vital to effective management of the subbasins terrestrial resources. Increased levels of baseline data collection and monitoring during and after project implementation will increase the ability for effective adaptive management.

- **Protect existing good quality habitat**
  Many areas of the subbasin contain terrestrial habitats in good condition particularly when compared to the rest of the Columbia Basin. For example, the native bunchgrass habitats of the subbasin are among the best remaining examples in the region. Protecting these habitats should be a top priority as they provide habitat for species that have lost habitat across much of their historic range, support ESA listed plant populations, provide reference conditions that may be useful to restoration efforts in other areas. Protection of areas while they are in good condition is far more cost effective than restoring degraded areas, if restoration is even feasible.

6.1.2.2 Rules to consider in considering when evaluating terrestrial project merit

In addition to identifying the above issues as the top priorities the terrestrial technical team developed a list of rules that they feel should be considered in evaluating the merits of terrestrial projects in the subbasin.

- Maximize overlap between terrestrial and aquatic benefits.
- Prioritize projects that benefit both fish, and wildlife species. When biological benefits are equal prioritize projects that also benefit local communities.
- Prioritize projects that benefit multiple species, address multiple limiting factors, and have the greatest expected biological benefits.
- Prioritize projects that benefit ESA listed species or work to prevent the need for listing other critically imperiled species.
- Prioritize projects that enhance connectivity between or expand areas of existing high quality habitat.

The planning team developed the following recommendations to help guide implementation of this aquatic and terrestrial species and habitats plan for the Imnaha subbasin.

6.2 General Recommendations

The Planning Team developed the following recommendations to guide implementation of the Imnaha Subbasin Plan.

While the purpose of this process is to mitigate the impacts of the federal hydropower system on fish and wildlife resources, the purpose of this plan is to maintain and enhance the condition of the Imnaha subbasin, providing for abundant, productive, and diverse aquatic and terrestrial species and habitats, while maintaining and enhancing local lifestyles, customs, cultures, and economic viability, including the use of natural resources (Imnaha Vision Statement). The Planning Team desires to accomplish this in manner which minimizes adverse impacts to stakeholders and maximizes local public support.

The Planning Team believes that this plan can provide opportunities for natural resource-based economies to recover in concert with aquatic and terrestrial species. Critical to the successful implementation of this plan is the increased understanding and appreciation of the need to maintain, protect, enhance, and/or restore a healthy and properly functioning ecosystem. The team recognizes the importance of respecting and honoring tribal and private property rights and public lands as well as the current local conditions, values, and priorities of the subbasin. The Planning Team believes in the importance of fostering ecosystem protection, enhancement, and restoration that result in stewardship of natural resources, recognizing all components of the ecosystem, including the human component.

The Planning Team also believes a scientific foundation that incorporates indigenous and local knowledge is needed to diagnose ecosystem problems, design, prioritize, monitor and evaluate management to achieve plan objectives. The Imnaha Subbasin Plan provides a next step in the process, but the short time frame and funding restraints limited the ability of this iteration of subbasin planning to provide a thorough scientific foundation and to integrate that foundation throughout the planning process. This information will also provide the scientific basis for the public involvement and education activities also called for in this plan.

This plan is consistent with existing plans currently in use for the Imnaha Subbasin including but not limited to the Wallowa County Salmon Plan and the Wallowa Whitman National Forest Plan as amended by the Hells Canyon Comprehensive Management Plan. For a number of program areas, such as road management, this plan supplements and does not conflict with the existing plans. See the inventory table x for a list of existing plans.

The purpose of the subbasin plan is to use an assessment of existing natural resources for fish and wildlife and the gaps in current efforts to determine a plan of recommended actions over the next five years that will mitigate and improve conditions. The species of importance, along with ESA and CWA considerations, have been detailed. Limiting factors in the subbasin have been identified, as well as the gaps in existing management that do not address these factors. The following is a prioritization of needed actions, followed by recommendations for implementing the actions.

6.3 Summary and Synthesis of Plan Conclusions

Problem statements were developed with the Aquatic and Terrestrial Technical Teams, and made available for review by the Planning Teams, using factors defined as limiting the potential of focal species or habitats in the Assessment (Assessment Section 1.5.1: Aquatic Resources Limiting Factors and Assessment Section 1.5.2: Terrestrial Focal Habitats Limiting Factors). Socioeconomic Problem Statements (Section 1.5.3) were developed by the Planning Team to address potential factors limiting successful implementation of this plan. Objectives and associated strategies were then developed to address each problem statement.

Aquatic and Terrestrial Objectives (Plan Section 3) were designed to address the needs of focal species and habitats. Objectives were developed to address problems defined for each focal habitat. Socioeconomic Objectives (Plan Section 3.2.3: Socioeconomic Components) are designed to provide operational guidance for implementing the terrestrial and aquatic protection and restoration objectives and strategies outlined in the plan.

Research, Monitoring, and Evaluation activities (Plan Section 4.4) are closely related to the vision, objectives and strategies described in Plan Section 2 and 3 of this plan. This section summarizes additional research, monitoring, and evaluation (RM&E) activities needed to aid in resolving management uncertainties. Data gaps and research needs were outlined by the TT. Monitoring and evaluation activities were described as well as the expected short- and long-term outcomes. Adaptive management is emphasized in this plan. To achieve each objective, strategies require a feedback loop for integration of additional information and modification of future activities.

Recommended actions to mitigate and improve conditions for fish and wildlife, over the next 5 years, were developed during prioritization exercises with the Technical Team, and available for review by the Planning Team (Plan Section 6.1: Prioritization). The Aquatic and Terrestrial Technical Teams each developed a list of rules for prioritization, based on reviews of other subbasin planning efforts, and a brainstorming exercise. From this list, the Technical Team choose a structure most appropriate for prioritization of activities in the Imnaha subbasin. Little effort to develop a quantified prioritization method was attempted due to lack of time and interest of the Technical Team.

The Technical Team did not wish to prioritize strategies, rather activities should be implemented as they present themselves, in the context of the prioritization scheme described in Plan Section 6.1.1: Aquatic Prioritizations and Plan Section 6.1.2: Terrestrial Prioritizations. Common rules for prioritization are: 1) build from strength by protecting areas in the best condition, 2) restore outwardly from areas of strength, 3) prioritize for multiple species benefits, 4) prioritize according to importance of limiting factors to be addressed, and 5) prioritize for maximum overlap between terrestrial and aquatic benefits. Water quality (excessive temperatures), water quantity, and excessive fine sediment were most often defined as limiting during aquatic prioritization exercises. The Terrestrial Technical Team determined that catastrophic fire, noxious weeds, and riparian degradation are the most limiting factors to focal terrestrial species and associated habitats in the Imnaha subbasin. The terrestrial team also recommended that the protection of existing high quality habitat and collection of scientifically sound baseline data were high priorities. The Aquatic and Terrestrial Technical Team finally determined that projects benefiting ESA species or habitats, or those that work to keep critically imperiled species from being listed, should be prioritized over projects that do not.

6.3.1 Aquatics Recommendations

The recommendations provided below represent a summary of aquatic needs identified in the subbasin assessment and management plan and should therefore not be considered a comprehensive list. The reader should refer to Sections 1.2.8 (Aquatic Environmental Conditions), 1.3 (Out of Subbasin Effects), and 1.5 (Identification and Analysis of Limiting Factors and Conditions) in the assessment and Sections 3.2.1 (Problem Statements, Objectives, and Strategies – Aquatic System), 4.4.1 (Aquatic RM&E), and 6.1.1 (Prioritization Recommendations – Aquatics) for additional details and discussion.

6.3.1.1 Subbasin-Level Recommendations

Based on information provided in the Imnaha Subbasin Assessment, the following recommendations should be considered;

1) Restoration. Based on the multi-species limiting factors analysis, high priority restoration areas are most common in the Big Sheep Creek watershed. Excessive stream temperature, low flows and channel form/stability are the most common limiting factors affecting multiple species. For optimal ecological benefits, restoration efforts should occur first in upland or headwater areas and proceed downriver.

   Restoration of lower- and middile-mainstem habitats in the Imnaha is identified as a moderate priority, based on multiple species occurrence and their life history needs. Common problems affecting the species that occur in these reaches include channel stability, low flows, high stream temperatures, and excessive sedimentation. Restoration efforts should occur first in upland or headwater areas and then proceed downriver to effectively address problems in the lower elevation portions of the subbasin.

2) Protection. Multiple species will benefit if headwater reaches are protected. The wilderness designation in many of the analysis areas of the upper mainstem Imnaha and Big Sheep Creek effectively addresses this priority and allows for additional prioritization.

   Priority areas identified as 'protect and restore' should be addressed in order to benefit multiple focal species (*e.g.*, HUCs 07Q, 08C, and 09J). These are areas, such as Lick Creek, that provide an important ecological/biological function for a given focal species, but would improve considerably given appropriate restoration actions occur.

3) A Regionally Coordinated RM&E Effort. According to the ISRP (2003b), the value of a monitoring and evaluation plan is greatly enhanced if different types of monitoring are integrated. Adherence of a regionally accepted, scientifically based RM&E approach,

will provide us with a better picture of species status at differing resolutions (*e.g.*, reach, HUC, watershed, population unit, subbasin, ESU, province). Status monitoring, as presented in the RM&E section (Section 4.4.1), will describe existing conditions and provide evidence of trend over time. The NOAA Fisheries (2002) RME Plan calls for status monitoring to document progress toward recovery of listed populations.

We propose the collection of performance measure data in order to describe differences or similarities between two or more groups of fish. Comparative performance testing, sometimes called effectiveness monitoring, should also occur within and among individual streams. Paired comparisons should be tested at multiple life stages and involve treatment vs. natural, treatment vs. reference, and treatment vs. treatment analysis.

4) Genetics Research: The collection of genetics data is defined as a research need for each focal species. This information will allow for the differentiation of populations and sub-populations, and provide for more effective management of the five focal species.

6.3.1.2 Species-Level Recommendations

Spring/Summer Chinook

Based on the assessment and management plan, the following actions should occur so as to address critical uncertainties over the IRBSH and IRMAI populations

- Collection of juvenile emigrant abundance data
- Determination of egg-to-emigrant survival rates
- Representative trapping and tagging across the entire emigration period
- Collection of adult escapement data
- Monitor out-of-basin survival via smolt-to-adult return rates.
- Collection of genetic information at the population level
- Collection of dispersal and stray rate information
- Collection of spawn-timing data

Based on QHA output, restoration actions should primarily occur on mainstem habitats in the lower third of the subbasin, working in an upstream to downstream progression. Actions conducive to the reduction of stream temperatures are most needed (*e.g.,* improvement of riparian function), as are those that improve baseflows, channel stability, and reduce sedimentation.

Headwater areas and key tributary habitat (*e.g.,* Freezeout, Camp, and Summit Creeks) are critical to spring/summer chinook and warrant protection. These habitats have comparatively high water quality (low pollutants), are well connected (low number of obstructions), have stable flows, and are relatively complex.

It will also be important to maintain and improve existing artificial production programs to buffer out-of-basin limiting factors and minimize occurrence of low population escapement.

Fall Chinook

Based on the assessment and management plan, the following actions should occur so as to address fall chinook (SNMAI) uncertainties:

- Collection of adult escapement data
- Additional assessment of outmigrant timing

Because of their limited distribution in the lower mainstem, habitat restoration activities that occur in upstream reaches (*e.g.,* mid- upper-elevations) would likely do as much for fall chinook as would those occurring in the lower five miles of the Imnaha. Efforts that improve base flow conditions and reduce sediment are most needed.

Since the majority of fall chinook habitat occurs in a roadless reach, the habitat is afforded a comparatively high degree of protection from degradation.

Summer Steelhead

Based on the assessment and management plan, the following actions should occur so as to address critical uncertainties over the IRMMT-s population;

- Determination of egg-to-emigrant survival rates
- Representative trapping and tagging across the entire emigration period
- Collection of adult escapement abundance and distribution data
- Monitor out-of-basin survival via smolt-to-adult return rates
- Collection of genetic information at the population level

Based on QHA output, habitat restoration actions should first occur throughout the majority of the Big Sheep Creek watershed, the lower half of the mainstem Imnaha, Grouse Creek, and Gumboot Creek. Actions conducive to the reduction of stream temperatures are most needed (*e.g.,* improvement of riparian function), as are those that improve baseflows, channel stability, and reduce sedimentation.

Continued and increased protection of headwater and tributary (*e.g.,* Cow, Lightning, Horse, Devils Gulch, Squaw, and Summit Creeks) habitats is needed for summer steelhead. Actions should be taken to ensure for the continued protection of the high water quality (low pollutants), adequate temperatures, and diverse habitats currently present in these areas.

It will also be important to maintain and improve existing artificial production programs to buffer out-of-basin limiting factors and minimize occurrence of low population escapement.

Bull Trout

Based on the assessment and management plan, the following actions should occur so as to address critical Imnaha bull trout uncertainties;

- Determination of relative proportions of resident and migratory life history forms
- Definition of bull trout use in the Snake River mainstem
- Definition of bull trout fidelity to their natal streams
- Continued collection of abundance and distribution data
- An evaluation of connectivity between local populations

Based on QHA output, restoration actions should be focused on migration corridors (*e.g.*, lower mainstem reaches of Little and Big Sheep Creeks and the Imnaha River) and in two key spawning and rearing areas (*e.g.*, Big Sheep Creek headwaters (HUC 07R) and the upper mainstem (HUC 09M) Imnaha). Restoration actions that improve connectivity, stream temperatures, base flows, and fine sediment will be most beneficial to the species.

Similar to the other focal species, protection of headwater habitats is a priority. Protection of migratory habitat (*e.g.*, maintenance of connectivity between local populations) is also needed by both fluvial and resident forms. Actions that provide for the continued maintenance of water quality, water quantity, connectivity and habitat diversity will benefit the species in these areas.

Pacific Lamprey

As evident throughout the assessment, there is very little known about Pacific lamprey in the Imnaha subbasin. Information that is critical to improve our understanding of Pacific lamprey in the subbasin includes;

- Population distribution
- Population abundance/density estimates
- Capture efficiencies
- Population monitoring
- Basic ecological information, including habitat use
- Within species biodiversity

Specific needs defined at the Columbia River Basin Lamprey Technical Workshop (March 9, 2004) and endorsed by USFWS (K. Paul, USFWS, personal communication, April, 2004) include the following:

- Lamprey status
- Basic Biology/Ecology, including but not limited to:
    - species and gender
    - migration
    - aging
    - reproduction

growth
feeding

- Genetic Structure
- Adult/Juvenile Passage
- Survival estimates
- Limiting factors
  environmental stressors
  habitat requirement/availability for life history stages
  host availability
- Restoration Actions
- Education and Outreach

6.4 Social Impact Conclusions

The Imnaha Planning Team participated in an exercise at two meetings during the Spring of 2004 to consider the social and economic implications of implementing the Imnaha Subbasin Plan. The results of these exercises were then reviewed and revised by the planning team and are presented in this section.

Maintaining a viable farming and ranching industry is critical to sustaining a local population in the subbasin, which is an important value to the planning team and local governments and groups. A number of terrestrial and aquatic objectives include recommendations that impact grazing practices. The plan strives to mitigate the impacts of the hydropower system on fish and wildlife while not significantly altering livestock management practices as they now exist. Grazing is an important natural resource use in the subbasin with important economic and multigenerational cultural traditions.

One concern identified by the Planning Team is that negative impacts to the ranching community could occur if there was an attempt to implement this plan too quickly and without adequate involvement of the affected ranchers. Many BMPs are widely accepted as general strategies. The goals need to be realistic and achievable. They need to be developed in concert with livestock producers with enough time in the process to allow successful transitions without major operational impacts. Livestock producers are not opposed to proper grazing practices, they are opposed to rapid, sudden required shifts that do not allow time to adjust operations with minimum disruption and economic consequences.

Projects that would improve the timing, duration, and intensity of grazing along with distribution of livestock could benefit ranchers as well as aquatic and terrestrial species and habitats. Many BMPs have been completed in the subbasin, but there is still room for additional projects on tributaries and on the mainstem Imnaha River. This has the potential, at least on public lands, to sustain existing numbers of cattle while improving aquatic and terrestrial conditions due to reduced impacts on key aquatic and terrestrial resources.

Timber management through proper forest practices will positively impact a number of objectives and strategies in this plan, i.e. sediment reduction, fuel load reduction, control of insects and disease. This plan is consistent with state and federal forest practices rules use in the industry. This plan will not have a significant negative impact on the timber industry, while potentially providing supplemental funds to reduce problems impacting aquatic and terrestrial resources.

Restoring fire regimes to a more historic trend in the Imnaha may benefit a number of stakeholders. Reducing impacts of catastrophic wildfire on forage resources is important to maintaining a stable local agriculture. These fires destroy the forage base and provide an avenue for invasive exotic plant invasion. They have economic impacts by reducing short-term forage resources and, through weed invasion, reducing long term forage. Restoring fire regimes will help avoid this problem, benefiting local communities and natural resource users. Reducing the impact of catastrophic fire will also benefit individuals living in the subbasin, by reducing the threat of loss of life and property. This plan will potentially reduce the loss of economic resources to the timber industry by reducing the potential loss of timber resources in the subbasin.

Noxious weeds invade habitats after fire and other disturbances. This impacts wildlife, agriculture, recreation, water quality, and residents of the subbasin. A need exists for more effective implementation of noxious weed strategies in the subbasin. More intense noxious weed problems tend to correspond to poor land use practices. The entire scale of the current invasive exotic plants control efforts needs to grow; there is a need for more funding, more projects, and more programs and activities to address current problems. Implementing the objectives and strategies in this plan will benefit all stakeholders. One concern to keep in mind, is that some implementation strategy can impact culturally important plants. This concern needs to be integrated into planning and implementation of noxious weed strategies.

Currently hunting, fishing and wildlife is an important industry in the state of Oregon. Successful implementation of this plan will benefit anglers, hunters and wildlife watchers by helping preserve, maintain and/or improve fish and wildlife populations and habitats. Unmanaged overuse of the riparian areas by recreationists can be a negative impact, and this concern needs to be integrated into planning and implementation of projects in riparian zones, especially on public lands.

6.5 Final comments

Implementation in the Imnaha Subbasin Plan needs to integrate information from the other major subbasins integral to this area. Fish and wildlife are not always restricted to subbasin boundaries. Future work needs to integrate the results of multiple subbasin planning and implementation efforts to address these multiple subbasin issues.

The Planning Team is concerned because it is unclear how future comments will be addressed and the plan revised. Review comments and revisions need to be addressed through a process that includes Planning Team involvement and oversight. This will include funding for Planning

Team involvement, potential coordinators, facilitation and review and update of the plan. Insufficient time existed for this to be a fully integrated planning process that allowed policy makers and public to integrate with the technical committees to meet the educational and public involvement objectives of this plan.

The Planning Team believes this process has provided positive interaction with stakeholders and has resulted in information to direct future implementation activities in the subbasin. This plan provides the rationale for increasing BPA funding to activities in the Imnaha. This plan provides an adequate foundation for prioritization and implementation of activities in the subbasin while pointing towards the need to develop additional information and planning to refine future activities.

The Planning Team intends that this plan will provide a structure for implementation and future research and planning in the Imnaha subbasin. This plan will streamline the process for project selection and implementation.

The Planning Team requests that funding be directed to implement the objectives and strategies as outlined and prioritized in this plan.

7 References

Bangs, E. and S. Fritts. 1996. Reintroducing the gray wolf to central Idaho and Yellowstone National Park. U.S. Fish and Wildlife Service, Helena, MT. Website: http://www.wolfology.com/id93.htm

Bisbal, G.A. 2001. Conceptual design of monitoring and evaluation plans for fish and wildlife in the Columbia River ecosystem. Environmental Management, 28(4):433-453.

Bureau of Land Management (BLM). 2002. Lower Snake River Ecosystem Analysis at the Watershed Scale. U.S. Department of the Interior, BLM, Cottonwood Field Office, Cottonwood, ID.

Cassirer, E. F. 1995. Wildlife Inventory, Craig Mountain Mitigation Area, Idaho. Idaho Department of Fish and Game, Nongame and Endangered Wildlife Program, Lewiston.

Chilcote, M.C., C. Dale, K. Kostow, H. Schaller, and H. Weeks. 1992. Wild fish management policy. Biennial Prog. Rep., 31 p. Oreg. Dep. Fish Wildl., P.O. Box 59, Portland, OR 97207.

Columbia Basin Fish and Wildlife Authority (CBFWA). 1999.

Columbia Basin Fish and Wildlife Authority (CBFWA). 2004. Draft Collaborative Systemwide Monitoring and Evaluation Project. Available at http://www.cbfwa.org/rme.htm. CBFWA, Portland, OR.

Columbia Basin Research (1999). Columbia River Dart Data Access in Real Time. University of Washington, School of Fisheries. http://www.cqs.washington.edu/dart/dart.html.

Dennis, B., P.L. Munholland, and J.M. Scott. 1991. Estimation of growth and extinction parameters for endangered species. Ecological Monographs, 61(2): 115-143.

Doppelt, B.; Scurlock, M.; Frissel, C. and Karr, J. (1993). Entering the Watershed: A New Approach to Save America's Ecosystems. Covelo, CA: Island Press.

Federal Caucus. 2000. Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery Strategy. http://www.salmonrecovery.gov/Final_Strategy_Vol_1.pdf

Ford, M. J. 2002. Applications of selective neutrality tests to molecular ecology, a review. Molecular Ecology, in press

Hesse, J.A., and J.R. Harbeck. 2000. Northeast Oregon hatchery spring/summer chinook salmon conceptual monitoring and evaluation plan. Prepared for Bonneville Power Administration. DOE/BP-3267.

Hesse, J.A., N. Espinosa, M. Blenden, and R. Sharma. In prep. Tributary-specific adult steelhead abundance: Imnaha River Subbasin, Oregon 2000 - 2003. Nez Perce Tribe Department of Fisheries Resources Management. Lower Snake River Compensation Plan Technical Report 2004-??. Lapwai, Idaho.

Hill, W. G. 1981. Estimation of effective population size from data on linkage disequilibrium. Genet. Res. (Cambridge) 38: 209 216.

Hill J.L. and K.L. Gray. 2004. Conservation Strategy for Spalding's catchfly (*Silene spaldingii* Wats.). U.S. Fish and Wildlife. Boise, Idaho.

Holmes, E.E. 2001. Estimating risks in declining populations with poor data. Proceedings of the National Academy of Science USA 98: 5072-5077.

Holmes, E.E., and W.F. Fagan. 2002. Validating population viability analysis for corrupted data sets. Ecology 83 (9): 2379-2386.\

Independent Scientific Review Panel (ISRP). 2003a. Review of Draft Clearwater Subbasin Plan for the Northwest Power Planning Council.

Independent Science Review Panel (ISRP). 2003b. Review of revised mainstem systemwide proposals for research, monitoring and evaluation. Prepared for the Northwest Power Planning Council. ISRP 2003-6.

Independent Science Review Panel (ISRP). 2004. ISRP Step Two Review of the Northeast Oregon Hatchery (NEOH) Spring Chinook Master Plan: Monitoring and Evaluation Plan (ISRP 2004-10). < http://www.nwcouncil.org/library/isrp/isrp2004-10.pdf >

Jordan, C. and 15 co-authors 2002. Mainstem/Systemwide Province Stock Status Program Summary. Guidelines for Conducting Population and Environmental Status Monitoring. February 22, 2002. Prepared for the Northwest Power Planning Council. http://www.cbfwa.org/files/province/systemwide/subsum/020515StockStatus.pdf

Krimbas, C. B. and S. Tsakas. 1971. The genetics of Dacus oleae. V. Changes of esterase polymorphism in a natural population following insecticide control selection or drift? Evolution 25:454 460.

Lewontin, R. C., and J. Krakauer. 1973. Distribution of gene frequency as a test of the theory of the selective neutrality of protein polymorphisms. Genetics 74:175 195.

National Marine Fisheries Service (NMFS). 2000. Biological Opinion on the Federal Columbia River Power System. NMFS, Portland, OR. Website: http://www.nwr.noaa.gov/1hydrop/hydroweb/docs/Final/2000Biop.html

National Marine Fisheries Service (NMFS). 2002. Memorandum from Bob Lohn to Frank Cassidy regarding establishment of interim abundance and productivity targets for ESA listed salmon and steelhead in the Interior Columbia Basin. Available online via: http://www.nwr.noaa.gov/occd/InterimTargets.pdf

Nei, M. and F. Tajima. 1981. Genetic drift and estimation of effective population size. Genetics 98:625 640.

Nez Perce Tribe; Confederated Tribes of the Umatilla Indian Reservation and Oregon Department of Fish and Wildlife (1990). *Imnaha River Subbasin Salmon and Steelhead Production Plan*.

Northwest Power and Conservation Council (NPCC). 2000. Columbia River Basin Fish and Wildlife Program: a multi-species approach for decision making. Available at http://www.nwcouncil.org.

Northwest Power and Conservation Council (NPCC). 2001. Technical Guide for Subbasin Planners, Council Document 2001–20.

Northwest Power and Conservation Council (NPCC). 2003. Subbasin Planning website. <http://www.nwcouncil.org>.

Northwest Power and Conservation Council (NPCC). 2004. Subbasin Planning website. <http://www.nwcouncil.org>

Oregon Watershed Enhancement Board. 2003. 2001-2003 Oregon Plan Biennial Report. Salem, Oregon. Website: http://www.oweb.state.or.us/publications/OR_Plan_Report01-03.pdf

Oregon Department of Environmental Quality (ODEQ). 2000. Oregon Nonpoint Source Control Program Plan. Portland, Oregon

Oregon Department of Environmental Quality (ODEQ). 2004. Oregon Nonpoint Source Pollution Program. Website: http://www.deq.state.or.us/wq/nonpoint/npp.htm

Pacific Northwest Aquatic Monitoring Partnership (PNAMP). 2004. Considerations for Monitoring in Subbasin Plans – for the Pacific Northwest Aquatic Monitoring Partnership. May, 2004. http://www.nwcouncil.org/fw/subbasinplanning/admin/guides/pnamp.pdf

Quigley, T. M. and Arbelbide, S. J., Eds. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins. U.S. Department of Agriculture, Forest Service, Portland, OR.

Rieman, B. E. and Dunham, J. B. (1999). *Metapopulations and Salmonids: A Synthesis of Life History Patterns and Empirical Observations*. Boise: U. S. Forest Service, Rocky Mountain Research Station; Biological Resources Research Center.

Ruediger, Bill, Jim Claar, Steve Gniadek, Bryon Holt, Lyle Lewis, Steve Mighton, Bob Naney, Gary Patton, Tony Rinaldi, Joel Trick, Anne Vandehey, Fred Wahl, Nancy Warren, Dick Wenger, and Al Williamson. 2000. Canada lynx conservation assessment and strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT.

U.S. Environmental Protection Agency (USEPA). 2004. Total Maximum Daily Load Program: Region 10: the Pacific Northwest. Website: http://yosemite.epa.gov/R10/water.nsf/

U.S. Fish and Wildlife Service (USFWS). 1986. Recovery plan for the Pacific bald eagle. Portland, OR.

U.S. Fish and Wildlife Service (USFWS). 1987. Northern Rocky Mountain Wolf Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado. 119p.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1996. Habitat Conservation Planning Handbook.

U.S. Fish and Wildlife Service (USFWS). 2000. Revised Recovery Plan for MacFarlane's Four o'clock. Portland, Oregon.

U.S. Fish and Wildlife Service (USFWS). 2002. Chapter 18, Southwest Idaho Recovery Unit, Idaho. 110 p. In: U.S. Fish and Wildlife Service. Bull Trout (Salvelinus confluentus) Draft Recovery Plan. Portland, Oregon.

U. S. Forest Service (USFS). 1998. Steelhead Consultation for Big Sheep Creek Section 7 Watershed: Assessment of Ongoing and Proposed Activities. Wallowa-Whitman National Forest.

U.S. Forest Service (USFS). 2003a. Imnaha Subbasin Multi-Species Biological Assessment (2003-2005). Wallowa-Whitman National Forest.

U.S. Forest Service (USFS). 2003b. Land Resource Management Plan. Website: http://www.fs.fed.us/publications/

U.S. Forest Service (USFS). 2003c. Hells Canyon National Recreation Area Comprehensive Management Plan Final Environmental Impact Statement, Volume 1. U.S. Department of Agriculture, USFS, Pacific Northwest Region.

Utter, F., P. Aebersold, and G. Winans. 1987. Interpreting genetic variation detected by electrophoresis. In N. Ryman and F. Utter (editors). Population Genetics and Fishery Management, p. 21-45. University of Washington Press, Seattle.

Wallowa County Comprehensive Land Use Plan, Adopted 5/21/03. From the Wallowa County Website.

Wallowa County and Nez Perce Tribe (1993; revised in 1999). *Salmon Habitat Recovery Plan with Multi-Species Habitat Strategy*. Nez Perce Tribe, Lapwai, Idaho.

Waples, R. S. 1988. Estimation of allele frequencies at isoloci. Genetics 118:371-384.

Waples, R. S. 1990. Conservation genetics of Pacific salmon. III. Estimating effective population size. J. Heredity 81:277-289.

Waples, R. S. 1989. A generalized method for estimating effective population size from temporal changes in allele frequency. Genetics 121:379-391.

Wisdom, M. J., R. S. Holthausen, D. C. Lee, B. C. Wales, W. J. Murphy, M. R. Eames, C. D. Hargis, V. A. Saab, T. D. Rich, F. B. Samson, D. A. Newhouse, and N. Warren. 2000. Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad Scale Trends and Management Implications. U.S. Department Agriculture, Forest Service, Pacific Northwest Research Station General Technical Report PNW-GTR-485 Portland, OR.

Zar, J.H. 1984. Biostatistical analysis, 2nd edition. Prentice-Hall, Englewood Cliffs, New Jersey.

8 Technical Appendices

Appendix A – Supplemental Information for Aquatics Objectives and Strategies

Appendix Table 1. Numerical criteria reviewed from various plans pertaining to the Imnaha River Subbasin to develop subbasin goals for adult fish returns. CRITFC=Spirit of the Salmon; 1990 Plan= 1990 Imnaha Subbasin Salmon and Steelhead Production Plan; NMFS 2002=NMFS Draft Interim Abundance Goals; CRFMP=Columbia River Fish Management Plan; LSRCP=Lower Snake River Fish and Wildlife Compensation Plan; NEOH=Northeast Oregon Hatchery Program

Species	Long-term Return Objective	Natural Spawning Component	Hatchery Spawning Component	Total Spawning Component	Harvest Component	Overall Goal/Notes
Spring chinook						
CRITFC	5,740	3,800	----	----	700	
1990 Plan	6,700	3,821- 4,768	----	----	----	USACE 1975; Carmichael and Boyce 1986
NMFS 2002		2,500	----	----	----	Interim Abundance Goal
CRFMP		25,000[1]	10,000[1]	35,000[1]		At Lower Granite
LSRCP	3,216	----	400	----	----	Mitigation goal (48%)
NEOH	6,700	variable	??	variable	> 700	Sliding scale and full production with new facilities
Fall chinook						
CRITFC	3,000	----	----	----	----	
1990 Plan	300	----	----	----	----	USACE 1975 historic estimate
NMFS 2002	2500[2]	----	----	----	----	Interim Abundance Goal (Snake River)
LSRCP	18,300	68	-----	----	----	To project area (Snake River) and mitigation goal
A-Run Steelhead						
CRITFC	4,315	2,100	----	----	2,000	
1990 Plan		2,100	----	----	2,000	Thompson et al. 1958
NMFS 2002		----	----	----	----	Interim Abundance Goal
CRFMP	<62,200[3]					At Lower Granite
LSRCP	1,920	----	195/364	----	----	Mitigation goal – Current
Bull Trout						
Lamprey						

Species	Long-term Return Objective	Natural Spawning Component	Hatchery Spawning Component	Total Spawning Component	Harvest Component	Overall Goal/Notes
CW Tech. Group	10,000[4]	----	-----	----	----	Based on 60's count at L. Snake River dams

1 CRFMP, which has expired (US v. Oregon), establishes interim management goals for fish passing over the Lower Granite Dam; Snake River specific goals are not defined.

2 Represents interim abundance goal for Snake River ESU

3 CRFMP, which has expired (US v. Oregon), establishes interim management goals for fish passing over the Lower Granite Dam; Snake River specific goals are not defined.

4 Interim goal is based on historic (late 1960's) counts >30,000 at Lower Snake River dams

Appendix Table 1 References:

Carmichael, R. W and R. Boyce. 1986. Grande Ronde River Spring Chinook Production Report (United States versus Oregon). Oregon Department of Fish and Wildlife, Portland, Oregon.

USACE (United States Army Corps of Engineers). 1975. Lower Snake River Fish and Wildlife Compensation Plan. Special Report. U.S. Army Corps of Engineers. Walla Walla, Washington. 95pp. plus Appendices.

Appendix B – RM&E Appendix Tables

Appendix Table 2. Definitions of key performance measures used to evaluate fish populations and habitat in Imnaha M&E efforts (CSMEP unpublished data)

	Performance Measure Primary Data	Definition of Peformance Measure
Abundance	Adult Escapement	Derived or raw measure. Number of adult fish that have "escaped" past fisheries to a certain point (e.g., the mouth of the Columbia). Equals ***adult spawner abundance*** if considering all fisheries (i.e. adults on spawning ground). May be derived using additional data such as harvest information (catch or rates), escapement to spawning ground (from weir or redd counts), upstream conversion rates, etc (e.g., Beamesderfer et al 1997). It is a raw measure if it is escapement to the spawning ground.
	Fish per Redd	Derived measure. Number of spawners (male + female) /# of counted redds, or the number of females per redd.
	Adult Spawner Abundance	Derived or Raw measure. Direct count of the number of fish on spawning ground (e.g., wier count) (or expanded estimate from redd counts, carcass recovery)
	Index of Spawner Abundance (redd counts)	Raw measure (primary). Counts of redds in spawning areas. This is data from which spawner abundance is estimated (e.g., Snake River spring-summer chinook). Data may be collected in a number of ways for variety of purposes such as index counts (e.g., peak counts on small section of tributary for trends), or extensive area counts over a large portion of a tributary approaching a complete census (absolute abundance), using a probability based sampling approach such as EMAP for presence/abscence type surveys.
	Hatchery Fraction	Raw measure (primary): Percent of fish on spawning ground that originated from hatchery and strayed to natural spawning ground. Determined from carcass or weir sampling.
	Harvest	Raw measure (primary). Number of fish caught in ocean, mainstem or tributary fisheries (commercial, tribal, or recreational). Determined from commercial landings, creel surveys, etc.
	Index of Juvenile Abundance (Density)	Raw measure (secondary). Number of fry, parr, or smolts per unit area of rearing habitat.
	Juvenile Emigrant Abundance	Raw measure (primary). Estimates of the total number of fry, parr, or smolts emmigrating from tributary streams (e.g., determined from rotary screw trap estimates).
	Hatchery Production Abundance	Raw measure (primary). Number of parr, or smolts released from a hatchery per year.

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Smolt Equivalents	Derived measure. Requires estimating number of smolts to some point in time. For example, converting the number of smolts from a tributary to the number of smolt equivalents at the first mainstem dam. An estimated tributary-to-dam survival rate is multiplied by the estimated smolt abundance for a tributary. Parr abundance can also be expressed in terms of smolt equivalents. This requires an estimated parr-to-smolt-at-dam survival rate, which is multiplied by the estimated number of parr. This latter survival rate includes both overwinter survival and tributary-to-dam survival components.
	Run Prediction	Derived measure. Short term forecast of expected future adult returns to some point (e.g., mouth of Columbia, or Snake River) based on current data (e.g. # smolts out, prior yearrs adult returns, etc.).
Survival-Productivity	Smolt-to-Adult Return Rate	Raw measure (secondary): Number of adults from a given brood year returning to a point (e.g., LGR dam) divided by the number of smolts that left this point 1-3 years prior, integrated over all return years.
	Parent Progeny Ratio (lambda, adult-to-adult)	Derived measure: Lamda, the median annual population growth rate estimate from adult-to-adult data (BiOp 2000, pg 6-4). Raw or derived measure: adult-to-adult can be either the ratio of return spawner to parent spawner abundance using expanded estimates, or a raw measure using ratio of return redds to parent redds.
	Recruit/spawner (smolt per female or redd)	Derived measure: Production to some life history stage derived as the ratio of returns to some location (e.g., smolts out, or adult returns to Columbia R., adult returns to the Yakima river) divided by the number at some life stage preceding it. For example, smolt production is the ratio of smolt abundance to brood year spawner abundance.
	Pre-spawn Mortality	Raw measure (primary): percent of returning adults that die after reaching spawning ground, but before spawning.
	Juvenile freshwater survival rate (egg-to-fry/parr.smolt, parr-to-smolt)	Derived or raw measure: Derived if estimated using information from independent programs (e.g., redd counts, fecundity estimates, and parr estimates collected in separate studies for the same tributary could be used to estimate an egg to parr survival rate). Raw measure if estimated in studies (e.g., use of instream incubation boxes to estimate survival-to-emergence (an index of egg-to-fry survival), or release of wild adult spawners to fenced-off stream areas followed by estimates of fry or parr abundance from those spawners to estimate egg-to-fry, or egg-to-parr survival rates).
	Juvenile Survival to first mainstem dam	Raw measure (secondary): Survival rate measure estimated from detection of PIT tagged smolts at first mainstem dam, or model derived survival rates based on detections at first and second mainstem dams (e.g., using SURPH, Steve Smith NOAA). Smolts or parr are tagged in the tributary rearing areas.

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Juvenile Survival past Mainstem Dams	Raw measure (secondary): Survival from first dam where stock enters maintem Columbia or Snake River to Bonneville. Derived from PIT tag detections.
	In-hatchery Life Stage Survival	Raw measure (secondary): egg to fry, parr or smolt survival in hatchery. Ratio of number of eggs spawned to number at lifestage.
	Post-release Survival	Raw measure (secondary): Survival from stage released (e.g., parr or smolt) to further sampling points (e.g. rotary screw traps at outlet of tributary, first mainstem dam encounterd by smolts, dam encountered on return).
Distribution	Adult Spawner Spatial Distribution (within tributaries)	Raw measure: Tributary spawner distribution - extensive estimates of where spawners are found within a tributary. Subbasin spawner distribution - presence/absence surveys across mulitple tributaries within a subbasin.
	Stray Rate	Derived or raw measure (secondary): Carcass surveys of spawning grounds, or wier sampling, looking for marks or tags or taking scale and tissue samples for DNA analysis.
	Juvenile Rearing Distribution	Raw measure: Raw measure at smaller spatial scales, for example Idaho Fish and Game's General Parr Monitoring program which collects parr counts in multiple tributarys and sites within them.
	Disease Frequency	Percent of fish containing particular diseases or prescence/absence of a particulatr disease. (Need to develop a better definition, Paul Kucera suggest contacting Kathy Clemens at the Dworshak fish hatchery).
Genetic	Genetic Diversity	Indices of genetic diversity - measured within a tributary (heterozygosity - allozymes, microsats), or among tributaries across populations aggregates (e.g., FST).
	Reproductive Success (Parentage)	Derived measure: determining hatchery:wild proportions, effective population size is modeled.
Life History	Age–at–Return	Raw measure (primary): Age distribution of spawners on spawning ground determined from length or scale analysis from carcass surveys.
	Age–at-Emigration	Raw measure (primary): Age distribution of emigrants (e.g., proportion of emigrants at fry, parr, pre-smolt, and smolt stages) from tribbutarys determined from rotary screw trap or weir collection, scale collection, or inferences from size.
	Size-at-Return	Raw measure (primary): Size distribution of spawners on spawning ground determined from length or scale analysis from carcass surveys.
	Size-at-Emigration	Raw measure (primary): Size distribution (length, weight) of emigrants (e.g., proportion of emigrants at fry, parr, pre-smolt, and smolt stages) from tribbutarys determined from rotary screw trap or weir collection.
	Condition of Juveniles at Emigration	
	Adult Spawner Sex Ratio	Raw measure (primary): carcass or wier counts.

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Fecundity	Derived or raw measure (primary): Derived if determined indirectly using existing length-fecundity relationships. Raw measure if based on direct sampling of returning females.
	Adult Run-timing	Raw measure (primary): arrival at mouth of major tributaries. Peak, range, 10th-90th percentiles
	Spawn-timing	Raw measure (primary): within major tributaries. Peak, range and 10th-90th percentiles.
	Juvenile Emigration Timing	Raw measure (primary): within major tributaries. Peak, range and 10th-90th percentiles.
	Mainstem Arrival Timing (first mainstem dam)	Raw measure (primary): Mouth of Columbia (Bonneville dam). Peak, range and 10th-90th percentiles.
Habitat	***Water Quality***	**Habitat definitions (based on Hillman 2003, see that ref for fuller definitions).**
	Temperture	Water temperature
	Turbidity	Sediment related indicators of water quallity,
	Conductivity	Ability of water to conduct an electric current. Measured as micromhos/centimeter (μmhos/cm)
	pH	Concentration of hydrogem ions in water (moles per liter)
	Dissolved Oxygen	Amount of dissolved oxygen in water. Usually measure as mg per liter (mg/L).
	Nitrogen	Indicator of nutrient loading.
	Phosphorous	Indicator of nutrient loading.
	Habitat Access (artificial physical barriers)	
	Road Crossings	Artificial physical barrier
	Diversion Dams	Artificial physical barrier
	Fishways	Artificial physical barrier
	Habitat Quality	
	Dominant substrate	Most common particle size that makes up the composition of material along the streambed. This indicator describes the dominant material in spawning and rearing areas.
	Embeddedness	A measure of the degree to which fine sediments surround or bury larger particles. An indicator of the quality of overwintering habitat for juvenile salmonids.
	Depth fines	Depth fines refers to the amount of fine sediment (<0.85 mm) within the streambed. Hillman 2003 recommends estimating it at depth of 15-30 cm (6-12 inches) within spawning gravels.
	LWD (pieces/km)	Large Woody Debris (LWD) is large pieces of relatively stable woody material located within the bankfull channel and appearing to influence bankfull flows. Also referred to as Large Organic Debris (LOD) and Coarse Woody Debris (CWD). The definition of LWD varies greatly amongst institutions (see Hillman 2003 page 48).

Performance Measure	
Primary Data	**Definition of Peformance Measure**
Pool frequency (pools/km)	Slow water habitat with a gradient <1%, normally deeper and wider than aquatic habitats upstream and downstream from it, must span half the wetted width, inclued the thalweg, and maximum depth must be at least 1.5 times the crest depth.
Pool quality	Ability of pool to support the growth and survival of fish, based on size (diameter and depth) and amount and quality of cover.
Side channels and backwaters (off channel habitat)	Types of off-channel habitat.
Channel condition	
Width/depth ratio	An index of cross-section shape of stream channel at bankfull level.
Wetted width	Width of water surfac measured perpendicular to the direction of flow. Used to estimate water surface area, which is used to calculate density of fish within the site or reach.
Bankfull width	Width of the channel (water surface) at the bankfull stage, which corresponds to the channel forming discharge.
Bank Stability	Streambank stability in an indicator of streambank condition.
Riparian Condition	
Riparian structure	Type and amount of various types of vegetation within the riparian zone. Used to evaluate health and level of disturbance of the stream corridor. Provides an indication of the present and future potential for various types of organic inputs and shading.
Riparian disturbance	Prescence and proximity of various types of human land-use activities within the riparian area (e.g., walls, dikes, riprap, dams, etc.). Affects the quantity and quality of aquatic habitat for fish.
Canopy cover	Riparian canopy cover over a stream.
Flows and Hydrology	
streamflow	
Watershed Condition	
Watershed road density (e.g., roads/km^2)	An index of total length of roads within a watershed.
Riparian-road index	Total mileage of roads within riparian areas divided by the total number of stream kilometers within the watershed (e.g., roads falling within federal buffer zones i.e. all areas within 300 ft either side of a fish bearing stream, within 150ft of a permanent nonfish-bearing stream, or within the 100-year floodplain).
Land Ownership	Index of watershed disturbance. Describes surface status of the basin - delineates the portions of the basin owned by federal, state, county, tribal, and private entities.
Land use	Index of watershed disturbance. Deliniates the portions of the basin that are subject to specific land uses (e.g., urban, agriculture, range, forest, wetlands, etc.).

Appendix C—Location of subwatersheds