PROJECT TITLE:

Adult Steelhead Escapement Monitoring - Imnaha River Subbasin

A. Abstract

Snake River Basin steelhead (*Oncorhynchus mykiss*) are listed as threatened under the Endangered Species Act. Yet little tributary specific status and trend information of A-run aggregates upstream of Lower Granite Dam exists. The NOAA Fisheries Service determined that there are at least five populations of A-run and five populations of B-run steelhead in the Snake River Steelhead ESU. The Imnaha River is host to one of the Snake River A-run steelhead populations.

We propose to quantify adult steelhead escapement into the Imnaha River Subbasin and describe the population's spatial distribution within the subbasin. A properly monitored Imnaha steelhead population will contribute towards understanding the status and viability of the entire Snake River ESU and informed management decisions. In addition, NOAA Fisheries Service calls for monitoring and evaluating the viability of component populations using four complimentary criteria for "Viable Salmonid Populations". These are the monitoring priorities for Imnaha steelhead highly recommended by the Collaborative Anadromous Workshop in the Snake Basin strategy that will relate performance at the population scale to risks affecting the persistence of the entire DPS (Distinct Population Segment).

Therefore, researchers from the Nez Perce Tribes Department of Fisheries Resources Management have relied on numerous contemporary documents to develop a monitoring project that will implement the VSP monitoring recommendations, apply the RME objectives found in the 2009 Fish and Wildlife Program, address critical uncertainties from the Council's 2006 Columbia River, and execute reasonable and prudent alternative (RPA) 50.6 in 2008 Federal Columbia River Power System Biological Opinion documents.

This fast track proposal, along with other related projects in the Imnaha Subbasin, will use floating weirs, fixed weirs, resistivity weirs, and PIT tag array methodology. Results from these multiple methods will provide natural and hatchery adult abundance, distribution, life history, and genetic information in the Imnaha River drainage.

Executive Summary (provided as a concise overview of entire proposal prior to presentation of problem/need statement)

This fast track project will provide high precision population status and trend information for Imnaha River steelhead. Information regarding Snake River steelhead is considered a high priority for informing managers[1]. Population abundance and productivity data are used by

[1] Management decisions should be taken with relevant information that is modified by continuous evaluation of existing programs, changing circumstances and new scientific knowledge (NPCC 2009, HSRG 2004). Research, monitoring, and evaluation (RME) is the heart of this adaptive management process (ISRP 2005-14

multiple entities in the Columbia Basin (e.g. assessing ESA listing status, harvest season opportunities, and effectiveness of management actions). Most important is the ability to describe a population's abundance relative to management goals, quasi-extinction thresholds, sustainable harvest, and ecological process. The Imnaha River steelhead population is unique in the Snake River DPS in that it: 1) is physically small enough to conduct sampling of steelhead (mainstem flow and manageable number of spawning/rearing aggregates), 2) has a dendritic structure of spawning areas occurring across the entire range of elevations available to Snake basin DPS steelhead (spawning in areas from 1,000 feet up to 6,000 feet), and 3) has a supplementation program occurring in just two of its spawning aggregates.

This project will employ a variety of monitoring techniques including floating weirs, fixed weirs, and PIT tag arrays throughout the Imnaha River drainage. We will incorporate other monitoring results conducted under the Lower Snake River Compensation Program for a comprehensive understanding of the Imnaha steelhead population. The ISEMP project (BPA Project No. 200301700) is also a fast track proposal that will install two PIT tag arrays in lower Imnaha River. These arrays will be relied upon with their representative PIT tagging of Snake basin DPS adult steelhead at Lower Granite Dam to provide one measure of steelhead population escapement to the Imnaha River. Weirs will monitor adult fish passage and distribution from February through June, while PIT tag arrays will operated year around.

Given the desire for escapement data, hatchery composition, and age structure information on the population, physically handling of a portion of the run is necessary to enable biological sampling. This project will provide high accuracy and precision escapement estimates to Imnaha tributaries hatchery fraction, age structure, age-at-return, size-at-return, age-at-emigration, percent females, adult run-timing, and within population spatial structure/distribution.

The Regional RM&E Collaboration strategies for Snake River basin spring/summer Chinook and steelhead call for high precision estimates of adult abundance (coefficient of variation of 15% or less) in at least one population per life history type per Major Population Group. High precision priority populations identified included Imnaha River steelhead (Coordinated Anadromous Workshop 2010). In addition, adult abundance data from these populations was identified as necessary to fulfill Federal Columbia River Power System RPAs: 50.5 (CAA/NOAA/NPCC RM&E Workgroup 2009 and Coordinated Anadromous Workshop 2010).

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and 15, USACE et al. 2007, CSMEP 2008, NPCC 2009). Collection and analysis of data is required at varying spatial scales: local (population, reach, watershed), region (MPG, ESU, subbasin), and basin-wide (Columbia Basin, Pacific Northwest, province) to inform decision makers by a diverse set of authorities, including but not limited to the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Plan (FWP), Federal Columbia River Power System Biological Opinion (FCRPS BiOp), Endangered Species Act (ESA) recovery plans. As a fisheries co-manager, the Nez Perce Tribe collects and uses RME data to inform a variety of management decisions (CSMEP 2008). It is our desire to establish and maintain sufficient data to support sound decision making in multiple forums.

B. Problem statement: technical and/or scientific background

Study Area:

The Imnaha River subbasin is located in northeastern Oregon and encompasses an area approximately 1,577 km^2 (Figure 1). A comprehensive description of the Imnaha River subbasin is found in the Imnaha Subbasin Plan (Saul et al. 2004). The mainstem Imnaha River flows north for 128 km from its headwaters in the Eagle Cap Wilderness Area (elevation 3,048 m), to its confluence with the Snake River at river kilometer (Rkm) 309 (elevation 288 m). The Imnaha River subbasin is fairly linear with one major tributary, Big Sheep Creek, and multiple small tributaries. The Imnaha River is part of the National Wild and Scenic Rivers System with sections classified as wild, recreational, and scenic.

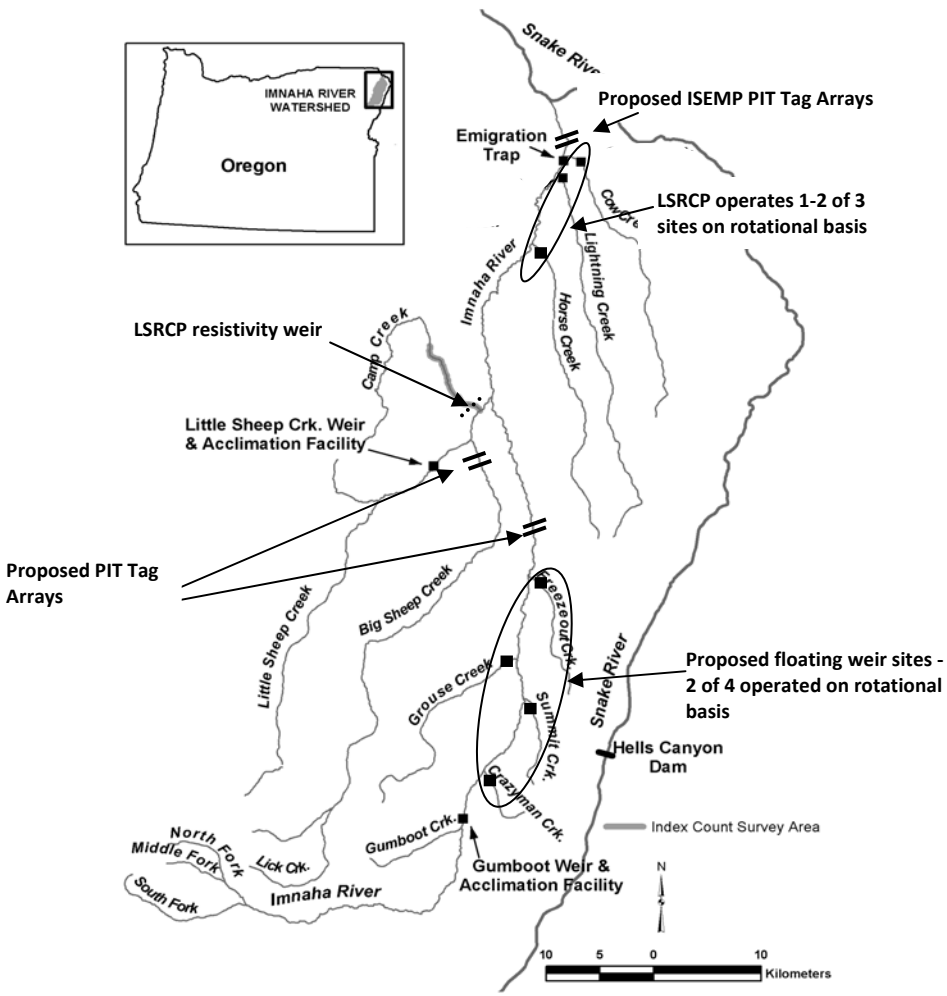

Figure 1. Imnaha River Subbasin with current and proposed steelhead activities.

Problem Statement:
The Imnaha River subbasin represents one of at least five major populations of A-run steelhead upstream of Lower Granite Dam (NMFS 2000). Historically, the Imnaha River supported a vital run of summer steelhead. According to the U.S. Army Cops of Engineers, historic peak escapement of A-run summer steelhead to the Imnaha subbasin was estimated to be 4,000 fish (USACE 1997). Like many steelhead populations in the Pacific Northwest, Snake River steelhead have declined significantly (Nehlsen et al. 1991). Today, all Snake River steelhead (*Oncorhynchus mykiss*) are listed as threatened under the Endangered Species Act. The NOAA Fisheries Service estimated the current population growth rate (lambda) for the A-run component of the Snake River steelhead Evolutionary Significant Unit (ESU) at 0.72 to 1.0 (CRI 2000) based solely on counts of A-run steelhead to Lower Granite Dam.

Currently there is little quantitative information available to determine the abundance of spawning adult steelhead in tributary streams above Lower Granite Dam (Busby et al. 1996; CRI 2000). Escapement estimates for Snake River steelhead to Lower Granite Dam are determined from counts at Lower Granite Dam. This estimate represents the most consistent, longest, and one of the few quantitative indicators of Snake River steelhead abundance.

However, resource managers are not currently monitoring the effectiveness of Snake River steelhead conservation actions for a threatened species at an ecologically appropriate scale (Botkin et al. 2000). Monitoring the status of subpopulations provides more detailed information on the status of the species than does an aggregate measure of abundance (NOAA Fisheries Service 2009). Yet, population abundance, growth rate, spatial distribution and diversity of steelhead in tributary specific areas in the Snake River Basin are functionally non-existent. Although some Imnaha adult steelhead information is available from limited redd counts and a few small tributary weirs, it is unknown if these sources are suitable as an index of trend or even representative of the entire Imnaha Subbasin (Saul et al. 2004). Steelhead redd counts are not physically possible throughout most the Imnaha River drainage due to inaccessibility and high turbidity.

<u>Therefore, accurate and comprehensive adult steelhead abundance information for the entire Imnaha Subbasin represents a critical data gap</u> (Saul et al. 2004).

Scientific Background:
Some background knowledge of Imnaha River steelhead does exist. Once past Lower Granite Dam, Snake River steelhead spawn throughout the Snake River Basin. A-run steelhead production areas previously identified are subbasins of the Grande Ronde River, lower Clearwater River, lower and upper Salmon River and the Imnaha River (NOAA Fisheries Service 2000). Adult steelhead migration timing past Lower Granite Dam starts as early as June and continues through May the following year. Staging of steelhead in the lower Imnaha River begins in September (Carmichael et al. 1989). Movement into spawning areas is thought to begin in March.

Camp Creek, a tributary to the mainstem Imnaha, has been monitored by Oregon Department of Fish and Wildlife (ODFW) via spawning ground surveys since 1966 (Rabe et al. 2001). An adult collection facility in Little Sheep Creek, another Imnaha tributary, provides annual counts of

hatchery and natural steelhead. Carmichael et al (1989) presented a summary of wild steelhead characteristics observed in the Imnaha River Subbasin during the first years of the Little Sheep Creek facilities operations. The Nez Perce Tribe monitors adult escapement into the lower spawning tributaries of the Imnaha with portable floating weirs as part of a Lower Snake River Compensation Plan project. Annual escapement into those streams has been determined since 2000. Estimates have ranged from 39 to 128 in Cow Creek and 36 to 232 in Lightning Creek. The Nez Perce Tribe also operates a resistivity weir in Camp Creek. Resistivity counters are a "hands off", passive technology that has a proven record of accurately counting upstream migrating salmonids (Aprahamian et al 1996). Nez Perce Tribe has estimates for Camp Creek since 2008 and plans to continue operation of its resistivity weir in that steam.

One of two endemic A-run steelhead hatchery production programs in the Snake River is operated within the Imnaha River Subbasin. The Lower Snake River Compensation Plan operates an adult steelhead collection and juvenile steelhead acclimation facility on Little Sheep Creek. In 1998 fisheries co-managers entered into a U.S. vs. Oregon dispute about how to utilize the LSRCP supplementation program to restore steelhead in the Imnaha River. Challenges in refocusing the program, include a lack of understanding of how to supplement natural production without affecting genetic and life history characteristics of the wild population and the lack of information on population dynamics in other areas outside Little Sheep Creek and the other tributaries with existing weirs. Hence, some uncertainty exists about the Imnaha steelhead production program as well as the status and trend of natural steelhead population in the subbasin.

C. Rationale and significance to regional programs

In light of the uncertainty within the Imnaha steelhead population and the growing need for basin-wide, standardized RM&E designs, the Nez Perce Tribe propose a monitoring and evaluation project that functions within the framework of regional programs. The goals, objectives and methods of this proposal are consistent with and/or recommended by the Columbia River Basin Fish and Wildlife Program, Imnaha Subbasin Plan, 2008 FCRPS Biological Opinion, PNAMP/CSMEP/AHSWG papers, as well as ISRP, Council, NOAA Fisheries Service and BPA recommendations.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the Federal Columbia River Power System Biological Opinion (NOAA Fisheries Service 2008). The objectives of this proposal are related to the RPAs identified in the federal Biological Opinions and will help advance federal ESA survival and recovery goals. These federal documents rely on monitoring and evaluation to assess the affects of proposed actions intended to improve the status of ESA listed stocks of Chinook salmon and steelhead in the Columbia Basin.

The 2008 FCRPS Biological Opinion (NOAA Fisheries Service 2008), Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS BiOp (Dec 1, 2009 Draft), and Coordinated Anadromous Workshop (2010 c) describe Reasonable and Prudent Alternatives (RPA's) for research, monitoring and evaluation (RM&E) actions. The

overall intent of RM&E is to provide information needed to support planning and adaptive management and demonstrate accountability related to the implementation of FCRPS ESA hydropower and offsite actions for all Evolutionary Significant Units (ESU's). The Action Agencies were directed to undertake RM&E through project implementation and compliance monitoring, status monitoring, action effectiveness research, and critical uncertainties research in nine RM&E strategy areas. RM&E Strategy 1 identified the need for monitoring the status of selected fish populations including Snake River steelhead (RPA 50). Priority recommendations to address RPA gaps include "Review and modify existing Action Agencies' fish population status monitoring projects to improve their compliance with regional standards and protocols, and ensure they are prioritized and effectively focused on critical performance measures and populations" (50.5 and 50.6). In the recommendations for steelhead, the RPA workgroup recommended "Imnaha River should be monitored for fish in and fish out to complement habitat restoration gap analysis and modeling for RPA 56.1. This project would provide the fish in estimate. Therefore, this proposed monitoring project will translate the intentions and concepts of the federal Biological Opinion RPAs into actions.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the Regional RM&E Collaboration Strategies

Quantifying abundance, survival, distribution, and diversity (VSP) of all populations is desired by fisheries managers. However a subset of populations for intensive status monitoring and other areas for trend/index monitoring is prudent for efficient assessment and allocation of limited resources. Despite multiple recommendations for increased and improved monitoring (ISAB/ISRP 2009-1, ISRP 2008-4, ISRP/ISAB 2005-15, NPCC 2009, Botkin et al. 2000), a commonly accepted description of what type, location, and replication of RM&E that is needed in the Columbia River basin was lacking until just recently. Columbia Basin natural resource managers, funding agencies, and regulatory entities worked together in 2009 to produce a coordinated anadromous monitoring strategy that establishes the scope, spatial coverage and desired precision for monitoring and evaluating population status and trends, hatchery, habitat, hydro, diversity, and data management and access of anadromous salmonids in the Columbia Basin (Coordinated Anadromous Workshop 2010). The research, monitoring, and evaluation strategy developed by the Coordinated Anadromous Workshop can be reviewed in full at http://www.cbfwa.org/ams/FinalDocs.cfm. The Snake River basin steelhead strategy calls for high precision estimates of adult abundance (coefficient of variation of 15% or less) in at least one population per life history type per Major Population Group (MPG). High precision priority populations identified included the Imnaha River steelhead population. In its recommendations, for steelhead, the RPA workgroup stated, "The Imnaha River should be monitored for fish in and fish out to complement habitat restoration gap analysis and modeling for RPA 56.1".

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the Columbia River Basin Fish and Wildlife Program

The intended goals of the 2009 Fish and Wildlife Program (NPCC 2009) are furthered with the initiation of this project. The Fish and Wildlife Program (FWP) calls for biological objectives that are empirically measurable and expressed in quantitative terms. Monitoring and evaluation are needed to resolve key program uncertainties. Strategies identified in the adult passage subsection (NPCC 2009) include evaluation of escapement numbers to spawning grounds.

Strategies identified under the Research, Monitoring and Evaluation subsection identifies the primary RM&E strategies as: 1) identify priority fish and wildlife and ecosystem elements of the Program that can be monitored in a cost-effective manner, evaluate the monitoring data and manage the Program based on results, 2) research and report on key uncertainties, 3) make information from this program accessible to the public, and 4) to the extent practicable ensure consistency with other processes. The purpose of the monitoring and evaluation strategies is to assure that the effects of actions taken under this Program are measured, that these measurements are analyzed so that we have better knowledge of the effects of the action, and that this improved knowledge is used to choose future actions. Monitoring and evaluation of tributary specific adult steelhead abundance and productivity in the Imnaha River as a key biological performance measure is closely linked to biological objectives the Council desires.

In addition, the Council adopted 57 subbasin management plans in 2005 and they are now considered core elements of the Council's current Fish and Wildlife Program. The Council strongly expects that projects implemented through the Program will be consistent with the goals, limiting factors and actions in the subbasin plans. The Imnaha Adult Steelhead Escapement Monitoring project fulfills that expectation. Therefore, the monitoring and evaluation as described in our proposal align within the conceptual framework and strategy established in the FWP.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the Imnaha Subbasin Plan and Subbasin Summary

Columbia Basin entities completed rigorous efforts to develop extensive subbasin plans that include monitoring and evaluation components. The Fish and Wildlife Program is clear that these regional subbasin plans are intended to coordinate activities and related objectives and strategies in the subbasins.

The proposed project will provide the mechanism for many of the objectives and strategies detailed in the Imnaha Subbasin Plan and Subbasin Summary. Summer steelhead are a priority and an identified focal species selected for recovery efforts in the subbasin. In particular, the proposed project will address the needs expressed in the Subbasin Summary.

- *Continue and expand efforts to quantify juvenile abundance and smolt-to-adult return rates (SAR) of wild/natural and hatchery reared steelhead.* This proposal will quantify adult steelhead abundance in tributary specific spawning aggregates and develop spawner to spawner ratios over time.
- *Continue and expand monitoring of hatchery supplementation and interactions with natural fish.* This proposal will quantify the contribution (proportion of total adult steelhead) of hatchery origin fish into non-supplemented tributaries throughout the subbasin.
- *Need to determine genetic population structure to define steelhead sub-populations within the subbasin*. This proposal will collect representative tissue samples from adults in all spawning aggregates in the Imnaha River subbasin and will complement ongoing genetic analysis from young-of-the-year O.mykiss throughout the Imnaha River subbasin.

- *Use improved statistical sampling techniques to ensure current spawning ground surveys are an appropriate measure of productivity.* This proposal will provide a direct measure of adult steelhead escapement upon which subsampling and escapement indices can be compared to results obtained from the Camp Creek spawning ground counts.
- *Need to calculate returns per spawner from index surveys to determine if this relationship is improving as smolt passage facilities are modified at Columbia and Snake River dams. Consider alternative approaches to assess population status.* This proposal would provide best measure of population status and provide non-biased and accurate spawner/recruit data.
- *Need to determine life history and movement patterns of steelhead including assessment of adult holding areas, juvenile rearing areas, and juvenile migration patterns.* This proposal will identify adult holding areas and provide descriptions of fish movement/behavior.
- *Need to determine extent of hatchery straying within the subbasin to control potentially adverse genetic effects on the endemic population(s).* This proposal will quantify the extent of hatchery dispersion into tributary streams
- *Need to determine extent of summer steelhead distribution within the subbasin at various life history stages.* This proposal will identify the presence/absence of anadromous steelhead in all major tributaries.
- *Need to monitor summer steelhead by examining drainage escapements and population trends.* This proposal initiates a long-term monitoring of steelhead escapement in the Imnaha River Subbasin for the drainage and its tributaries.

Finally, high priority strategies identified by Imnaha subbasin planners and posted on the Council's site that are associated with this proposed project are: *1) Monitor the status of focal species and quantify limiting factors with priority species being Chinook salmon, steelhead and Pacific lamprey 2) Evaluate the effectiveness of management actions, 3) Implement the full Monitoring and Evaluation Plan contained in the Imnaha Subbasin Management Plans.*

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to Council's Columbia River Basin Research Plan

Co-managers, such as the Nez Perce Tribe are expected to help resolve a wide range of critical uncertainties associated with population status and trend and society's recovery actions. Two specific programmatic uncertainties from Columbia River Basin Research Plan (2006) that this propose project will help address are:

- Can salmonid populations in the Columbia River be increased and sustained over the long-term, given the multiple biological, physical and cultural constraints?
- Can the diversity of anadromous salmonid stocks be sustained over the long-term?

The Research Plan makes clear the need for monitoring and evaluation, including status and trend monitoring, to address those uncertainties. In addition, the Council expects managers to provide information to evaluate project outcomes, project objectives, and programmatic standards within an adaptive management framework. This plan acknowledged that monitoring contributes needed information to address whether biological and programmatic performance

objectives in the Fish and Wildlife Program, subbasin plans, FCRPS Biological Opinion and ESA recovery plans were being met. Use of monitoring data to recommend management changes, identify factors that limit achieving performance standards, and identifying which mitigation actions are most effective at addressing limiting factors was emphasized. Collection of natural origin Imnaha steelhead escapement and the long-term status and trend information that this project can provide seem to agree with intent of the NPCC (2006) research plan.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the ISRP

The Independent Scientific Review Panel (ISRP 2005) provided retrospective recommendations on monitoring in subbasin plans. The ISRP identified the need to develop a coordinated system wide monitoring and evaluation program. Recommendation 1 was to develop a sound census monitoring procedure to examine fish population and habitat trends over time. This project provides monitoring of natural origin adult steelhead abundance and productivity in the Imnaha River at the population level. The ISRP also recommends that as data are obtained on status and trends of fish populations that regression models be developed to predict abundance or presence/absence of focal species.

In addition, the ISRP has consistently recommended the need for storage of primary data and metadata collected in research studies in the Columbia River basin. The Department takes seriously the need to make primary data and metadata available within the region (ISRP 2005). In addition to annual progress reports posted to websites, we will utilize project specific and region-wide databases that have been developed to centralize data associated with widely used data collection activities and standardized performance measures (Beasley et al 2008). The Nez Perce Tribe website (Nez Perce Department of Fisheries Resources Management - Research) will house a standardized database for primary data, description of meta-data (utilizing NOAA data dictionary), and summary/annual reports related to all projects. The department is currently working towards making this important data available through the Tribe's website, both the real-time and summarized performance measure information will be in 2010.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the PNAMP Groups

Bonneville Power Administration encourages M&E project proponents to develop proposals within a common, regional framework and commit to a standard monitoring design. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) is developing standard protocols for fish population and watershed condition monitoring and recommends a universal status monitoring design. The Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) developed standard design approaches for status and trend monitoring and action effectiveness. Both these endeavors provide support and guidance for monitoring projects like the Imnaha project.

Many of the performance measures (biological indicators) listed in ***Recommendations for Coordinating State, Federal, and Tribal Watershed and Salmon Monitoring Programs in the Pacific Northwest*** (PNAMP 2004) are also planned for in this proposal with accompanying sampling protocols and methods. The proponents of this proposal are keenly aware of the recent AFS publication; ***Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends of Salmon and Trout Populations*** (Johnson et al. 2007) and use it regularly as a reference document. Many of the "key questions" identified in the ***Strategy for Coordinating***

Monitoring of Aquatic Environments in the Pacific Northwest (PNAMP 2005) are also identified in the proposal as "management questions" specific to the Imnaha situation.

Thus, the proposal compliments the recommendations and desired direction of PNAMP. A coordinated regional approach to monitoring and evaluation in northeast Oregon will result in information with broad applicability and give empirical evidence that society needs to judge the effectiveness of its recovery actions. The proponents of the proposal stand ready to implement this type of monitoring and evaluation for which PNAMP is advocating.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to BPA Responsibilities

The following criteria ensure that the project addresses BPA's responsibilities under the Pacific Northwest Electric Power Planning and Conservation Act (1980) and will help BPA meet its natural resource obligations.

1. The proposed project provides assessment of supplementation for Grande Ronde and Imnaha salmon populations affected by hydropower development within the Columbia River Basin and provides evaluation of off-site mitigation and enhancement of Columbia River fish populations (Section 4(h)(5).

2. The proposal compliments the activities of state and Tribal co-managers, provides research and monitoring measures (Section 4(h)(6)(A) and is consistent with the priority objectives and performance measures in BPA's Supplemental Information for Research, Monitoring and Evaluation Proposals (BPA 2005).

3. The proposal is based on and supported by the best available scientific knowledge 4(h)(6)(B). In addition, the plan helps BPA advance regional coordination and standardization of monitoring efforts.

4. The proposal is consistent with the legal rights of Indian Tribes and with BPA's Tribal policy 4(h)(6)(D). The NEOH M&E Plan compliments BPA's desire to "seek mutually beneficial business partnerships with the Tribal governments through its various programs" and helps execute BPA's trust responsibilities (DOE Order No. 1230.2-Apr.8, 1992).

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to Oregon's Steelhead Plan

Monitoring of steelhead population status is a stated objective for the Oregon Department of fish and Wildlife. The first goal of Oregon's Steelhead Plan is to sustain healthy and abundant wild populations of steelhead. The following objective will be used to achieve this goal:

- Objective 5. Monitor the status of wild steelhead populations so that long-term trends in populations can be determined.

The Relationship of the Imnaha Adult Steelhead Escapement Monitoring proposal to the Spirit of the Salmon Plan

Wy-Kan-Ush-Me-Wa-Kush-Wit (1995) provides guidance to establish and monitor escapement checkpoints at mainstem dams and in index subbasins. Methods to be used should use the least intrusive method to collect the necessary information. It further recommends establishing

additional monitoring programs for each of the subbasin tributary systems to monitor adult escapement and resulting smolt production, and to evaluate (by measuring the number of adults returning) the ability of managers to meet checkpoints at mainstem dams and in index subbasins.

D. Relationships to other projects

Co-managers work cooperatively in the effort to restore healthy ecosystems in the Imnaha Subbasin. Thus, within the context of steelhead recovery, a synergistic relationship exists between this proposed monitoring and evaluation project and numerous ongoing projects and endeavors in the subbasin. Ongoing RM&E and supplementation projects were developed to meet a diverse range of management needs. They have received extensive technical review by co-managers and the Independent Science Review Panel (ISRP) through previous Provincial Review processes. Existing projects include hatchery production evaluations under BPA and LSRCP programs, habitat restoration efforts and research and monitoring projects addressing natural population status.

The Lower Snake River Compensation Program (LSRCP) provides facilities, equipment, and personnel to assist production, evaluations, and fish health monitoring for Northeast Oregon Chinook recovery projects. The Nez Perce Tribe's LSRCP Evaluations project (BPA ID # 200107) monitors adult steelhead escapement in Imnaha tributaries (Lightning, Cow, Horse, and Camp creeks). Stock status of wild steelhead in the Imnaha River subbasin was initiated in 2000 with operation of an adult escapement weir in Lightning Creek. This effort has been expanded to Cow Creek in 2001 and Horse Creek in 2008. The current proposal relies on the continuation of this monitoring and identifies Cow, Lightning, Horse, or Camp creeks as a test site for a resistivity counter due to the ability to link tests to direct counts. The LSRCP Program cooperators in Oregon assessed steelhead population structure through genetic information from juvenile *O. mykiss.* A sample collection strategy was developed and implemented between 1999 and 2001. Twenty areas were targeted for sample collections. This proposal will collect and store tissue samples from adult *O. mykiss* that will be made available for long term monitoring of population genetic structure and diversity.

The LSRCP program through ODFW (BPA ID # 200109) operates the Little Sheep Creek adult collection and acclimation facility. Evaluations of hatchery returns and wild returns to the Little Sheep Creek weir are conducted annually under this project.

The Imnaha River Smolt Monitoring (BPA ID# 199701501) project monitors juvenile fish emigration from the Imnaha River subbasin. This project, in coordination with NPT LSRCP efforts, provides time series of timing and survival estimates through the hydro system. This project will be expanded to provide juvenile production estimates and smolt-to-adult survival rates for both Chinook and steelhead. PIT tagged returning adult steelhead will be monitored in this proposal's weirs and PIT tag arrays. Recoveries of fish representatively PIT tagged within the basin and at Lower Granite Dam as adults will allow this project to monitor natural and hatchery steelhead abundance and distribution to the through the Imnaha River subbasin. These projects together will provide a full picture of steelhead population status in the Imnaha River subbasin as defined by McElhany et al. (2000).

Steelhead supplementation is an experimental strategy that has considerable promise but also many associated uncertainties. The genetic consequences of supplementing natural populations with hatchery-reared fish are among those uncertainties. This issue cannot be addressed without an adequate monitoring program. The NMFS project entitled Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead (BPA ID# 198909600) provide co-managers with expertise and information regarding the nature and extent of the genetic impact of steelhead supplementation in the Imnaha Subbasin.

Managers recognize the necessary connection between steelhead recovery actions and habitat. Habitat condition is thought to be a limiting factor influencing abundance in the Imnaha Subbasin (Saul et al. 2004). Many efforts are directed towards local habitat conditions in the Imnaha systems. Several newly proposed projects that have the potential to contribute towards Protect and Restore the Imnaha/Big Sheep Watershed (BPA ID# 200725700). These efforts relate directly to the NEOH program in that they influence the quality of the aquatic habitat inhabited by endangered steelhead. Other existing habitat projects include the Wallowa County Culvert Inventory (BPA #200207300), and Grande Ronde Model Watershed Restoration projects (BPA ID# 199202601) projects. These activities are integral components of a comprehensive recovery effort that includes monitoring endeavors like the proposed Imnaha Adult Steelhead Monitoring project.

Staff associated with the Northeast Oregon Hatchery project (BPA ID #198805301) are drafting an HGMP for steelhead in the Imnaha River subbasin. The Northeast Oregon Hatchery project will provide a comprehensive umbrella for evaluations of Chinook and steelhead once completed. As part of the NEOH a new Imnaha weir (Gumboot facility) will be constructed that will allow operation/trapping through high flow conditions. This weir will be operated to monitor adult steelhead as part of this proposed project.

The Imnaha Adult Steelhead Monitoring project is also related to the Integrated Status and Effectiveness Monitoring Program (ISEMP) Salmon River project (BPA ID # 200301700) whose primary purpose is to determine whether innovative methods can be employed to increase the accuracy and precision of adult abundance estimates for summer Chinook salmon and steelhead at the subpopulation, population, and major population group scale. The ISEMP study has installed PIT tag arrays in South Fork Salmon and Lemhi rivers to quantify both natural origin adult salmon and steelhead escapement. Results from ISEMP investigations have both regional and subbasin level application. ISEMP in the fast track proposal process has put in for the money to install two PIT tag arrays in the Lower Imnaha River to assist this project in quantification of the distribution and abundance of steelhead in the Imnaha River basin.

The Nez Perce Harvest Monitoring Project (BPA ID # 200206000) monitors anadromous fisheries conducted by the Nez Perce Tribe. Primary focal species are Snake River spring, summer, and fall Chinook salmon, and steelhead to implement on the ground harvest monitoring in the Clearwater River, Salmon River, Imnaha River, Grande Ronde River, Tucannon River, and in the Columbia River in Zone 6. Quantification of harvest is essential for tributary run reconstruction and evaluation of the effectiveness of supplementation.

E. Project history

This project was proposed as a new project in 2002 (200205600) and received favorable (fundable) reviews. However because of lack of money and priority this project was not funded in 2002. Project proponents modified methods to include advances in PIT tag technology and integrated the project with ongoing and other fast track proposals.

F. Describe a) biological/physical objectives, b)work elements, c) methods and metrics

Goal: To establish steelhead population status information in the Imnaha River Subbasin to support a scientifically defendable fisheries management process and to provide society with information regarding recovery of the population.

Management Questions: Managers and policy makers also require specific information for their processes. Answers to the following questions will help inform managers and policy makers.

- What is the status of wild steelhead adults in the Imnaha River Subbasin? (abundance and population growth rate)
- What behavior attributes of adult steelhead migration impact tributary specific population dynamics? (metapopulation structure)
- What is the genetic stock structure (gene flow, effective population size in relation to actual anadromous adult returns, genetic diversity/ heterozygosity) of anadromous steelhead across tributaries in the Imnaha River Subbasin? (genetic)
- What is the rate of dispersion of hatchery produced fish to non-outplanted tributaries in the Imnaha subbasin? (hatchery:natural interactions and distribution)
- Are returns of hatchery and wild origin adults to Little Sheep Creek or a subset of tributaries representative (abundance and characteristics) of wild steelhead to the entire Imnaha River Subbasin? (distribution and scale of needed monitoring)

After establishing the management goal and considering management questions, researchers developed objectives that will define progress towards achievement of those goals and that will provide a measurable definition of attainment (Krueger and Decker 1993). The following objectives, then, were formulated to meet the goal stated above and to address local management needs along with regional expectations.

OBJECTIVE 1: Installation and Maintenance of Floating Weirs and PIT Tag Arrays.

Work Element 70. **Install Fish Monitoring Equipment**
Work Element 165. Produce Environmental Compliance Documentation

Task 1.1: Obtain materials and fabricate floating weir (one-time costs). Design floating weir to operate in streams characteristic of the Imnaha River tributaries. We desire to use the most "fish friendly" technologies available that will produce the best results. Washington Department of Fish and Wildlife has proven out this technology in the Asotin Creek system, thus we will be utilizing their designs.
Task 1.2: Subcontract with Biomark Inc. for the installation and yearly checks of two PIT tag arrays (one-time costs). PIT tag arrays will be installed in Big Sheep Creek and upper

Imnaha River. Biomark Inc. which has installed many systems over the course of 2008-2009 and is sole contractor currently offering this proven technology.
Task 1.3: Environmental and cultural approvals. Floating weirs and PIT tag arrays have (with our other projects) complied with NEPA and Corps of Engineers 404D categorical exclusion parameters and we will work with appropriate entities to comply with those standards. Cultural review of all sites will be completed through the Nez Perce Tribe Cultural Resource Department.
Task 1.4: Repair and Maintenance of floating weirs and PIT tag arrays. Both the floating weirs and PIT tag arrays will be repaired and maintained for successful operation of those devices.
Task 1.5: Install resistance board floating weirs in two of the following streams on rotational basis: Freezeout Creek, Grouse Creek, Crazyman, and Summit Creeks.

OBJECTIVE 2: Quantified Steelhead Escapement and the Collection of Biological Data

Work Element 157. Collect/Generate/Validate Field and Lab Data
Work Element 158. Mark/Tag Animals
Work Element 162. Analyze /Interpret Data

Task 2.1: Operate resistance board floating weirs in two of the following streams: Freezeout Creek, Grouse Creek, Crazyman, and Summit creeks.
Task 2.2 Operate the new permanent weir on the upper Imnaha mainstem.
Task 2.3: Conduct mark-recapture studies to estimate adult escapement as a back-up population estimate if direct measurement is not achieved in Task 2.1 streams.
Task 2.4: Collect biological information of fork length, sex, scales, general fish health, examine for marks/tags, scan with PIT tag and CWT scanners, and collect fin tissue sample for DNA analysis from all adult steelhead captured in individual tributaries.
Task 2.5: Determine the genetic stock structure of adult steelhead throughout the Imnaha River subbasin.

General Methods to Meet Objective –

Total natural and hatchery abundance and distribution of the Imnaha system will incorporate all available information obtained through operation of floating weirs, fixed weirs, resistivity weirs, and adult estimation through PIT tag recapture information. Results from these multiple methods will provide natural and hatchery adult abundance, distribution, life history, and genetic information in the entire Imnaha River drainage.

Resistance board floating weirs will be installed in two of the four upper Imnaha tributaries (Freezeout Creek, Grouse Creek, Crazyman Creek, Summit Creek), per year (on a rotating basis)(Figure 2). In addition, the Imnaha weir, once rebuilt, will be operated during the time of steelhead immigration to capture, enumerate and collect data from adults. The floating weirs consist of three long panels of PVC pipe. The pipes are spaced at 1 1/8 inches apart and are held together by HDPE stringers throughout the length of the panels. These panels are placed in the thalweg where the majority of stream flow exists. The upstream end is anchored to the bottom of the stream and the downstream end is held up at an angle by floatation boards. The side curtain fence is connected to the outer edges of the panels to keep fish from swimming over the

under water portion of the panels. The rigid trap box is placed next to the bank next and the anchored upstream portion of the panels. A small deflector fence is installed upstream of the trap box to deflect debris onto the floating panels. This design allows for logs and accumulation of smaller debris to pass over the top of the floating panels by simply sinking the floating panels enough to push debris downstream and resume floating when the excess weight is removed by stream flow.

Steelhead in the upstream movement box will dipped out with cotton dip net and place into a moist canvas sling/measuring box. Data including fin clips, PIT tags, sex, spawning condition (pre/post), and fork length will be recorded. Scales will be collected from just behind the dorsal fin and above the lateral line using a blunt knife and forceps. A paper hole punch will be used to collect fin tissue from the caudal or dorsal fins for DNA genetic characterization before release upstream of the trap. A double left opercular punch will be given using a paper hole punch and a uniquely numbered Tyvek disk tag will be applied to the right operculum. Each fish will also receive a PIT tag in the dorsal sinus cavity for future detections on passover PIT tag arrays and downstream dams (kelts). Steelhead and non-target species will be measured and released above the weir.

Steelhead captured in the downstream movement box will be examined for opercular punches and Tyvek and PIT tags. Marked fish will be checked for spawning condition (pre or post-spawn) and released downstream. Downstream moving non-marked steelhead and non-target species will be handled with the same procedures as upstream moving fish with the exception of a downstream release.

It is likely that weir/trap operation will be discontinuous due to high flow and debris. Depending on the relationship of the non-operation dates to run timing and the period of time traps are not operated assumptions could be violated. Testing of the assumptions and selection of the most appropriate mark/recapture approach will be done on an annual basis. Unbiased estimates of population abundance can achieved with as few as four recaptures (Cousens et al 1982). Recent studies using similar methods in the Imnaha River subbasin have demonstrated the ability to recapture 40 to 50 percent of marked fish (over 15 recaptures). Adjusted Peterson (Chapman 1951; Seber 1982), and Schaefer (1951) estimates are commonly used but biased if assumption are not met (Cousens et al 1981). McGregor et al. (1991) used stratified population estimation (Chapman and Junge 1956; Darroch 1961) due to ability to accommodate varying capture probabilities in tagging and recovery. We will use this approach and stratify upstream trapping time periods if the tests of chi-square tests of tagged to untagged recoveries over time are violated. Stratified abundance estimates have larger confidence intervals than un-stratified. Cappiello and Bromanghin (1997) discuss using Bailey closed population model (Seber 1982) and used coefficient of variation describe the relative accuracy and precision of the multiple population estimates. Special mention is made that the methods should be tested under low abundance levels, due to increased needed accurate and precise estimates of minimum escapements. This may likely be the case in the study streams being addressed. Rajwani and Schwarz (1997) address adjustment of estimates for missed tags in salmon escapement surveys. We do not believe that missed tags identification is an issue with our study design. Fish receive two marks, which have long-term retention and easy identification. Multiple software packages exist that compute mark/recapture population estimates, including Arnason at al. 1996 and SPAS

which computes Darroch, Schaefer, Pooled Petersen, least-squares, and maximum likelihood (ML) Darroch estimates.

Tissue samples will be collected from all adult steelhead. Fish from these tributaries will be characterized by using a suite of microsatellite markers. This work will complement similar analysis that is ongoing under the Fish and Wildlife Service's Lower Snake River Compensation Plan (LSRCP) evaluation studies on juvenile steelhead in 20 tributaries in the Imnaha and Grande Ronde river subbasins and to support the ongoing GSI study at Lower Granite Dam. The primary objective is to describe the genetic stock structure, gene flow between spawning aggregates, and determine effective population size. These efforts will provide a substantial body of genetic data for the entire Imnaha population.

The two floating weirs and the Imnaha weir will be operated beginning late-February. The floating weirs will operate until July 1 or 10 days after the last steelhead is captured and then removed. Operation dates will be adjusted for migration timing in individual tributaries. The traps will be checked twice a day for captured fish and debris maintenance.

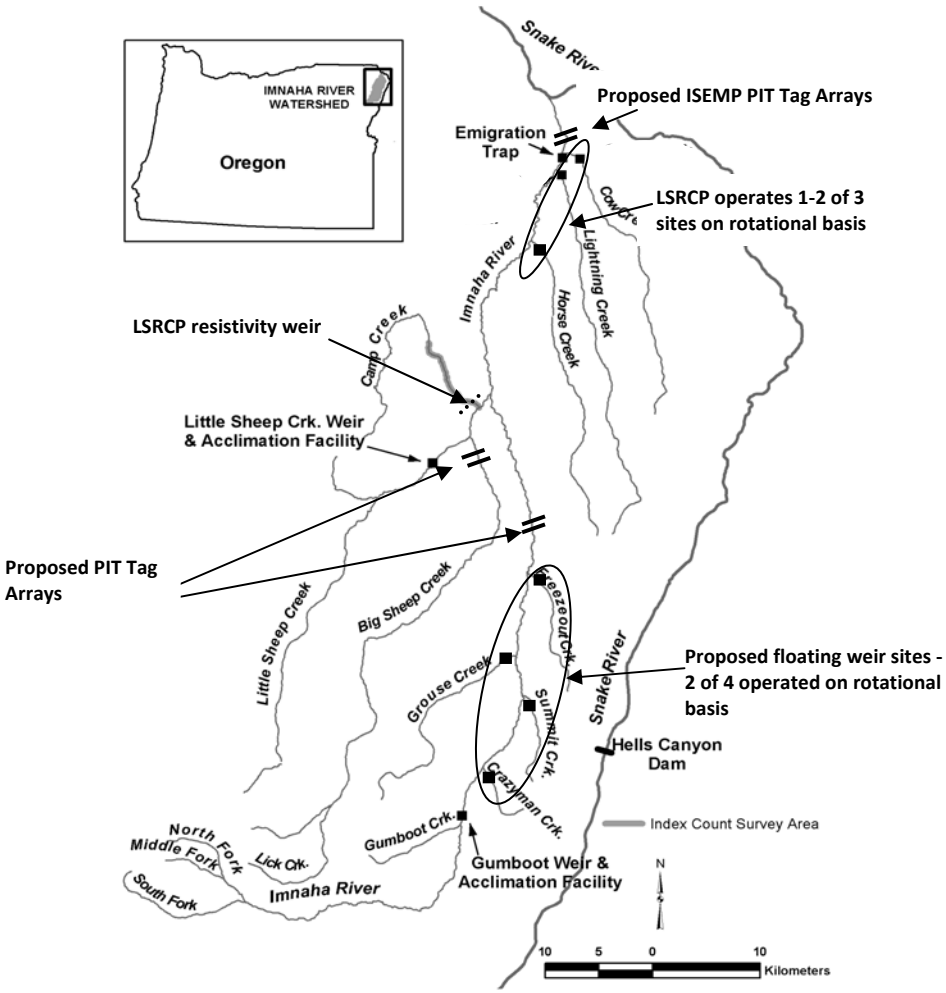

Figure 2. Imnaha River Subbasin with current and proposed steelhead activities.

Fixed and Resistivity Weirs – Operated through funds provided by the Lower Snake River Compensation Plan.

PIT tag array systems are comprised of instream and streamside components that allow for successful detection and storage of individual time stamped occurrences of PIT tag fish passing over the instream antenna array. Arrays will be installed in Big Sheep Creek and the upper Imnaha River from this proposal (Figure 2). Two additional PIT Tag arrays will be installed through the ISEMP fast track proposal.

Instream Components - Consists of multiple 3x20 foot Biomark pass-over (flat panel) antennas placed end to end and perpendicular to stream flow flush with the existing river substrate. The antennas have a high PIT tag detection probability up to 15 inches with maximum detection ranges of 20 to 22 inches above the antennas.

Streamside Components - Each Array location will have stream side equipment that consists of a custom built, heavy-duty lockable metal enclosure that houses the electronics, a thermoelectric generator, and a semi-portable propane tank(s). The enclosure is weather resistant, insulated and fan cooled for temperature control then mounted on a 3 inch galvanized pole and suspended 36-48 inches above the ground.

The metal enclosure houses a Destron Fearing FS1001M multiplexing transceiver that can control up to six individual antennas, Campbell Scientific CR1000 Datalogger and CFM memory module with a 2 GB CF card, FTS GS-4000-RGM satellite modem that allows two-way communications and remote downloading of the stored data, and a Campbell Scientific PS100 power supply and battery back-up. Each site also has a temperature probe connected to the CR1000 with stream temperatures recorded every 5 minutes.

The system is powered by a Global Thermoelectric Model 5060 generator that burns approximately 1.5 gal/day of propane and outputs 2 amps at 27 VDC. Fuel is supplied from portable propane tank(s). Thermoelectric generators (TEG) are extremely reliable, safe, tested, and used widely by the USFS and NOAA fisheries (T. Etter personal communication). At each site, all equipment will be painted camouflage and all cables buried to reduce visual impacts.

Data Retrieval and Storage - At each array, the data logger stores files containing; scanned PIT tags, water temperature, individual antenna diagnostics, and transceiver settings and status data of the system. All four data files from each array are collected every two hours using the satellite linked phone modem. Twice weekly TAG files are converted into a PTAGIS format from each site and uploaded to PTAGIS and available online at: http://www.ptoccentral.org/dbaccess/InStrmDtctn/InStrmDtctn_query.html

Representative marking of natural and hatchery steelhead. Utilizing passover array systems for generating adult abundance estimates will only be successful if; 1. natural and hatchery steelhead are representatively marked as juveniles or as adults; and 2. enough marks are applied to get sufficient recaptures for calculation of abundance estimates with an acceptable level of variance.

Hatchery steelhead- In 2008 the cooperators of the LRCP program started representatively PIT tagging a subsample of the releases of hatchery steelhead and Chinook in the Snake Basin (this includes the Imnaha) at numbers sufficient to generate adult abundance estimates for recaptures to Lower Granite Dam. This project will be able to utilize those representatively marked hatchery fish to calculate abundance with acceptable variance from the three Imnaha River basin PIT tag arrays proposed (Figure 2).

Natural steelhead – The current ISEMP project started marking natural adult steelhead at Lower Granite Dam in 2009 (3,800 PIT tags in natural steelhead were applied) in order to estimate abundance of natural steelhead into the South Fork Salmon and Lemhi River systems. A sample size analysis was completed to evaluate different tagging rates at LGD and varying efficiencies of the PIT tag arrays at detecting the marked fish. Utilizing their analysis the Imnaha River should be sufficient to estimate populations of steelhead in the Imnaha River basin (Jody White, Quantitative Consultants personal comm.). The power analysis completed for the Imnaha River is provided below (provided by Jody White, Quantitative Consultants Inc.).

To get the numbers of fish that potentially contribute to the Imnaha River, we used the IDFG's 2008 GSI results. Imnaha River reporting group had an estimated 9.5% or 3,300 fish (95% CI: 2,400-4,800) migrate upstream of LGD.

For the PIT tagging modeling, I used two likely array efficiencies (75% and 90%) as well as three levels of tagging rates at LGD (5%, 10%, 15%), with a minimum of 2,000 sample size. The Nez Perce Tribe estimated (2008 & 2009) an array efficiency > 95% for adult Chinook salmon in the mainstem South Fork Salmon, but for steelhead I assumed that the arrays would be less efficient because of water conditions. I also added a 5% CV for dam counts to more realistically model the effect of the major sources of variation. I did not add tag loss, natural mortality, or harvest losses but the effect would be to decrease the number of fish available for interrogation at the antenna arrays.

Focusing on the PIT tagging objectives, Figure 3 illustrates the effect of run size, tagging rates and array efficiencies on the population estimates coefficient of variation (CV) for the Imnaha River. At the both array efficiency rates (75% & 90%) the CV is fairly consistent (5-5%) across the tagging rates and run sizes. Over all run sizes the CVs are also fairly stable for the Imnaha River regardless of tagging rate or array efficiency (Figure 3).

Because recapture efficiencies are high in all simulations the resultant CV's are acceptable for most management objectives. However bias can be a limiting issue with any capture/recapture design and the number of recaptures should be > 4-5 (standard capture/recapture literature) for minimally, unbiased estimates. The Imnaha River meets the minimum sample size at all tagging rates and run sizes (Table 2).

Table 1. Estimated number of unclipped steelhead migrating through the Lower Granite Dam fish ladder counting windows for 2000-2008 run years. Numbers include unclipped hatchery fish and do not take into account fall backs or fish that migrated during evening non-counting periods (personal communication with Fish Passage Center).

Steelhead Run at Lower Granite Dam	
Year	Wild Steelhead
2008	43,641
2007	32,998
2006	29,836
2005	35,977
2004	36,209
2003	45,391
2002	57,291
2001	47,716
2000	20,580

Table 2. Projected number of steelhead detected at Imnaha River PIT tag array(s) (array efficiency = 90%) for three proposed tagging rates (minimum 2,000) at the Lower Granite Dam (LGD) fish ladder. Using a contribution rate of 9.5% (95% CI = 2,400 2,800) of the total Snake River Steelhead run for the Imnaha River Steelhead population (obtained from Idaho Fish and Game Genetic Stock Identification Project).

Steelhead – Imnaha River = 9.5% of Run at Lower Granite
Array Efficiency = 90%

	Percentage Tagged (min. 2000 tags)		
Run Size	5%	10%	15%
5,000	171	171	171
10,000	171	171	171
15,000	171	171	192
20,000	171	171	256
25,000	171	214	321
30,000	171	256	385
35,000	171	299	449
40,000	171	342	513
45,000	192	385	577
50,000	214	427	641
55,000	235	470	705
60,000	256	513	769

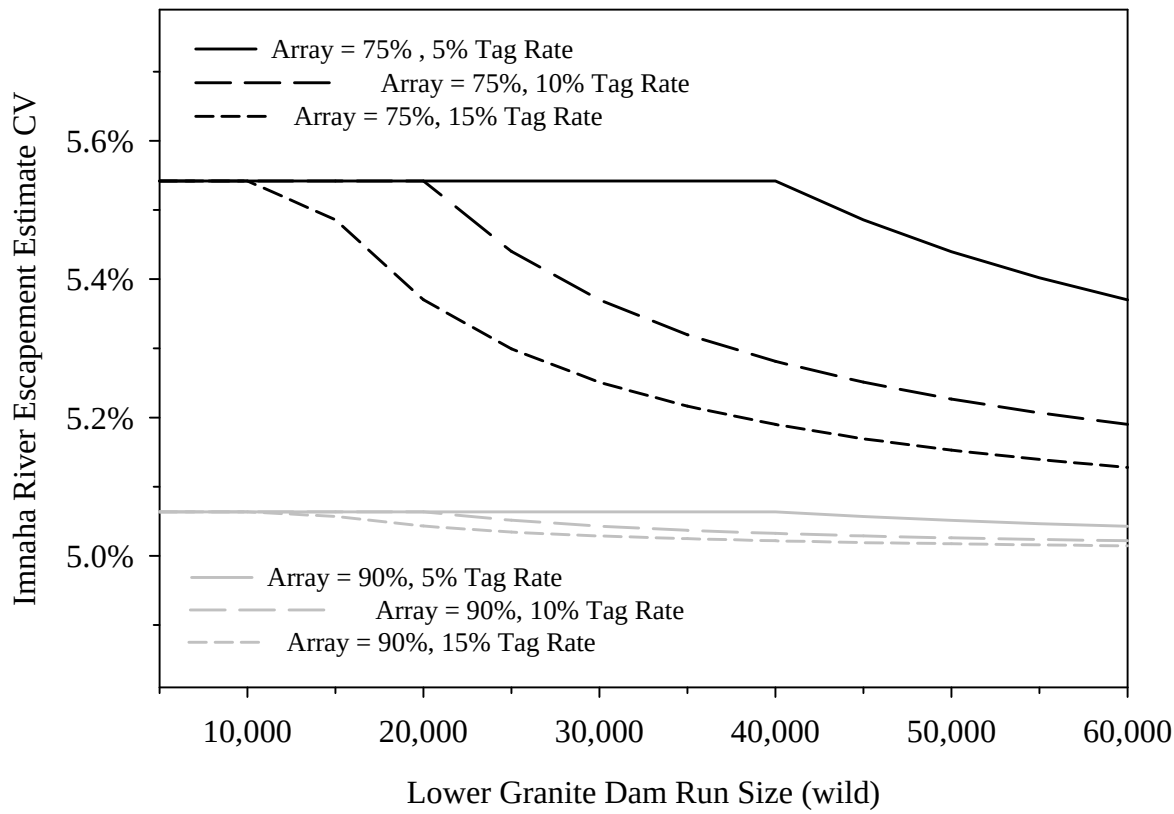

Figure 3. Imnaha River wild steelhead population estimated coefficient of variation (CV) using PIT tags placed at Lower Granite Dam for Imnaha River array efficiencies (75% and 90%) and three tagging rates (5%, 10%, 15%) at Lower Granite Dam over a range of Snake River Steelhead run sizes.

Data Analysis - The number of PIT tags passing site A is estimated using a mark re-capture estimator based on unique PIT tag detections both at site A and B (where B is the next detection site or detections from all sites past site A). Estimates can be made for defined tag groups. Tag groups may include detections stratified by species, life stage, origin, by specified release groups, and over discrete time periods. For a given tag group of interest, the number unique tags that passed site A ($Tags_A$) is estimated by using the Chapman (1951) modification of the simple Petersen-Lincoln mark-recapture estimator as

$$Tags_A = [(Det_A + 1)(Det_B + 1) / (Det_{A\,\&\,B} + 1)] - 1$$

where Det_A is the number of unique PIT tags detected at array A (marked group), Det_B is the number of unique PIT tags detected at site B (captures), and $Det_{A\,\&\,B}$ is the number of unique PIT tags detected at both sites A and B (recapture group).

The variance of the number of PIT tags that passed site A ($V(Tags_A)$) is estimated as

$$V(Tags_A) = [(Det_A +1)(Det_B +1)(Det_A – Det_{A \& B})(Det_B – Det_{A \& B})] \; / \; [(Det_{A \& B})^2(Det_{A \& B} +2)].$$

Detection Probability - The detection probability of PIT tags at A ($PTags_A$) is calculated as

$$PTags_A = (Det_A / Tags_A).$$

The variance of the detection probability of PIT tags at site A ($V(PTags_A)$) is calculated as (Thomson, 2002)

$$V(PTags_A)= (Det_A / Det_B{}^2)(Det_B / Tags_A) [1- (Det_B / Tags_A)][(Tags_A – Det_A) / (Tags_A -1)].$$

For juveniles moving downstream, the detection order is reversed in the equations in that detections at B are defined as the marks and detections at A are recaptures.

Abundance Estimate - The estimated abundance at site A ($Abun_A$) is simple an expansion of the number of PIT tags that passed the site by the PIT tag ratio as

$$Abun_A = (Tags_A) (Ratio)$$

where the ratio (Ratio) is the estimated number of total individuals (N_{total}) divided by the number of PIT tagged individuals (N_{tag}) as

$$Ratio= (N_{total}) / (N_{tag}).$$

The variance of the tag ratio (V(Ratio)) is calculated as

$$V(Ratio) = (N_{total} / N_{tag})^2 (V(N_{total}) / N_{total}^2)$$

and the variance of the estimated abundance ($V(Abun_A)$) is calculated as

$$V(Abun_A) = (N_{no\text{-}tag})^2 (V(Ratio)) + (Ratio)^2 (V(N_{no\text{-}tag})) + (V(N_{no\text{-}tag})) (V(Ratio)).$$

<u>Abundance and Distribution of Steelhead in the Imnaha River Basin</u>

Total natural and hatchery abundance and distribution of the Imnaha system will incorporate all available information obtained through operation of floating weirs, fixed weirs, resistivity weirs, and adult estimation through PIT tag recapture information (Table 3). Results from these multiple methods will provide natural and hatchery adult abundance, distribution, life history, and genetic information in the Imnaha River drainage.

Table 3. Monitoring sites and approach in the Imnaha River to calculate adult abundance, distribution, life history, and genetic measures.

Stream Section	Stream(s)	Monitoring Method			
		PIT Tag Array	Fixed Weir	Floating Weir	Resistivity Weir
Imnaha Basin	Imnaha River	X (ISEMP 200301700)			
Lower Imnaha from mouth to below a confl. Big Sheep	Cow, Lightning, Horse creeks			X – 1-2 of 3 on rotational basis (LSRCP)	
Big Sheep Creek	Little Sheep Creek		X		
	Big Sheep Creek above Little Sheep confl.	X			
	Camp Creek				X (LSRCP)
Imnaha between Big Sheep confl. and Gumboot Weir	Imnaha River above Big Sheep confl. Below Freezout Creek	X			
	Freezeout, Grouse, Summit, Crazyman creeks			X – 2 of 4 on rotational basis	
Upper Imnaha	Gumboot Weir		X		

Products / Milestones*:*

(1) Direct enumeration of adult steelhead escapement
(2) Recruit per spawner ratio for individual tributaries
(3) Female-to-female ratio for individual tributaries
(4) Arrival timing into Imnaha tributaries
(5) Steelhead distribution into Imnaha tributaries
(5) Length frequency and size-at-age
(6) Sex ratios
(7) Age-at-Return by sex
(8) Hatchery: Natural Composition
(9) Genetic structure of subpopulations
(10) Gene flow between subpopulations
(11) Effective population size

OBJECTIVE 3: Collection of Annual Stream Temperature and Discharge

Work Element 157. **Collect/Generate/Validate Field and Lab Data**

Task 3.1: Install constant recording thermographs and document hourly water temperature at the facility sites, year-round.
Task 3.2: Install a staff gauge and collect stream discharge information that is sufficient to develop discharge curves for each tributary.

General Method to Meet Objective - We will measure stream discharge at established transects on a weekly basis, and more frequently during freshet conditions to establish a discharge and staff gauge relationship. The staff gages used will be installed using the methods outlined in Harrelson et al. (1994). A Marsh McBirney Flo-mate model 2000 portable flow meter using a metric top setting wading rod will be used to measure stream discharge. Discharge is the sum of individual partial cross-sectional area times the corresponding mean velocity of the flow normal to the partial cross-sectional area. We will employ the midsection method (Buchanan & Somers 1969) for our discharge measurements.

Constant recording thermographs will be installed to describe water temperatures in major tributaries of the Imnaha River Subbasin. Adult steelhead spawner migration will then be examined in relation to water temperature and stream discharge to describe relation between these variables.

Products / Milestones: (1) Stream discharge and water temperature profiles for all study streams.
(2) Adult steelhead spawner migration timing in relation to water temperature and stream discharge.

OBJECTIVE 4: Coordination of Project Activities and Effective Communication of Results

Work Element 189. Regional Coordination
Work Element 161. Disseminate Raw/Summary Data and Results
Work Element 160. Create/Manage/Maintain Database
Work Element 165. Produce Environmental Compliance Documentation
Work Element 185. Produce PISCES Report
Work Element 132. Produce Annual Progress Report

Task 4.1 Prepare and submit Pisces 2011 statement of work and budget to the Bonneville Power Administration.
Task 4.2 Prepare and submit Pisces quarterly reports to the Bonneville Power Administration.
Task 4.3: Verify primary data and post with associated metadata to NPT and StreamNetweb sites.
Task 4.4: Develop Endangered Species Act Section 10 Permit summary reports
Task 4.5: Develop annual progress reports

Task 4.6: Develop peer reviewed journal publication on metapopulation status and dynamics.
Task 4.7: Supply stock status data to and participate in regional conferences and work groups including NMFS Technical Recovery Teams and NMFS Biological Opinion Evaluations.
Task 4.8: Participate in Northeast Oregon Annual Operating Plan (AOP) development.

General Method to Meet Objective – Coordination of activities with local co-managers will occur through several forums such as the Northeast Oregon Annual Operating Plan and LSRCP meetings. Department research and administrative staff will meet with the Bonneville Power Administration (BPA) and Northwest Power and Conservation Council (NPCC) staff as needed to coordinate BPA funded projects in the subbsin. Project coordination meetings with various agencies usually occur in Portland given that that is where both the BPA and NPCC project headquarters are located.

The Pisces statement of work will be developed and submitted to the Bonneville Power Administration 90 days prior to contract expiration, and will coordinated for research sufficiency, management, legal, and policy review. Pisces Statement of Work and Section 10 research permits will be also be submitted to the BPA's Environmental Compliance Group. All environmental compliance requirements will be coordinated and completed prior to 2011 research activities being undertaken. Other permitting requirements will depend upon results of engineering analysis and design, and NEPA. Currently, a Section 10 research permit application with the National Marine Fisheries Service exists for operation of weirs in four tributaries of the Imnaha River. The Nez Perce Tribe does not recognize that the Endangered Species Act takes precedence over or precludes Tribal sovereignty or rights in any manner. However, the Tribe does recognize that salmon are listed as a threatened species, and strongly believes in coordination efforts to monitor, conserve, protect and recover populations at low levels of abundance and high risk of extirpation. In that regard the Columbia River Inter-Tribal Fish Commission maintains a Section 10 permit, by and through the Bureau of Indian Affairs, coordinating Tribal activities relative to listed salmon and steelhead populations.

Data management and dissemination of project results and data is just as important as collecting data itself, but often receives less attention. Protocols for this project will ensure proper collection and validation of data, with redundant and secure storage. Project sponsors acknowledge the need to share updated information on adult natural origin salmon escapement, spawner abundance, and productivity as soon as it is available. The project will submit annual reports to the BPA web site (http://www.efw.bpa.gov/searchpublications/) to make project information available. Annual reports will also available on the Tribe's web site (Nez Perce Department of Fisheries Resources Management - Research). The project sponsor will also maintain an annual distribution list of managers, researchers, ICTRT members, and other recovery planners who receive hard copies of annual reports and maintain electronic correspondence to share key data sets.

In addition to annual progress reports posted to websites, we will utilize project specific and region-wide databases that have been developed to centralize data associated with widely used data collection activities and standardized performance measures (Beasley et al 2008). The Nez

Perce Tribe website (Nez Perce Department of Fisheries Resources Management - Research) will house a standardized database for primary data, description of meta-data (utilizing NOAA data dictionary), and summary/annual reports related to all projects. The department is currently working towards making this important data available through the Tribe's website, both the real-time and summarized performance measure information will be in 2010.

Appropriate components of program data and results are currently provided to the following websites: The tribe is a partner on the Snake Basin Hatchery working group that currently houses much of the Tribe's adult trapping data (Snake Basin Hatchery Data); Pacific States Marine Fisheries Commission (PSMFC), including: PIT Tag Information System (PTAGIS) and the Regional Mark Information System (RMIS); and StreamNet (StreamNet).

OBJECTIVE 5. Properly Administered Imnaha Steelhead Escapement Monitoring Project.

Work Element 119. Manage and Administer Projects

Task 5.1 Supervise project staff**.**

Task 5.2 Attend Pisces training and maintain current knowledge of Bonneville Power Administration contract requirements.

Task 5.3 Prepare and submit accrual reports to the Bonneville Power Administration.

Task 5.4 Abide by the Nez Perce Tribe policies and procedures as required.

General Method to Meet Objective - Several tasks have been mandated in the day to day administration of project operations. Pisces training will be attended as required and Bonneville Power Administration contracting requirements will be reviewed. Mandated accrual estimate reporting to the Bonneville Power Administration will be completed in June and September. Nez Perce Tribe policies and procedures will be adhered to as required (Human Resources, Finance, Resolutions, Administrative Actions, etc.) as will all other policy and personnel directions. Meetings and training will be attended as necessary to ensure policy and management consistency.

G. Facilities and equipment

This project will be operated out of the Nez Perce Tribe's Joseph Field Office. This office currently provides resources for multiple projects and personnel. Existing office personnel, equipment and support services (office manager, copier, fax, phone systems, etc.) are shared among all projects. Office and storage space will be made available to this project and its associated staff and equipment. Project office furniture, computers, and operating supplies will need to be purchased. Major equipment items will also need to be secured prior to implementation.

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Reference (include web address if available online)	Submitted w/form (y/n)
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I. Key personnel

We anticipate this project requiring 1 full time project leader, 1 full time biologist, 1 full time technician and 2 part time technicians. Additional key personnel that will also contribute to the success of the project follow with their individual resumes.

Jay Hesse, Research Division Director

Nez Perce Tribe Department of Fisheries Resources Management

Education

- Master of Science degree in Fisheries. Michigan State University, 1994.
- Bachelor of Science degree in Fisheries and Wildlife. Michigan State University, 1992.

Current Employment

Director of Biological Services (Research Division). Nez Perce Tribe, Department of Fisheries Resources Management. June 2004 – present.

- Research Division management: technical and procedure supervision/support of project leaders associated with 15 research projects with focus on population status assessment, hatchery effectiveness evaluations, and conservation throughout the Snake River basin.
- Department management: participation in fisheries management team activity coordination across all five divisions of the Department of Fisheries Resources Management; development and implementation of long-term Strategic Management Plan; and incorporation of technical data into management decisions and policy recommendations.
- Regional management: technical and management representation of Nez Perce Tribe in multiple Columbia River basin fisheries co-management forums including the Northwest Power and Conservation Council Fish and Wildlife Program project reviews, Recovery Implementation Science Team, *U.S. vs Oregon*, Columbia Basin Fish and Wildlife Authority, Snake River fall Chinook coordination meetings, Ad Hoc Supplementation Work Group; routine coordination and collaboration with state, tribal, and federal co-managers.

Past Employment

- Fisheries Research Coordinator. Nez Perce Tribe, Department of Fisheries Resources Management. October 1997 – June 2004.
- Fisheries Research Biologist - Project Leader. Nez Perce Tribe, Department of Fisheries Resources Management. July 1994 - October 1997.

Expertise

Expertise in anadromous fish population dynamics, hatchery effectiveness research, strategic planning, effective communications and multi-entity collaboration.

Relevant Recent Reports

Beasley C.A, B.A. Berejikian, R.W. Carmichael, D.E. Fast, M.J. Ford, P.F. Galbreath, J.A. Hesse, L.L. McDonald, A.R. Murdoch, C.M. Peven, and D.A. Venditti). 2008. Recommendations for Broad Scale Monitoring to Evaluate the Effects of Hatchery Supplementation on the Fitness of Natural Salmon and Steelhead Populations. Final Report of the *Ad Hoc* Supplementation Monitoring and Evaluation Workgroup (AHSWG). 82 pgs.

RIST (Recovery Implementation Science Team; G. M. Brown, Jr, C. Busack, R. Carmichael, T. Cooney, K. Currens, M. Ford, G. Helfman, University of Georgia, J. Hesse, P. Lawson, M. McClure, P. McElhany, G. Reeves, B. Rieman, M. Ruckelshaus, B. Thompson). 2009. Hatchery Reform Science; A review of some applications of science to hatchery reform issues. 93 pgs.

Jason Vogel, Research Division Deputy Director

Nez Perce Tribe Department of Fisheries Resources Management

EDUCATION:

M.S. in Fisheries & Utah State University, 1998
B.S. in Fisheries Resources Management, University of Idaho, 1995

DUTIES:

Monitors and guides technical implementation of adopted and contracted research. Serve as a liaison for regional coordination with state, federal and tribal agencies. Develop, implement, and

review projects, reports, publications, proposals and grants. Manage database development and web based data access for the department. Provide tribal fisheries research representation at federal and state meetings.

PROFESSIONAL EXPERIENCE:
Research Division Deputy Director. Nez Perce Tribe Department of Fisheries Resources Management. 2007 - Present.
Project Leader, Lower Snake River Compensation Plan Hatchery Evaluations Project. Nez Perce Tribe Department of Fisheries Resources Management. 2005 - 2007.
Project Leader, Johnson Creek Artificial Propagation Enhancement Monitor & Evaluations Project. Nez Perce Tribe Department of Fisheries Resources Management. 1998 - 2005.

PUBLICATIONS:
Beauchamp, D.A., C.M. Baldwin, J.L. Vogel, and C.P. Gubala. 1999. Estimating diel, depth-specific foraging opportunities with a visual encounter rate model for pelagic piscivores. Can. J. Fish. Aquat. Sci. 56(S1): 128-139.

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Rabe, C.D., D.D. Nelson, and J.L. Vogel. 2006. Johnson Creek Summer Chinook Salmon Monitoring and Evaluation Project. 1998-2005 Summary Report. Project Number 199604300, 131 electronic pages, (BPA Report DOE/BP-00016450-2), http://www.efw.bpa.gov/Publications/A00016450-2.pdf.

Vogel, J.L., J.A.Hesse, J.R. Harbeck, D.D. Nelson, and C.D. Rabe. 2005. Johnson Creek Summer Chinook Salmon Monitoring and Evaluation Plan. Northwest Power and Conservation Council Step 2/3 document. Prepared for BPA, 126 electronic pages, (BPA Report DOE/BP-00016450-3), http://www.efw.bpa.gov/Publications/A00016450-3.pdf.

Vogel , J.L. and D.A. Beauchamp. 1999. Effects of light, prey size, and turbidity, on reaction distances of lake trout (*Salvelinus namaycush*) to salmonid prey. Can. J. Fish. Aquat. Sci. 56:1293-1297.

James R. Harbeck, Project Leader
Nez Perce Tribe Department of Fisheries Resource Management

EDUCATION:
M.S. in Fisheries, Michigan State University, 1998
B.A. in Aquatic Biology, Grand Valley State University, 1994

DUTIES:
NPT Joseph Field Office supervision. Project implementation for the captive broodstock program and supplementation monitoring and evaluation in northeast Oregon. Specific duties include developing a monitoring and evaluation program for the NEOH project, coordinating

captive brood activities with ODFW, the collection and analysis of data associated with these programs, representing the Nez Perce Tribe in meetings with co-managers, personnel supervision, and proposal development.

PROFESSIONAL EXPERIENCE:

Field Office Supervisor, Nez Perce Tribe – 2004 to Present
Provide staff and administrative supervision for the field office

Project Leader, Nez Perce Tribe – 6/2001 to Present
Northeast Oregon Hatchery (NEOH) M&E Project Leader
Acting Captive Broodstock Project Leader

Fisheries Biologist, Nez Perce Tribe – 7/98 to 6/2001
Captive Broodstock Project Leader
Lostine River Monitoring and Evaluation Project Leader

Research Assistant, MSU Department of Fisheries and Wildlife –- 1995 -1998
Primary investigator for a steelhead trout evaluation study
Estimated the wild and hatchery composition and determined life history characteristics

Fisheries Aide, District 9, MDNR Fisheries Division – 1993-1995
Conducted lake and stream assessments and surveys
Assisted in stream rehabilitation projects

Environmental Consultant, Applied Ecology Group – 1993
Collected and identified aquatic invertebrates
Conducted literature searches for research projects

TECHNICAL PAPERS:

Hesse, J.H., J.R. Harbeck and R.W. Carmichael. 2004. Monitoring and evaluation plan for northeast Oregon hatchery Imnaha and Grande Ronde subbasin spring Chinook salmon. Prepared for BPA, DOE/BP-3267. Bonneville Power Administration, Portland, Oregon

Hesse, J A. and J.R. Harbeck. 2000. Northeast Oregon hatchery spring/summer Chinook salmon conceptual monitoring and evaluation plan. Pages 1-26 *in* Ashe et al. Northeast Oregon hatchery project: spring Chinook master plan. Bonneville Power Administran, Portland, OR. DOE/BP-3267.

Harbeck, J.R. 1998. Contribution and Comparative Life History Characteristics of Hatchery and Naturalized Steelhead in the Betsie River, Michigan. Master Thesis, Michigan State University, Lansing MI.

J. Environmental Compliance & Permitting (press tab in last cell to create new rows)

Permit name	Date	Ref #	Link to online permit (if available)
CRITFC – NPT Section 10 #1134 Take Permit	**Start:** 5/27/1998 **End:** 12/31/2012	1134-3R	https://apps.nmfs.noaa.gov/preview/applicationpreview.cfm?ProjectID=13485
CRITFC – NPT Section 10 #1339 Take Permit	**Start:** 01/01/2001 **End:** 12/31/2011	1339-2R	https://apps.nmfs.noaa.gov/preview/applicationpreview.cfm?ProjectID=4607