Reintroduction and Conservation Plan

for Anadromous Fish

In the Upper Deschutes River Sub-basin, Oregon

Edition 1: Spring Chinook Salmon and Summer Steelhead

Oregon Department of Fish and Wildlife

and

Confederated Tribes of the Warm Springs Reservation of Oregon

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1. INTRODUCTION

1.1 BACKGROUND

The Deschutes River basin above the Pelton Round-Butte Hydroelectric Project (“PRB”) was once home to native runs of summer steelhead, Chinook salmon, sockeye salmon, and Pacific lamprey. These runs had been substantially diminished in the upper basin by the time PRB was constructed in the 1950s and early 1960s, but were still significant. Available information suggests peak annual escapements in the 1950s were at least 1,600 adult summer steelhead and 800-900\(^1\) adult spring Chinook salmon (with perhaps twice this number harvested downstream). Naturally produced adult sockeye salmon returns were less than 100 mostly from effects of irrigation methods in the upper Metolius River subbasin tributaries. Efforts were made to provide fish passage and sustain the upper basin’s salmon and summer steelhead runs when the hydroelectric project was constructed, but the efforts failed and were abandoned in 1969. The runs could not be sustained primarily because deceptive surface currents confused smolts attempting to migrate seaward through Lake Billy Chinook (“LBC”), PRB’s upper-most reservoir. Most of the smolts failed to find their way from the head of the reservoir downstream to a fish collector installed at Round Butte Dam (Korn et al. 1967).

There has long been an interest in reestablishing anadromous fish runs in the upper Deschutes River subbasin. This interest has been strengthened in recent years as technological innovations have advanced and hydrodynamic modeling has suggested that the surface currents can be altered to favor the downstream passage of smolts. The relicensing of PRB provided the opportunity to implement these innovations in order to attempt to reestablish anadromous fish runs upstream.

The Federal Energy Regulatory Commission issued a new license for PRB on June 21, 2005, to Portland General Electric Company (“PGE”) and the Confederated Tribes of the Warm Springs Reservation of Oregon (“CTWSRO”), who are joint licensees (“Licensees”) for PRB. 111 FERC ¶ 61,450, order on reh’g, 117 FERC ¶ 61,112 (2006). The license, through mandatory conditions included in the license by the U.S. Fish and Wildlife Service (“USFWS”) and the National Marine Fisheries Service (“NOAA Fisheries”), requires implementation of the PRB Fish Passage Plan (PGE and CTWSRO 2004) to reinitiate fish passage through PRB. The license incorporates the terms of a Settlement Agreement entered into by the Licensees and 20 other parties, including the Oregon Department of Fish and Wildlife (“ODFW”) and CTWSRO. The license establishes a Fish Committee, which is made up of the Licensees, ODFW, CTWSRO, NOAA Fisheries, the USFWS, and other agencies and entities. All responsibilities and tasks of the Licensees with respect to fish passage and reintroduction are described in the

\(^1\) Redd (spawning nest) and adult counts documented by Montgomery (1955) combine to suggest about 820 adults in the upper basin during 1951 and about 930 in 1953.
Fish Passage Plan included as Exhibit D to the Settlement Agreement. These responsibilities include fish passage improvements at PRB, a wide variety of Test and Verification Studies, and longer term monitoring efforts. The license includes a schedule for meeting those obligations.

The central element of the Fish Passage Plan is a Selective Water Withdrawal ("SWW") structure that is now being constructed at Round Butte Dam to improve water quality in the lower Deschutes River subbasin and to create currents in the reservoir that should help guide smolts to an associated fish screening and collection facility (PGE and CTWSRO 2004). This new facility, which will protect fish in LBC from being entrained into power-generating turbines, has the potential to become the centerpiece of a multi-faceted effort to reestablish runs of fish that have been absent from the upper basin for more than 45 years.

Recognizing the fish reintroduction opportunity provided by the SWW structure, the Oregon Fish and Wildlife Commission ("FWC") adopted Oregon Administrative Rules in December 2003 that direct the ODFW to restore anadromous fish, including Mid-Columbia summer steelhead, into portions of their historic range upstream from PRB. Specific areas targeted for reintroduction include the Metolius River and tributaries, the Deschutes River from LBC upstream to Big Falls, Whychus Creek, and the Crooked River and tributaries upstream to Bowman and Ochoco Dams.

1.2 PURPOSE OF THIS PLAN

A successful effort to restore anadromous fish in areas above PRB will depend upon four key components: (1) effective fish passage at PRB, (2) fish management, (3) habitat conservation (maintaining good habitat, rehabilitating damaged streams), and (4) a well conceived adaptive management program. This “Reintroduction Plan” focuses on the fish management component of the effort, while also addressing fish passage, habitat conservation, and adaptive management issues as appropriate. In particular, it addresses the fish management responsibilities of the co-authors, ODFW and the CTWSRO. ODFW and CTWSRO are referred to collectively in this Reintroduction Plan as the Fish Managers. The Fish Passage Plan provides additional important information for the Licensees’ measures related to this reintroduction effort, including the fish passage program at PRB, the funding of high-priority habitat improvement measures, a variety of fish passage-related studies and monitoring, and adaptive management.

This Reintroduction Plan is intended to contribute to a successful reintroduction effort by identifying key fish management issues and how they will be resolved in an adaptive fashion. It discusses species and stocks to be reintroduced to areas above PRB, and provides general guidance on methods, release locations, numbers, timing, and adjustments in hatchery supplementation as populations become re-established. The goal of reintroduction is to restore self-sustaining and harvestable populations of native summer steelhead, Chinook salmon, and
sockeye salmon in the Deschutes River and its tributaries upstream from PRB, and to reconnect native resident fish populations that are currently fragmented by PRB.

Uncertainties regarding reintroduction continue to exist and will only become resolved as the program outlined in this Reintroduction Plan moves forward. In particular, the FWC has concerns about the ability to effectively collect and pass juvenile fish downstream through the hydro project and potential risks of introducing new diseases to resident fish populations in the upper basin. Because of these concerns, the FWC directed ODFW staff to selectively pass summer steelhead, spring Chinook salmon, and sockeye salmon into the drainage basin above PRB, and to minimize the risk of transferring new fish diseases upstream, until the ability to reestablish self-sustaining populations of anadromous species above PRB is proven.

1.3. RELATED PLANS, POLICIES, AND CONSERVATION EFFORTS

The Reintroduction Plan is a companion document to the plan for Anadromous Fish and Bull Trout Management in the Upper Deschutes, Crooked and Metolius River Subbasins (Marx 2004), ODFW’s Native Fish Conservation Policy (ODFW 2002), the state’s Hatchery Fish Management Policy (ODFW 2007), the Deschutes Subbasin Plan (NPCC 2004), and the PRB Fish Passage Plan (PGE and CTWSRO 2004). It is also informed by the Settlement Agreement Concerning the Relicensing of PRB (FERC Project No. 2030). Contents of this Reintroduction Plan will be reviewed for consistency and modified as necessary to remain compatible with the Mid-Columbia River Steelhead Recovery Plan that is currently under development, and with Deschutes River Basin Bull Trout Recovery Plan drafted by USFWS in 2003.

The basic goal of this Reintroduction Plan, restoring self-sustaining and harvestable runs of anadromous fish to the upper basin, is consistent with a variety of other written plans, both recent and long-standing. Some of these other plans are described below.
1.3.1. ODFW Fisheries Management Plans.

ODFW Fisheries Management Plans adopted by the FWC for the management of the Metolius River subbasin (Fies et al. 1996a), Upper Deschutes River subbasin (Fies et al. 1996b), and Crooked River subbasin (Stuart et al. 1996) subbasins, including Lake Billy Chinook, all include policy statements such as the following from the Crooked River Subbasin Plan: “Restore anadromous and migratory resident fish to their historic range in the Crooked River basin by improving upstream and downstream passage over artificial barriers.” OAR 635-500-1850. These subbasin management plans also include policy statements to protect, restore, and enhance fish habitat in the Deschutes basin and tributaries. For example, the Crooked River Subbasin Plan has objectives to protect, restore and enhance fish habitat, maintain or improve instream flow, improve water quality, and reconnect isolated and fragmented populations by restoring and improving passage over manmade barriers. OAR 635-500-1850. On December 12, 2003, the FWC adopted amendments to fish management plans to provide management direction for anadromous fish species in the Upper Deschutes, Crooked, and Metolius River subbasins, including areas upstream of PRB.

1.3.2. CTWSRO Fisheries and Land Management Plans.

The Deschutes River Subbasin Salmon and Steelhead Production Plan (ODFW and CTWSRO 1990) was developed in accordance with the Northwest Power Planning and Conservation Council’s (“NWPPCC”) Columbia River Basin Fish and Wildlife Plan. Its purpose is to guide the NWPPCC’s adoption of future salmon and steelhead enhancement projects in the Deschutes River system. The plan also summarizes agency and Tribal management goals and objectives, documents current management efforts, identifies problems and opportunities associated with increasing salmon and steelhead numbers, and presents preferred and alternative management strategies.

The Integrated Resources Management Plan (“IRMP I”) for the Forested Area (CTWSRO and BIA 1992) was developed to guide the development and use of the forested sections of the Reservation. One goal of the plan, the riparian resource management goal, identifies the need to “manage watersheds to protect the unique and valuable characteristics of riparian areas and improve water quality, aquatic habitat, and other water-dependent resources.” Several other resource goals in the plan are intended to guide the management of fish and aquatic resources on forested lands of the Reservation to protect specific resource components, including: biological diversity; Threatened, Endangered, and Sensitive species; and Wild and Scenic Rivers. The Integrated Resources Management Plan (“IRMP II”) for the Non-forested Areas (CTWSRO and BIA 1999) also identifies specific goals for the protection and management of water quality, riparian areas, and resident and anadromous fish. The IRMP II contains elements intended to provide for the protection and enhancement of threatened and endangered fish and aquatic species.
The CTWSRO have also developed the Warm Springs National Fish Hatchery Operation Plan (CTWSRO and USFWS 2007). The goals of this operation plan are to cooperatively operate the Warm Springs National Fish Hatchery to protect remaining wild fish populations and preserve their genetic integrity, maintain the existing physical characteristics of Warm Springs River anadromous fish stocks and their production above the hatchery, and not impact fish populations below the hatchery.

The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakima Tribes (CRITFC 1995) provides a framework to restore Columbia River salmon, outlining the cultural, biological, legal, institutional, and economic context within which the region’s salmon restoration efforts are taking place. Goals of the tribal salmon restoration plan include: (1) Restoring anadromous fishes to the rivers and streams that support the historical Cultural and economic practices of the tribes; (2) emphasizing strategies that rely on natural production and healthy river systems; (3) protecting tribal sovereignty and treaty rights; and (4) reclaiming the anadromous fish resource and the environment on which it depends for future generations.

### 1.3.3. The Oregon Plan for Salmon and Watersheds.

The Oregon Plan for Salmon and Watersheds (“Oregon Plan”) is a state-wide initiative that relies upon on volunteerism and local watershed councils to restore healthy watersheds that support the economy and quality of life of Oregon. It has four key elements, with success depending on the strong implementation of each. These elements include:

- coordinated state and federal agency and tribal actions to support private and voluntary restoration efforts, effectively implement regulatory programs, soundly manage public lands, and promote public education and awareness about watersheds and salmon;
- voluntary restoration actions by private landowners with support from citizen groups, businesses, and local government;
- monitoring watershed health, water quality, and salmon recovery to document existing conditions, track changes, and determine the impact of programs and actions; and
- scientific oversight to evaluate effectiveness and guide needed changes.

Multiple local groups are currently active in the areas where anadromous fish are to be reintroduced, and are working with landowners to improve habitats that will be important to these fish over the long run. These groups include, but are not limited to, the Upper Deschutes Watershed Council and the Crooked River Watershed Council.
1.3.4. ESA Recovery Plans.

1.3.4.1. Bull Trout.
On June 10, 1998, the USFWS listed the bull trout (Salvelinus confluentus) Columbia River Distinct Population Segment (“DPS”) as a threatened species under the federal Endangered Species Act (“ESA”) (63 FR 31647). This DPS was also included in the November 1, 1999, listing for bull trout in the coterminous United States (64 FR 58909). Populations in the Deschutes River are included in this listing. For the Columbia River DPS, the September 26, 2005, Final Rule (50 CFR 56212) identified 78 miles of critical habitat in the Lower Deschutes River subbasin (extending from Big Falls above PRB downstream to the confluence with the Columbia River). This included small areas of the lower Deschutes River subbasin, PRB reservoirs, and small areas of the Metolius and Deschutes River subbasins above PRB.

A draft recovery plan for the Deschutes Recovery Unit has been prepared by the USFWS in conjunction with the Deschutes Recovery Unit Team (USFWS 2003). The goal of the Deschutes River bull trout recovery plan is to “ensure the long-term persistence of self-sustaining complex interacting groups of bull trout distributed throughout the species’ native range, so that the species can be delisted.” The recovery plan establishes several objectives toward achieving this goal and identifies specific actions associated with each objective. Among these prescribed actions is restoring fish passage at the Pelton Round Butte Project and implementing a monitoring strategy.

1.3.4.2. Middle Columbia Steelhead.
The Middle Columbia River (“MCR”) DPS of steelhead (Oncorhynchus mykiss) was listed by NOAA Fisheries as Threatened, first on March 25, 1999 (64 FR 14517) and later reaffirmed on January 5, 2006 (71 FR 834). The 1999 listing determination was only for naturally spawned, anadromous populations of O. mykiss residing below impassable natural barriers. Resident O. mykiss are not included in the listed DPS. At present, MCR Steelhead occur in the lower Deschutes River subbasin below PRB. In its 2006 determination, NOAA Fisheries concluded that the Deschutes River hatchery stock (ODFW stock 66) should be considered part of the DPS, resulting in the stock being listed as a threatened species.

Continued recovery planning efforts for MCR Steelhead appear to be viewing the restoration of a self-sustaining population of summer steelhead in Whychus Creek as potentially important to species recovery.

1.3.5. Federal Forest and Land Management Plans.
The U.S. Forest Service (“USFS”) land and resource management plans for the Deschutes National Forest (USFS 1990) and Ochoco National Forest and Crooked River National Grassland (USFS 1989), and the U.S. Bureau of Land Management (“BLM”) Two Rivers
resource management plan (BLM 1986) all include standards for fisheries habitat protection. These plans also express support for the reintroduction of native fishes to their historical ranges.

The Metolius, Deschutes, and Crooked rivers, the major tributaries to Lake Billy Chinook, are all classified as National Wild and Scenic Rivers in the reaches just above the reservoir. The management plans for each of these federally managed segments support the goal of reintroducing anadromous fish to the area (USFS et al. 1996; BLM et al. 1992a, 1992b). The entire 100-mile length of the lower Deschutes River subbasin is a component of the Oregon State Scenic Waterways System, as well as National Wild and Scenic River, Recreation River area. The Lower Deschutes River Wild and Scenic River Management Plan (BLM et al. 1993, 1996) identifies recreation management goals for the lower Deschutes River subbasin. The recreation management goals for all segments of the lower river include management to maintain or enhance recreational fisheries values. The Metolius River subbasin from Head Springs down to Candle Creek, and the Deschutes River subbasin from Market Road downstream to LBC, have also been given State Scenic Waterway designations and have similar management goals.

1.4 NATURAL BENEFITS TO THE DESCHUTES RIVER ECOSYSTEM
Multiple ecological benefits of restoring fish passage through PRB and reestablishing runs of anadromous fish in the upper basin have been identified. Each of these would contribute to the conservation and recovery of native fish in the Deschutes River basin, including:

- reconnecting the diverse habitats of the upper basin with the lower Deschutes River and its tributaries;
- adding resilience to the basin’s aquatic communities by promoting species and life-history diversity as the fish respond to restored connectivity and the habitats made available to them;
- strengthening native fish populations by restoring migration and gene flow among dispersed sub-populations; and
- importation of marine-derived nutrients and other contributions of salmon, steelhead, to a healthy ecosystem.
2. CONCEPTUAL FRAMEWORK

Lichatowich (1998) developed a conceptual foundation for the management of native Deschutes River basin salmonids that considers the whole river ecosystem which is important when considering how to effectively initiate the reintroduction of anadromous salmonids to the upper basin. The conceptual foundation focuses on local adaptation, the importance of habitat connectivity, the development of diverse or unique life-history types in salmonids as a response to environmental variation, the diversity of aquatic environments present in the river system, and the changes that water development and riparian damage have caused in multiple streams that were once productive for these fish. With regard to anadromous fish reintroduction, this leads to several conclusions:

- success in re-establishing runs of anadromous fish in the landscape above PRB will depend both on effective fish passage at PRB and upon productive habitats in the project reservoir(s) and upstream tributaries;
- restoring the connectivity and quality of degraded habitats in the upper basin, and allowing the fish to express the diversity of life-histories that these habitats may allow, will be important to the productivity of any reestablished populations;
- improving the quality of salmonid habitats that have been degraded in the upper basin will require consideration of both the natural processes involved in stream recovery and the needs of human communities in the area;
- natural selection will play a central role in the success or failure of the reintroduction effort, and will exert its influence in tributaries to LBC, in the reservoir, and downstream;
- a successful reintroduction effort is likely to depend on initial stock selections and on the way in which fish genetic resources are managed (or not) so as to accumulate local adaptations;
- local adaptations will accumulate as reintroduced fish pass through full life-cycles and as multiple linked generations of fish utilize the environment upstream of PRB dams;
- reintroduction actions (or inactions) that encourage the development of local adaptations should be emphasized; and
- the relative abundance and diversity of the life-histories being expressed by reintroduced salmonids will be an important index of progress and should be monitored.

The principles just identified have been used to help guide initial planning for the reintroduction effort, and may be used as guideposts when questions arise about appropriate courses of action as the effort moves forward. Should any of the principles be proven wrong, it will be replaced with one consistent with scientific understanding at the time.
3. DECISION-MAKING

3.1 STRUCTURED DECISIONMAKING

Oosterhout (1998) and others involved in the recent relicensing process for PRB organized many of the complex decisions related to providing fish passage and reintroduction at PRB and reintroducing anadromous fish to the upper basin into component parts so as to simplify the decision-making process. The results of this effort, which were incorporated into the PRB Fish Passage Plan (PGE and CTWSRO 2004), established an adaptive management program and identified key uncertainties potentially affecting fish passage decisions and the success of reintroduction. The uncertainties were narrowed through a series of targeted studies and modeling efforts, but will to some extent remain unresolved until new fish passage systems and the performance of reintroduced species in upper basin habitats are tested. Such tests will either verify existing hypotheses, or cause alternate hypotheses to be developed and themselves tested. The uncertainties around which these hypotheses have been formulated, hereafter referred to as “issues”, include:

- the degree to which upper basin residents work together to make the reintroduction effort a success;
- how well smolts will pass downstream through LBC and into the SWW fish collection facility;
- the productive capability of upper basin habitats, actual fish stock performance in this habitat, and the degree to which both will improve through time;
- how available fish genetic resources should be used to maximize the probability of reintroduction success;
- the potential risk of introducing new fish diseases to the upper basin;
- the potential for predation on juvenile anadromous fish when in project reservoirs;
- the outcomes of potential competition between introduced and resident fish, particularly summer steelhead and resident rainbow trout, in various portions of the former anadromous fish zone within the drainage basin above PRB; and
- fishery impacts on outmigrant summer steelhead smolts and on adult salmon returning to the upper basin.

Structured, hypothesis driven decision-making is something to which this Reintroduction Plan aspires. Where possible, actions taken in the reintroduction effort will be based on explicit rationales and testable hypotheses that fit within the conceptual framework outlined earlier. Similarly, action(s) may be deferred or avoided on the basis of explicit rationales and testable hypotheses that fit within the conceptual framework. Monitoring and evaluation of the reintroduction program will measure progress toward achieving its objectives as well as allowing the explicit rationales and hypotheses behind actions taken, deferred, or avoided, to be tested and
either verified or revised. Where needed, revised rationales or hypotheses will guide adjustments in the reintroduction effort.

As this Reintroduction Plan was developed, biologists representing ODFW, CTWSRO, NOAA Fisheries, the USFWS, PGE, and other entities worked through a list of facts, assumptions, and hypotheses that formed the underlying rationales for the approach to be taken to reintroduce anadromous fish into the upper basin. These rationales relate to many of the issues that are identified above and that are discussed in the next section of the Reintroduction Plan. They are summarized for future reference in Appendix A.

3.2 RELATION TO LICENSE IMPLEMENTATION

The license and the Settlement Agreement define certain obligations of all the parties to the Settlement Agreement. This Reintroduction Plan is not intended to add to or modify the obligations of the Licensees under the license and Settlement Agreement or those of any other party to the Settlement Agreement, or to modify any statutory and regulatory authorities of any of the parties to the Settlement Agreement. This Reintroduction Plan, dealing with fish management efforts, is one piece of the overall planning and work needed for successful fish passage and reintroduction.2

Successful implementation of this Plan will require many decisions by the Licensees, Fish Managers, Fish Agencies, and Fish Committee.3 Some of these decisions are governed by the provisions of the new license and the Settlement Agreement and are subject to the decision making and dispute resolution processes set forth in those authorities; others are governed by statutory and regulatory authorities outside of the license and Settlement Agreement. It is the intent of the Fish Managers that decisions under this Plan will be made according to the process in the new license and Settlement Agreement where such decisions are also governed by the license or Settlement Agreement and to coordinate fish management efforts in a manner that respects the authorities, expertise and obligations of the Fish Managers, Licensees, Fish Agencies, and Fish Committee. Use in this Reintroduction Plan of any decision-making terms is not intended to identify which reintroduction decisions are subject to the license and Settlement Agreement and which are not, or to be dispositive as to the decision making or dispute resolution processes applicable to the decision. Silence as to how a decision is to be made is not intended

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2 Other parts include but are not limited to the Fish Passage Plan, the annual Fish Passage Work Plan, the Hatchery Annual Operating Plan, and Testing and Verification study plans.

3 Fish Agencies are defined in the license and Settlement Agreement as NOAA Fisheries, USFWS, ODFW, and CTWS BNR. The Fish Committee is defined in the license and Settlement Agreement as the Licensees, NOAA Fisheries, USFWS, ODFW, CTWS BNR, U.S. Forest Service, Bureau of Indian Affairs, Bureau of Land Management, CTWS Water Control Board, Oregon Department of Environmental Quality, and an NGO representative.
to create a presumption as to the decision-maker or the decision making or dispute resolution processes applicable to the decision.

For decisions that might affect federally-listed T&E species, the Fish Managers will work with USFWS or NMFS, as appropriate, to ensure consistency with recovery plans and other ESA related requirements.
4. KEY ISSUES AND GENERAL APPROACH TO FISH REINTRODUCTION

4.1. SALMON REINTRODUCTION AS A COLLECTIVE EFFORT

The design, construction, and operation of state-of-the-art fish passage facilities at PRB will be a testament to strong resource stewardship. It will also be a critical step toward achieving the goals of this Reintroduction Plan. However, maximum success in returning self-sustaining and harvestable runs of anadromous fish to the upper basin will depend on more than just fish passage at PRB’s dams and through its reservoirs. Adaptive fish management and good stewardship of upper basin habitats will also be important (Figure 4-1). Assuming efforts to resolve fish passage difficulties in LBC succeed, the strength of future upper basin runs of anadromous fish will reflect the collective efforts of many individuals and groups, both public and private, whose actions will affect the fish and/or their habitat.

![Diagram](Image)

*Figure 4-1. The three basic components of an effective effort to return optimal runs of anadromous fish to the upper basin: fish passage, habitat rehabilitation, and fish management.*

4.2. FISH PASSAGE AND PASSAGE EFFICACY

Three-dimensional hydrodynamic modeling by Khangaonkar (1999) and Yang et al. (2000) suggests that the currents in LBC will be changed by the SWW facility in ways that should enable more effective downstream passage for smolts and other downstream migrants. Modeling suggests that fish entering the reservoir’s Deschutes and Crooked River arms may be most effectively guided to the SWW (Figure 4-2). However, the actual performance of the SWW facility at changing currents in the reservoir and at collecting juvenile fish that are attempting to pass downstream through the reservoir will remain uncertain until the facility is tested. Because
effective smolt passage through the reservoir is viewed as essential to reestablishing self-sustaining and harvestable runs of summer steelhead, spring Chinook salmon and/or sockeye salmon above PRB, much attention early in the reintroduction program will be on Test and Verification studies of facility performance (PGE and CTWSRO 2004). Coupled with evaluations of how effectively adult fish can be passed upstream from Pelton Trap on the lower Deschutes River and into LBC, results of this testing and their relationship to interim targets (measures of success; Table 4-1) will play a critical role in the evolution of the fish reintroduction program.

Table 4-1. Measures of success for the evaluation of fish passage at PRB. (Source: 119 FERC ¶ 62,006 (2007)).

<table>
<thead>
<tr>
<th>Item</th>
<th>Criteria and Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Screen Hydraulic Criteria</td>
<td>NOAA Fisheries smolt criteria</td>
</tr>
<tr>
<td>2. Downstream Passage Facility Survival (from Round Butte collection to lower Deschutes River release point)</td>
<td>93 percent smolt survival during first five years of operations. 96 percent smolt survival after the first five years of operation.</td>
</tr>
<tr>
<td>3. Upstream Passage Facility Survival (from lower Deschutes River collection point through Adult Release Facility)</td>
<td>95 percent during first five years of operations. 98 percent after the first five years of operations.</td>
</tr>
<tr>
<td>4. Round Butte Reservoir Downstream Passage during first five years of Operation of Passage Facilities</td>
<td>&gt;50 percent of a statistically significant sample of tagged steelhead or spring Chinook outmigrants from any Project tributary¹.</td>
</tr>
<tr>
<td>5. Round Butte Reservoir Downstream Passage after first five years of Operation of Passage Facilities</td>
<td>&gt;75 percent survival of PIT-tagged smolts calculated as a rolling 4-year average beginning after the first five years of SWW operation¹.</td>
</tr>
</tbody>
</table>

¹ The 50 and 75 percent efficacy thresholds apply to tests of statistically significant samples of tagged steelhead or spring Chinook outmigrants from any tributary to LBC.

Phase 1 of the fish reintroduction and testing program will begin by releasing pathogen-screened juvenile fish (eggs, fry, smolts) into the upper basin. However, returning adult fish will not be released upstream of PRB until Phase 1 goals are met (see Section 5). Initially, smolts produced in and leaving the upper basin will be given unique tags or marks other than clipped adipose fins. The marking program is intended to reduce harvest by downstream fisheries when returning as adults and so that they can be differentiated as being of upper basin origin when
Figure 4-2. Surface currents in Lake Billy Chinook with and without the SWW facility operating in the forebay of Round Butte Dam, per hydrodynamic modeling by Khangaonkar (1999) and Yang et al. (2000).
arriving as adults at the Pelton Trap. When smolt passage meets agreed-upon measures of success the program will transition from Phase 1 to Phase 2 (see Section 5, footnote 2). In this phase, smolts collected at the SWW facility will continue to be uniquely marked or tagged and then passed downstream into the lower Deschutes River subbasin. However, salmon or summer steelhead returning to the Pelton Trap as adults after having reared in the upper basin environment (either as pathogen-screened juveniles or as the naturally produced descendants of such) will be passed upstream to complete their lifecycles. This passage of adults will increase the risk of introducing a new fish disease to the upper basin (see Section 4.4.2), but will represent an essential step toward the development of fish populations better adapted to upper basin habitats.

As the selective passage phase of the reintroduction effort progresses, continued evaluations and improvements at PRB’s fish passage facilities will be intended to achieve higher levels of fish passage effectiveness. If the reintroduction program meets the escapement goals for a species or multiple species as outlined in Section 4.5.4, the decision to transition to an upstream passage system for all adult fish not bearing hatchery-origin marks will be explored. The decision to move to such a system would depend on a status review of the upper basin runs and would follow a decision process outlined in the Pelton-Round Butte Fish Passage Plan (PGE and CTWSRO 2004). To assist with the status review, a stock recruitment or predictive model may be developed for spring Chinook salmon and summer steelhead upstream of PRB to determine specific escapement numbers necessary to meet conservation goals.

4.3. HABITAT CONDITIONS

Aquatic habitat upstream of Round Butte Dam is known to be suitable for use by the anadromous species historically present in the upper basin. Recent assessments combined with modeling suggest that with passage through Lake Billy Chinook it has the potential to support a very large sockeye salmon population (in the reservoir itself), sizeable populations of summer steelhead in Whychus Creek and in the lower Crooked River subbasin, and somewhat smaller runs of Chinook salmon. Uncertainty remains, however, about (1) how productive these species will prove to be in existing upper basin habitats and (2) the degree and rate at which fish passage impediments and degraded habitat conditions in some upper basin streams will be addressed.

4.3.1. Quantity, quality, and productive capacity of available anadromous fish habitat.

There are at least 250 stream miles of potential anadromous fish habitat within the reintroduction area, plus the highly productive 4,000-acre aquatic environment of LBC, and additional habitat in Suttle Lake as well as Lake Simtustus (Figure 4-3). Habitat conditions vary considerably among the streams that will become accessible to anadromous fish reintroduced above Round Butte Dam (Riehle 2000). Potentially accessible streams in the Upper Deschutes River Subbasin
(the mainstem Deschutes River, Whychus Creek, and a few small tributaries) provide at least 36 miles of habitat, much of it in fair to good physical condition but also affected to varying degrees by water withdrawals. The Metolius River subbasin contains approximately 108 miles of potential anadromous fish streams, most very cold and undisturbed. Anadromous fish habitat in the lower Crooked River subbasin will become accessible to adult anadromous fish when passage impediments at Opal Springs Hydroelectric Project (FERC Project No. 5891, “Opal Springs”, a half-mile above the reservoir) and a few others are remedied, and totals 105 stream miles. Much of the habitat in the Crooked River subbasin is affected by streamflow depletion, but there may be options for ameliorating this situation in the mainstem Crooked River subbasin with larger seasonal releases of stored water from Bowman Dam.

Current estimates of the potential for smolt production within the reintroduction area are available for summer steelhead (Cramer and Beamesderfer 2006; Ackerman et al. 2007) and spring Chinook salmon (Oosterhout 1999; Lovtang 2005). These estimates, with those for spring Chinook salmon adjusted to account for conditions not considered by Oosterhout (1999) or Lovtang (2005), are given in Table 4-2. Although juvenile spring Chinook salmon are known to rear to smolt in artificial reservoirs elsewhere in the Northwest and may do so to some degree here, the potential for this type of rearing in Lake Billy Chinook has not been quantified. Regardless, and accounting even for the future benefits of habitat improvements in the reservoir’s tributaries, it is anticipated that sockeye salmon may offer the greatest opportunity for developing truly large salmon runs in the upper basin. Sockeye salmon reintroduction will be specifically addressed in Edition 2 of this Reintroduction Plan.
Figure 4-3. The known historic distribution of anadromous fish in the Deschutes Basin, including planned reintroduction areas in the Upper Deschutes Basin above PRB but below Big Falls, Bowman Dam, and Ochoco Dam (source: Lichatowich 1998).
Table 4-2. Recent estimates of the potential for summer steelhead and spring Chinook smolt production above PRB.

<table>
<thead>
<tr>
<th>Stream/reservoir</th>
<th>Estimated smolt production potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summer steelhead (Ackerman et al. 2007)</td>
</tr>
<tr>
<td>Lake Billy Chinook</td>
<td>---</td>
</tr>
<tr>
<td>Deschutes River</td>
<td>0 – 7,514&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Whychus Creek</td>
<td>15,325</td>
</tr>
<tr>
<td>Subbasin total</td>
<td>15,325 – 22,839</td>
</tr>
<tr>
<td>Metolius River</td>
<td>---</td>
</tr>
<tr>
<td>Abbott Creek</td>
<td>---</td>
</tr>
<tr>
<td>Brush Creek</td>
<td>---</td>
</tr>
<tr>
<td>Candle Creek</td>
<td>---</td>
</tr>
<tr>
<td>Canyon Creek</td>
<td>---</td>
</tr>
<tr>
<td>First Creek</td>
<td>---</td>
</tr>
<tr>
<td>Jack Creek</td>
<td>---</td>
</tr>
<tr>
<td>Jefferson Creek</td>
<td>---</td>
</tr>
<tr>
<td>Lake Creek</td>
<td>---</td>
</tr>
<tr>
<td>Seven other tributaries</td>
<td>---</td>
</tr>
<tr>
<td>Subbasin total</td>
<td>---</td>
</tr>
<tr>
<td>Crooked River (Below Highway 97)</td>
<td>11,557 – 15,840&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crooked River (Highway 97 – Lone Pine Bridge)</td>
<td>1,296</td>
</tr>
<tr>
<td>Crooked River (Lone Pine Bridge – CRFC)</td>
<td>4,357-9,571&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crooked River (CRFC – Bowman Dam)</td>
<td>0 – 32,237&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>McKay Creek</td>
<td>3,262</td>
</tr>
<tr>
<td>Ochoco Creek</td>
<td>5,321</td>
</tr>
<tr>
<td>Subbasin total</td>
<td>25,793 – 67,527</td>
</tr>
<tr>
<td>Total</td>
<td>41,118 – 90,366</td>
</tr>
</tbody>
</table>

<sup>a</sup> The low estimate is exactly that of Ackerman et al. (2007), while the high estimate assumes 50% of maximum smolt production in areas that once supported steelhead but where these authors now predict resident rainbow trout will exhibit strong competitive dominance over the anadromous form.

<sup>b</sup> The given range of estimates reflects that the production of spring Chinook smolts in this area may be severely constrained by high virulence of the disease-causing parasite Ceratomyxa shasta.

<sup>c</sup> The range of estimates given does (high) and does not (low) include habitat from the lower end of Camp Polk downstream to Alder Springs.

<sup>d</sup> The estimate of smolt production capacity is based on maximum juvenile Chinook densities observed in fall during two years in which fry were released experimentally into the Metolius system, per Lovtang (2005). Estimates for warmer streams within that system (Abbott, Brush, First, and Lake creeks) have been adjusted upward by a factor of 3 to account for low seeding of this stream type when studied by Lovtang, then multiplied by 1/3 to account for the approximate fall parr-to-spring-smolt conversion rates seen in the Warm Springs River system.

<sup>e</sup> Cramer and Beamesderfer (2007) consider habitat in the Metolius subbasin more suitable for resident trout.

<sup>f</sup> Lovtang (2005) estimates that 38% of the potential smolt production of the warmer streams (Abbott Creek, Brush Creek, First Creek, and Lake Creek) in this cold system may be inaccessible to adult Chinook. Specifically, First and N.Fk. Lake creeks may be inaccessible to due insufficient late-season flows.
4.3.1.1. **Summer steelhead.**

The most recent estimates of summer steelhead production potential above LBC range from 41,118 to 90,366 smolts, depending on whether or not reintroduced summer steelhead are successful in areas where summer water temperatures are cold and that are now strongholds for resident rainbow trout (Table 4-2). Cramer and Beamesderfer (2006) and Ackerman et al. (2007) make a strong argument that summer steelhead will be unsuccessful in these areas. This is the initial operating assumption for the reintroduction program.

Beamesderfer (2002) applied a lifecycle model to an assumed rearing capacity of 9,400 summer steelhead smolts for currently accessible habitats above the reservoir, including the mainstem Deschutes below Steelhead Falls and Whychus Creek, and predicted average summer steelhead escapements of 438 adults spawning in the upper basin. This estimate was based on assumptions of 90 percent reservoir passage efficacy and 5.4% smolt-to-adult survival. Factored upward to take updated smolt capacity into account, the estimate translates to 714 adult summer steelhead escaping to spawn in currently accessible areas. Beamesderfer (2002) used a capacity estimate of 20,500 summer steelhead smolts and the same assumptions to model adult escapements that might occur with passage at Opal Springs Dam on the lower Crooked River subbasin. Results suggest spawning escapements above PRB with improved passage but without habitat restoration would increase to 955 adults. Adjusting Beamesderfer’s (2002) model results again to account for updated smolt capacity, his escapement with passage at Opal Springs Dam translates to 1,915 summer steelhead. All of these estimates are recognized as uncertain, but they do clearly suggest that the reintroduction area may support a fairly large run of summer steelhead if smolt passage efficacy at PRB is high.

Historic records from spawning ground counts and weir captures in Whychus Creek between 1950 and 1965 provide an indication of potential summer steelhead production in Whychus Creek, and are consistent with the adjusted estimates of potential run size given above. Montgomery (1952, 1953) estimated that a minimum of 582 adult summer steelhead used Whychus Creek in 1952 (461 counted) and 1,000 spawned there in 1953 (619 counted). Numbers of summer steelhead passed over Pelton Dam between 1956 and 1960 ranged from 323 to 1,619 adults (Ratliff and Schulz 1999).

4.3.1.2. **Spring Chinook salmon.**

The latest estimates of the capacity of upper basin streams to produce spring Chinook salmon range from 159,956 to 292,243 smolts (Table 4-2), with the lower number reflecting conservative assumptions about whether the species will or will not be productive where the parasite *Ceratomyxa shasta* is thought to be abundant or summer water temperatures have been documented to exceed 22-23 C. The initial operating hypothesis of the reintroduction effort is that they will not and that the lower estimate(s) are most reasonable under existing conditions. Most of the current production potential for spring Chinook salmon in streams above PRB
appears to reside in the Metolius River subbasin, where the species was last seen in abundance and in the portion of the mainstem Crooked River affected in summer by coldwater releases from Bowman Dam.

Potential runs of adult spring Chinook salmon into the upper basin have not been formally modeled using the latest smolt capacity estimates, but such simulations may be performed in the near future. Simulations by Beamesderfer (2002) using the Passage Risk Assessment Simulation Model (PasRAS) and input parameters as described by Oosterhout (1999) demonstrated the effects of various reservoir passage efficiencies on the production potential for Chinook salmon upstream from PRB. Simulations included production in the Metolius River subbasin, Whychus Creek, and the Crooked River subbasin and suggested that annual escapements of adults above PRB would increase 2.5-fold as passage survival from the tributaries and into the SWW collection facility increased from 60 percent to 90 percent. None of his runs suggested spring Chinook salmon escapements would average more than 500 fish, but modeling the potential for Chinook salmon runs in the system has proven difficult (Dr. G. Oosterhout, Decision Matrix, pers comm.).

Spawning ground counts from the 1950s provide some indication of at least the historic potential for spring Chinook salmon in the Metolius River subbasin and in Whychus Creek. ODFW biologists documented between 100 and 648 adult spring Chinook salmon during annual spawning ground counts on Whychus Creek and at the Metolius River weir (located below Jack Creek) between 1951 and 1958 (ODFW 1958). As suggested in the introduction to this Reintroduction Plan, annual runs exceeding 2,000 adult spring Chinook salmon appear to have been returning toward spawning areas in the Metolius River subbasin in a couple of years during the first half of the 1950s. Estimates of runs this large are based on the magnitude of downstream fisheries and an accounting of both the adults and redds counted during historic surveys by ODFW.

4.3.1.3. Summer-fall Chinook salmon.

There are no estimates available of the upper basin’s potential for producing the “ocean-type” Chinook salmon that Lichatowich (1998) and others believe are best suited to the lower mainstem reaches of the Deschutes and Crooked Rivers immediately upstream of LBC. The initial hypothesis adopted for potential reintroduction efforts is that these fish will be better suited than spring Chinook salmon to the mainstem Deschutes River below Steelhead Falls (at River Mile 127) and the mainstem Crooked River below the Lone Pine Bridge (at River Mile 30). In both instances, prevailing thermal patterns and the presumed presence of *Ceratomyxa shasta* would seem to favor summer-fall Chinook salmon over spring Chinook salmon. In the case of the lower Crooked River, late season flow augmentation might be necessary to allow adult fish to reach potential spawning areas.
Counts of adult Chinook salmon that passed PRB before fish passage was abandoned in 1969 show modest numbers of fish passing upstream each summer after July 1, the date that was used historically to segregate spring-run from summer-run fish in the counts of fish passing Pelton Dam. Annual passage of these later-run fish varied from 33 to 473 between 1957 and 1969 (D. Ratliff, PGE, pers comm.).

4.3.2. Habitat restoration efforts.

There is high potential for increasing the quantity and quality of habitats that will be available to anadromous salmonids upstream of Round Butte Dam, and taking advantage of these opportunities will be important to the long-term success of the reintroduction program. Descriptions of these opportunities can be found in ODFW’s subbasin-specific fish management plans for the Upper Deschutes (Fies et al. 1996b), Metolius River (Fies et al. 1996a), and Crooked River (Stuart et al. 1996) subbasins. Streamflow restoration, riparian improvements, streambank stabilization, and passage and screening of diversion dams should be primary areas of emphasis (Marx 2003). There are already substantial ongoing efforts to take advantage of these opportunities (Figure 4-4). The Upper Deschutes Watershed Council, Crooked River Watershed Council, Oregon Water Trust, Deschutes Land Trust, Deschutes River Conservancy, state agencies through the Oregon Plan, PGE, the CTWSRO, federal land managers, and others have all placed a priority on restoring habitat for salmonids.

Two explicit hypotheses will be tested during the reintroduction effort, and there are reasonable expectations that they will be proven correct. These are: (1) that high-priority habitat protection and restoration needs for anadromous salmonids have been correctly identified in the upper basin
Figure 4-4. Priority stream reaches and habitat restoration projects in the Deschutes Basin (source: Deschutes Subbasin Plan).
and will be addressed and (2) efforts to take advantage of available restoration opportunities will improve in effectiveness through time and yield important increases in the productive capacity of some upper basin habitats. Monitoring by multiple parties in the upper basin, and responses by the reintroduced fish themselves, will verify or disprove these hypotheses.

4.4. FISH MANAGEMENT

This Reintroduction Plan intends to couple adaptive fish management with effective fish passage facilities and suitable habitat conditions above Round Butte Dam to encourage the emergence of diverse and productive natural runs of anadromous fish above PRB. Success in this regard is likely to depend on effective management of fish genetic resources, on how fish health is managed to limit disease-related risks, and on making whatever management adjustments might prove appropriate to address possible fish predation in PRB reservoirs, unintended interactions between anadromous and resident fish, and fishery impacts.

4.4.1. Genetic resource management.

A successful reintroduction effort is likely to depend on initial stock selections and on the way in which reintroduced salmon and summer steelhead populations are managed so as to accumulate local adaptations. Initial stock selections are likely to be critical, as is careful use of hatchery supplementation that balances a desire to provide a demographic boost to developing natural populations against recognition that natural adaptation and development of self-sustaining runs depends on limiting hatchery influence on the populations. Similarly, progressing to the point that reintroduced runs are completing full lifecycles in their “new” environment and linking these lifecycles through multiple generations of fish will be essential to the development of populations well adapted to the upper basin. Each adult returning to the upper basin, and particularly adults whose genetic makeup reflects multiple generations of selection by upper basin habitats, will be viewed as the program’s most valuable asset and treated as such.

4.4.1.1. Stock selection.

Stock selections will be made with reference to the priorities established in and in a manner consistent with the Settlement Agreement. Because of their responsibilities in connection with the ESA and fish passage authority under the Federal Power Act, the USFWS and NOAA Fisheries also have jurisdiction – for example, the decision to pass adult summer steelhead and the stock chosen for passage above the Project may require consultation with NMFS. Specific stock priorities for each species to be reintroduced have already been developed by the Fish Managers, agreed upon, and identified in the PRB Fish Passage Plan (PGE and CTWSRO 2004). These stock priorities, as well as the influence that stock availability may have on the actual use of fish for broodstock, are discussed in detail in Section 5 of this Reintroduction Plan.
Generally, stocks to be used for reintroduction are those native to the Deschutes River basin, with wild fish given preference as those most fit for life in the wild, and hatchery-origin fish of native strains used where or when wild fish are unavailable. The availability of fish for broodstock, and particularly the availability of wild-origin fish, will vary from year to year due to fluctuations in fish abundance downstream of PRB. Stock selection decisions, as influenced by fish availability, will therefore be made on an annual and perhaps seasonal basis.

4.4.1.2. Hatchery programs.
Round Butte Hatchery (“RBH”) will play a key role in the reintroduction program and will follow progressive broodstock selection/mating and incubation/rearing protocols to the degree allowed by available facilities, funding, and staffing levels, so as to limit potentially unfavorable influences on fish genetic resources. At present, however, the hatchery is a largely conventional fish production facility. Chinook salmon and summer steelhead adults will be held in the present holding ponds. At spawning, adults will be sampled for pathogens as detailed in the Fish Health Management Plan and only eggs from specific pathogen free adults will be used for reintroduction. The whirling disease parasite, *Myxobolus cerebralis*, is not present in gametes and thus would not be passed with eggs or fry hatched at the hatchery. Incubators will be utilized at least through the eyed stage. When eggs or fry are ready to be released or moved to a satellite incubation location, they will be transferred by hatchery personnel. Appropriate disinfection procedures will be followed for eggs and equipment during these transfers. Conservative disease control measures will also be applied to any smolts produced in the hatchery as part of the program.

The hatchery program supporting the reintroduction effort will strike a balance between providing demographic support to emerging runs of locally adapted fish and carefully reducing this support when appropriate, so that the runs will emerge to express their full biological potential. Hatchery activities (i.e., proposed egg take numbers, stock selection, rearing schedules, hatchery practices, and release numbers, dates, and locations) associated with the program will be outlined in the annual Fish Passage Work Plan, where they will be accompanied by rationales that are consistent with the conceptual framework outlined in this document. The coordination between the Annual Fish Passage Work Plan and the Hatchery Annual Operating Plan (“AOP”) will extend between calendar years, as is illustrated in the figure included as Appendix B. A draft annual Fish Passage Work Plan will be submitted to the Fish Committee for review by January 1 each year. A revised draft work plan incorporating preliminary comments from the Fish Committee will be distributed to the Fish Committee by March 1 and presented at the annual spring fisheries workshop sponsored by the Licensees. In accordance with the license, the Licensees will prepare a final annual Fish Passage Work Plan by April 1. ODFW will be given a draft of the annual Fish Passage Work Plan in advance of its preparation.
of the AOP to facilitate preparation of the AOP. The AOP, which covers the July 1 to June 30 time period (the State fiscal year), will be consistent with the activities planned in the annual Fish Passage Work Plan. Consistent with the Hatchery Agreement, a proposed AOP will be submitted to the Licensees by April 15 each year. The Licensees will distribute a copy of the AOP to the Fish Committee for 30-day review. A final AOP will be completed by June 15. The two plans will be particularly important prior to completion by ODFW, and acceptance by NOAA Fisheries, of final Hatchery and Genetics Management Plans (“HGMPs”) covering fish hatchery activities associated with the reintroduction effort.

ODFW, in coordination with NOAA Fisheries, will complete revised draft HGMPs for programs at RBH as soon as available funds and staffing allow, and within 18 months after the date of this Reintroduction Plan. The draft HGMPs will then be finalized and NOAA Fisheries will make its decisions on acceptance of the HGMP within 6 months of receipt.

4.4.1.3. Method(s) of reintroduction.

Direct releases of adult anadromous fish into the upper basin would be the preferred option for establishing new fish runs. This method would mimic the way in which fish re-colonize areas naturally and assure that natural selective pressures are shaping new upper basin fish populations as early as possible (Table 4-3). However, the risk of introducing new or more virulent fish disease into the upper basin is a major concern (see Section 4.4.2). Therefore, this approach will not be used to start this program. Assuming downstream passage of juvenile anadromous fish at PRB meets agreed-upon measures of success (see Section 5.1, footnote 2), adult anadromous fish will be allowed to repopulate the upper basin, but only after they have first reared as juveniles above Round Butte Dam. In the cases of summer steelhead and Chinook salmon the juvenile fish that are reintroduced to the upper basin to initiate the program will need to be screened for pathogens prior to release.

The general approach selected for initiating runs of summer steelhead and spring Chinook salmon to the upper basin is to release eggs, fry and smolts into suitable rearing habitats upstream from PRB. Released fry are anticipated to rear from 1 to 4 years in tributary or reservoir habitats prior to smoltification while smolts should immediately migrate toward the collection facility. Smolts will be collected at the SWW Fish Transfer Facility located in the forebay of Round Butte Dam, differentially marked, and released in the Deschutes River.
<table>
<thead>
<tr>
<th>Lifestage</th>
<th>Method of release</th>
<th>Potential advantages</th>
<th>Potential disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>Directly into Lake Billy Chinook</td>
<td>Mimics the process by which anadromous fish naturally re-colonize an area. Maximizes natural selection and movement toward locally adapted populations. By allowing the fish to disperse to areas upstream of PRB it reduces the effort required to distribute fish among appropriate areas.</td>
<td>Relatively highest risk of introducing new fish diseases (screening difficult to impossible), making this approach unworkable in the near-term. Potential for high pre-spawn mortality. Lack of experimental control over re-colonized areas. Uncertainty in fish dispersal from early releases will re-colonize the best available habitats (i.e., may result in inefficient use of the fish available for reintroduction).</td>
</tr>
<tr>
<td></td>
<td>Directly into specific tributaries</td>
<td>Same advantages as above, plus two additional advantages. Better experimental control over re-colonized areas. Greater assurance that fish will use the best available habitats early in the reintroduction effort.</td>
<td>Relatively highest risk of introducing new fish diseases (screening difficult to impossible), making this approach unworkable in the near-term. Risk of even greater pre-spawn mortality with increasing distance that adults are transported.</td>
</tr>
<tr>
<td>Eggs</td>
<td>Egg boxes planted in streambed gravels, or similar approaches</td>
<td>Allows for careful screening against fish diseases not present in the upper basin. Place strong emphasis on natural selection by limiting the number of lifespans not acted upon by the upper basin environment. Provides experimental control over re-colonized areas.</td>
<td>Highly labor intensive. Adverse environmental conditions during incubation could dramatically reduce fish survival in some years, particularly given that eggs placed in streams above PRB would likely be concentrated in a relatively few specific geographic locations.</td>
</tr>
<tr>
<td>Early fry</td>
<td>Streamside incubators</td>
<td>Allows for careful screening against fish diseases not present in the upper basin. Place strong emphasis on natural selection by limiting the number of lifespans not acted upon by the upper basin environment. Provides experimental control over re-colonized areas. May assure selection for appropriate spawning timing of adults by incubating eggs at actual stream temperatures.</td>
<td>Labor intensive. Potential for incubator failure(s) to cause catastrophic losses of fry. Fry dispersal may be limited by number and distribution of streamside incubators. Fry may compete with resident fish for food and space (something that might be viewed as a risk or as an opportunity to assess relative habitat suitability).</td>
</tr>
<tr>
<td>Directly into selected stream areas</td>
<td>Allows for careful screening against fish diseases not present in the upper basin. Place strong emphasis on natural selection by limiting the number of lifespans not acted upon by the upper basin environment. Potentially better fry dispersal than that associated with streamside incubators.</td>
<td>Very labor intensive. Assurance of selection for appropriate spawn timing of adults and emergence timing of fry depends on hatchery incubation temperatures at the hatchery to those in the receiving stream and releasing fry into the stream at the same time that naturally incubated juveniles would emerge. Fry dispersal will be poorer that for early fry releases. Fry may compete with resident fish for food and space.</td>
<td></td>
</tr>
<tr>
<td>Advanced fry</td>
<td>Directly into selected stream areas</td>
<td>A low for careful screening against fish diseases not present in the upper basin. Great emphasis on natural selection than smolt releases. Reliance on hatchery capacity is lower than for smolt releases. Avoid high levels of random (i.e., non-selective) mortality at the egg and early fry stages (an advantage primarily when the fish used are already well-matched to the receiving stream).</td>
<td>Labor intensive. Assurance of selection for appropriate spawn timing of adults and emergence timing of fry depends on hatchery incubation temperatures at the hatchery to those in the receiving stream and releasing fry into the stream at the same time that naturally incubated juveniles would emerge. Fry dispersal will be poorer than for early fry releases. Fry may compete with resident fish for food and space.</td>
</tr>
<tr>
<td>Smolts</td>
<td>Directly into targeted areas</td>
<td>Allows for careful screening against fish diseases not present in the upper basin. High egg survival rates in the hatchery allow production of large numbers of fish for reservoir passage and collection efficiency tests per adult directed for broodstock. Smolt releases may produce sizeable numbers of adults returning to help re-colonize the stream in the subsequent generation.</td>
<td>Places low near-term emphasis on natural selection and adults returning from smolt releases may produce few natural smolts if they and their offspring are poorly adapted to the environment of the receiving stream. Males of hatchery-produced smolts can be associated with elevated levels of residualization (in effective out-migration). If fish of wild stock are used, hatchery rearing is likely to diminish their fitness in the wild. Strongly reliance on hatchery rearing capacity. Might reduce development of acclimation areas because fidelity of adults to release sites (and thus any level of experimental control over areas re-colonized) depends on acclimation.</td>
</tr>
</tbody>
</table>
downstream from the Re-regulating Dam. Returning adults will be captured and sorted at the Pelton Fish Trap located near the Reregulating Dam (River Mile 100.1). Those adults identified as originating in upper basin habitats will be transported and released in the Round Butte Dam forebay, or may be used as broodstock for upstream supplementation if the downstream passage of smolts through LBC has not yet met agreed-upon measures of success. Guidelines for juvenile distribution and criteria for adult passage are outlined elsewhere in this Reintroduction Plan (see Section 5). Specific details on measures to be taken to minimize handling stress in fish passed at PRB are given in the Fish Passage Plan or subsidiary documents other than this Reintroduction Plan.

Four different methods may be used to reintroduce disease-screened juvenile salmon and steelhead upstream of PRB: streamside incubators, Vibert boxes, direct fry releases, and smolt releases. It is anticipated that one or more of the methods will be utilized to minimize the risk inherent in any one method. However initial releases will utilize fry or smolts in order to diminish inherent limitations associated with stream-side incubators and Vibert boxes (discussed below). Details of these reintroduction methods for each year will be included in the annual Fish Passage Work Plan.

Streamside Incubators.
Streamside incubators are essentially troughs similar to old-style hatchery incubation troughs that allow for the hatching of fish eggs in baskets. Each chamber of the incubator is built so that water coming through the trough upwells through the egg basket. These incubators may be used where and if there is assistance through ODFW’s Salmon Trout Enhancement Program (“STEP”) and an adequate site with a reliable supply of high quality water can be found. They are therefore likely to be limited to public involvement types of projects in the upper basin. The major drawback of these incubators is they require considerable maintenance, and are subject to problems with plumbing and water supply.

Vibert Boxes.
Vibert boxes are plastic containers with slots that are designed to mimic the egg pocket of natural salmonid redds. They are filled with clean gravel and eyed eggs are placed within the spaces of the gravel. The boxes are then buried in artificial redds and the eggs allowed to hatch, and the fry to swim out of the box and emerge naturally. The major benefit of using Vibert boxes is that they closely mimic natural incubation by and take advantage of the natural temperature cycle during the last portion of the incubation and entire intergravel period. This natural temperature cycle will promote emergence at the time wild fish would emerge from the gravel. Vibert boxes will be considered where there is volunteer assistance to help with the reintroduction, but adequate sites for streamside incubators cannot be found. The major drawback with Vibert boxes is that the eggs incubating within them are subject to mortality from siltation and scouring during high water events.
**Fry Releases.**

Fry releases will provide the primary means of reintroducing summer steelhead and spring Chinook salmon. Fry reared at Round Butte Hatchery would have the advantage of reduced hatchery effort and cost compared to the production of hatchery smolts. Having the ability to control water temperature at the hatchery will allow, within reason, the production of fry at desired times to coincide with and mimic the natural swim-up time. The advantages to using fry include minimizing the deleterious effects of the hatchery environment on post-release survival, avoiding the problem of accurately determining when juveniles are smolting and are ready for release, and allowing fry to rear and smolt naturally in tributary streams before outmigrating. The disadvantage of fry releases are reduced survival from competition, predation, and environmental factors. Fry are also subject to problems in the hatchery including epizootics of IHN virus that can destroy entire incubator stacks of fry, or prevent upstream movement of survivors of the epizootic.

When used to reintroduce anadromous species into the upper basin, direct fry releases will occur in known spawning and rearing areas as outlined by species. Releases will attempt to disperse small numbers of fry (20 to 50 at a time) over a broad area encompassing several miles of stream in slow water habitats as recommended by Lovtang (2005).

**Smolt Releases.**

Smolt releases have the advantage of high survival and thus the ability to produce the greatest numbers of outmigrants from a given number of parents or eggs. They will be used to provide fish for evaluations of passage effectiveness through LBC and into the SWW collection system, as well as to amplify the demographic boost that a limited number of wild-origin fish from below PRB that are available for broodstock can provide early runs of upper basin salmon and summer steelhead. Smolt releases allow for differential marking to assist in evaluating survival and migration from distinct release sites. The disadvantage to using smolt releases include prolonged exposure to the hatchery environment and the deleterious effects this has on post-release survival, increasing the risk of epizootics from the crowded hatchery environment, and the problem of accurately determining when juveniles are smolting and ready for release.

The possibility of acclimating smolts at upper basin sites prior to release by holding them in temporary holding areas that allow volitional emigration by fish was identified by the Fish Committee after the Settlement Agreement and Fish Passage Plan were completed and PRB’s new FERC license issued. While not essential to implementation of the reintroduction program, such acclimation would enhance the program by encouraging proper smolt migratory behavior, limiting the potential for residualization, and improving fish homing to release areas if the smolts
return as adults. If used for smolts released for reservoir passage tests, ponds allowing volitional emigration might improve the migratory performance of test fish. Smolt acclimation will occur if the Fish Managers or other Fish Committee members can secure the funding needed to acquire, install, and operate the temporary ponds.

4.4.1.4. Encouraging local adaptation.
The reintroduction program will be conducted to encourage development of locally adapted populations of salmon and summer steelhead. This will mean using hatchery supplementation no more than is necessary to initiate and build new fish runs to the point that they can be removed from demographic support and allowed to truly test their ability to adapt and persist in their “new” environment. Moving in this direction will require that the anadromous fish populations that develop above PRB are monitored, so that informed decisions can be made about where and when to reduce or eliminate hatchery supplementation. Additional information on the monitoring program associated with the reintroduction effort is given in Section 4.5.

If needed, annual adjustments to hatchery supplementation levels to develop self-sustaining, harvestable, and locally adapted runs of anadromous fish above PRB will be made. These decisions will reflect a desire to develop locally adapted runs of fish, and a need to reduce supplementation levels in response to increased natural returns of adult fish (see Section 5). Each such decision, including specific rationales consistent with the conceptual framework outlined in this Reintroduction Plan, will be documented in the annual Fish Passage Work Plan and, as appropriate, the AOP.

4.4.2. Fish health management.
Fish health management procedures and precautions will be followed according to the ODFW Fish Health Management Policy (OAR 635-007-0960 through 635-007-0985) during initial phases of fish reintroduction and remain in effect until a decision is made to move to volitional upstream passage of adult fish. Careful and detailed fish health monitoring, surveying, overview and precautions will be in place during the selective passage phase of the reintroduction.

Resident trout upstream of Round Butte Dam have been isolated from the remainder of the Columbia Basin for over 40 years. As such they have not been exposed to newly introduced or more virulent pathogens found downstream. The fish pathogens that have the greatest potential to adversely impact the Pelton Round Butte fish passage program, and existing fish populations upstream of PRB, are (1) *Myxobolus cerebralis* (whirling disease); (2) recently evolved strains of Infectious Hematopoietic Necrosis Virus (IHN virus); (3) *Ceratomyxa shasta*, the causative agent of ceratomyxosis; and (4) *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD).
*Myxobolus cerebralis* is a myxosporean parasite and the causative agent for whirling disease. This parasite has a two-host life cycle including the fish and an oligochaete worm, *Tubifex tubifex*. The tubifex worm releases the infective triactinomyxon spores which infect the host fish. Spores released from salmonids in turn infect the worms. Infected salmonids can die from the infection or survive and exhibit lesions in skeletal tissues and deformities from destroyed cartilage. The most dramatic example of effects from this parasite have occurred in the Madison River in Montana where rainbow trout populations are reported to have declined to 25 percent of their former population levels following introduction of the parasite. To date, the only confirmed observations of *M. cerebralis* spores in the Deschutes basin have come from fish downstream of PRB. These fish were strays from watersheds in Idaho, southwest Washington and northeast Oregon where the parasite is known to occur. The presence of *M. cerebralis* has not been confirmed in anadromous fish of Deschutes River basin origin.

Passing only fish of Deschutes River basin origin or adults known to have been reared in an *M. cerebralis* free environment reduces the risk of introducing the parasite to areas upstream of PRB. In order to minimize risk of introducing *M. cerebralis* with summer steelhead and Chinook salmon reintroduction, only egg or juvenile life stages will initially be released upstream. Adult Chinook salmon, summer steelhead, and sockeye salmon returning to the Pelton Trap will only be passed upstream if they are known to have originated from areas upstream of PRB (note: these fish will be migrating down and back up the Columbia and risk exposure to the parasite, but this exposure will occur at a much less susceptible stage in their lives). Bull trout have been identified as having a low inherent susceptibility and exposure risk to *M. cerebralis* so pose minimal risk for transferring the parasite.

Whirling disease and other disease risks will be monitored by ODFW Fish Health Specialists as part of the overall fish health assessment and adaptive management strategy with corresponding integration of standard actions and procedures to avoid or minimize their effects. Although *M. cerebralis* has been identified as the most significant fish health risk for introduction, other pathogens such as IHN virus) and Bacterial Kidney Disease (BKD) may also influence passage. Preliminary disease screening and management procedures for differing stages of the anadromous fish reintroduction effort have been identified in the Fish Health Management Program Plan (PGE and CTWSRO 2006), filed with FERC pursuant to Article 419 of the new PRB license on December 14, 2006, and approved on January 31, 2007. 118 FERC ¶ 62,086 (2007).

### 4.4.3. Predation in the reservoir.

There are concerns that predators and particularly bull trout that are seasonally concentrated in the Metolius River arm of LBC, could consume substantial numbers of juvenile Chinook salmon as these smaller fish attempt to rear in, or migrate through, the reservoir. Should this occur, it
could affect the ability of an upper basin run of Chinook salmon to sustain itself. Potential impacts of predatory fish other than bull trout are unknown, although a substantial population of smallmouth bass, plus smaller numbers of rainbow trout, northern pikeminnow, and brown trout, are present in PRB reservoirs. It has also been suggested that a fraction of the reintroduced Chinook salmon population might residualize in the reservoir and grow to become sizeable pelagic predators that would pose a risk to younger salmonids.

Predation in LBC has been studied in two systematic efforts. A study of bull trout food habits was conducted to better define the relationship between this predator species and its prey, especially kokanee (Schulz et al. 1997; Beauchamp and Van Tassell 2001). The food habits of littoral fish species (northern pikeminnow, smallmouth bass, brown trout, and rainbow trout) have also been studied (Lewis 1999). Additional predator studies are planned beginning in 2009, as discussed in the PRB Fish Passage Plan (PGE and CTWSRO 2004).

If monitoring results suggest predation in LBC will impair development of self-sustaining and harvestable runs of sockeye salmon, Chinook salmon, summer steelhead, or another anadromous species above PRB, actions will be evaluated and considered to reduce this predation.

4.4.4. Competition with resident fish.

Competition may occur in the upper basin between reintroduced Chinook salmon and sockeye salmon, kokanee salmon, and bull trout, all of which may spawn in similar areas during Fall, and is certain to occur between reintroduced summer steelhead and the resident rainbow trout that currently occupy accessible portions of the upper basin that were historically dominated by summer steelhead. In fact, available literature suggests that in those areas well suited to summer steelhead, reductions in the abundance of resident rainbow trout may eventually be 70-90 percent. Resident rainbow trout are expected to dominate in areas where they did historically, such as the Metolius River subbasin and the mainstem Deschutes River subbasin above Lake Billy Chinook, or where habitat conditions have changed to favor non-anadromous fish, such as the Crooked River subbasin in the coldwater zone below Bowman Dam (Cramer and Beamesderfer 2006).

Potential competition among the species will be monitored so as to better understand how the reintroduced populations of fish are making use of the upper basin and their effects on the species now present. With regard to summer steelhead and resident rainbow trout, information on the consequences of their interactions may affect the levels of hatchery supplementation believed needed in areas suited to the anadromous form of the species during the initial stages of reintroduction.
4.4.5. Harvest.

A long term goal of this Reintroduction Plan is to develop upper basin runs of anadromous fish that will support sport, commercial, and Tribal fisheries. However, in the near term, harvest mortality is one factor that may impede development of self sustaining populations above PRB. Losses of outmigrant fish prior to collection at the SWW combined with natural selection acting upon fish that initially will be less than perfectly suited to upper basin habitats may leave the developing runs vulnerable to additional sources of mortality. Concerns about fishery impacts on the developing runs include inadvertent harvest of juvenile summer steelhead in upper basin trout fisheries. Also, out of basin impacts on adult and juvenile fish may occur that are beyond the control of the Fish Managers. Harvest regulations will be developed by the Fish Managers to limit the effects of in basin fisheries below PRB.

Fishery impacts on the developing runs will be monitored. Appropriate management adjustments will also be made if needed, including potential changes to the Fishery Management and Evaluation Plan (FMEP) for the Mid-Columbia River Steelhead DPS (ODFW 2007).

4.5. MONITORING, EVALUATION, AND ADJUSTMENT

4.5.1. Monitoring.

The effectiveness of the anadromous fish reintroduction effort will be monitored to document successes and to inform course-corrections that may become important. The monitoring will have three primary elements: Fish Passage Monitoring, Ecosystem Integrity Monitoring, and Fish Hatchery Monitoring. Most components of the first two elements have already been developed and are either described in the Fish Passage Plan (PGE and CTWSRO 2004) or will be outlined in Test and Verification Study Plans and other documents required to be developed by the licensees under the FERC license for PRB. Additional monitoring components considered likely to be helpful to the reintroduction effort are either in place as part of ongoing fish management programs, are under development, or will be implemented if funding can be secured. Fish Hatchery Monitoring will address issues unique to hatchery operations and be conducted consistent with the state’s Fish Hatchery Management Policy (ODFW 2007). The full monitoring effort associated with reintroduction-related hatchery operations that may affect ESA-listed species will be incorporated into one or more final HGMPs for RBH by 31 December 2009 (see Section 4.4.1.2).

The monitoring effort to be applied to the anadromous fish reintroduction program is outlined in Appendix C and Table 4-4. Information given in Appendix C describes monitoring required under the operating license for PRB and is structured according to specific monitoring functions. The information given in Table 4-4 indicates which species-specific issues the monitoring effort will (identified by solid squares or circles) or may (identified by open circles) address, which
entity in the upper basin has responsibility for the monitoring related to each issue, and how far the monitoring related to each issue will or may extend into the future.

4.5.1.1. Fish Passage Monitoring.
As outlined by the Fish Passage Plan (PGE and CTWSRO 2004) and shown in Appendix C and Table 4-4, this element of the monitoring program will focus on addressing a variety of issues important to successful species reintroductions. These include fish passage efficiency (adult collection, adult passage through PRB and to spawning areas, smolt reservoir passage, collection efficiency at the SWW structure, and smolt injury and mortality rates), the productive capacity of upper basin habitats (habitat availability, habitat effectiveness, riparian condition), and a mix of biological concerns (escapement, spawning success, competition, predation, disease, smolt production, harvest, and the sustainability of natural runs).

4.5.1.2. Ecosystem Integrity Monitoring.
Ecosystem Integrity Monitoring will focus on long-term trends in the connectivity (habitat links, nutrient contributions), biodiversity (number of native species per trophic level, number of functional feeding groups), and natural production (the number, size, productivity, and life-history diversity of populations) of anadromous fish above Round Butte Dam (see Appendix C).

4.5.1.3. Fish Hatchery Monitoring.
Monitoring at the fish hatchery will focus on multiple issues important to the quality of fish collected and produced for use in the reintroduction program. Per the state’s Hatchery Fish Management Policy (ODFW 2007), monitoring of hatchery produced fish and their performance will include:

- broodstock selection including source, number, size, fecundity, and life history, timing, disease history, and disease treatment;
- pre-release performance such as survival, growth, and fish health by life stage;
- the numerical production advantage provided by the hatchery program relative to natural production;
- water quality, flow, and other physical conditions in the hatchery through the production cycle; and
- success of the hatchery program in meeting conservation program objectives.

Details of the full hatchery monitoring program will be provided in the HGMPs described earlier in Section 4.4.1.2.
Table 4-4. Monitoring and evaluation efforts for the anadromous fish reintroduction effort above the Pelton-Round Butte Hydroelectric Project.

<table>
<thead>
<tr>
<th>JUVENILE SALMONS</th>
<th>SPECIES OF INTEREST</th>
<th>SPECIFIC EFFORT(S)</th>
<th>MONITORING PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. Assess the abundance of rearing juveniles.</td>
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<tr>
<td>1b. Assess the distribution of rearing juveniles.</td>
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<tr>
<td>2. Examine habitat use and partitioning by species to determine intra and inter-specific competition.</td>
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<tr>
<td>3. Identify specific areas predisposed to producing the re-introduced species and/or midstream trout.</td>
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<tr>
<td>4. Assess smolt migration patterns and timing from the tributaries.</td>
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<tr>
<td>5. Assess juvenile movement and survival within and through reservoirs.</td>
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<tr>
<td>6. Assess downstream passage effectiveness through the hydropower complex.</td>
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<tr>
<td>7. Assess juvenile migration and movement through lower Deschutes and Columbia rivers.</td>
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<tr>
<td>8. Assess mortality associated with reservoir fisheries to determine both harvest and hooking mortality.</td>
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<td></td>
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<tr>
<td>9a. Assess levels of predation in Project reservoirs.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>9b. Assess levels of predation elsewhere, and levels of competition in Project reservoirs and tributaries.</td>
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<tr>
<td>10. Assess effectiveness of passage and level of entrainment into unscreened irrigation diversions.</td>
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<tr>
<td>11. Assess the health of rearing and migrating fish.</td>
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<tr>
<td>12. Develop and implement genetic monitoring plan.</td>
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<tr>
<td>13. Assess potential interactions with salmonids in the lower Deschutes River.</td>
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<table>
<thead>
<tr>
<th>ADULT SALMONS</th>
<th>SPECIES OF INTEREST</th>
<th>SPECIFIC EFFORT(S)</th>
<th>MONITORING PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assess migration timing of upper Deschutes origin fish in the lower Deschutes River.</td>
<td></td>
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<tr>
<td>2a. Assess harvest and hooking mortality in reservoir fisheries.</td>
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<tr>
<td>2b. Assess harvest and hooking mortality in lower and/or other upper basin fisheries.</td>
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<tr>
<td>3. Assess upstream passage effectiveness at the hydropower complex.</td>
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<tr>
<td>4. Implement fish health monitoring for adult migrants and resident populations in the upper Deschutes basin.</td>
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<tr>
<td>5. Assess effectiveness of upstream passage at other upper basin barriers.</td>
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<tr>
<td>6. Assess spawning distribution and abundance in the upper basin.</td>
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<tr>
<td>7. Assess adult life history and migratory patterns.</td>
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<tr>
<td>8. Assess potential food and habitat quality.</td>
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<thead>
<tr>
<th>FISH HATCHERY MANAGEMENT</th>
<th>SPECIES OF INTEREST</th>
<th>SPECIFIC EFFORT(S)</th>
<th>MONITORING PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Collect and sort adults.</td>
<td></td>
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</tr>
<tr>
<td>2. Monitor and implement disease management program.</td>
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<td></td>
<td></td>
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<tr>
<td>3. Monitor and implement genetic management program.</td>
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<tr>
<td>4. Assess hatchery rearing techniques and adaptively manage to maximize survival of outplants.</td>
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<tr>
<td>5. Assess effectiveness of release strategies.</td>
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<tr>
<td>6. Assess handling mortality of juvenile and adult.</td>
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<thead>
<tr>
<th>WATER QUALITY MANAGEMENT</th>
<th>SPECIES OF INTEREST</th>
<th>SPECIFIC EFFORT(S)</th>
<th>MONITORING PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Physical conditions in Project reservoirs and the lower Deschutes River.</td>
<td></td>
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<tr>
<td>LONG-TERM MONITORING</td>
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<tr>
<td>1. Water quality in Project reservoirs and the lower Deschutes River.</td>
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<tr>
<td>2. Fish passage monitoring (downstream passage effectiveness, habitat capacity, and biological components)</td>
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<tr>
<td>3. Ecosystem integrity monitoring (connectivity, biodiversity, and natural production components)</td>
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<table>
<thead>
<tr>
<th>FHMP = Fish Health Monitoring Plan</th>
<th>TV-ASS = Test-and-Verification -- Adult Salmonid Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>HGMP = Hatchery Genetic Management Plan, ODFW</td>
<td>TV-JSS = Test-and-Verification -- Juvenile Salmonid Studies</td>
</tr>
<tr>
<td>HAOP = Hatchery Annual Operations Plan, ODFW</td>
<td>TV-RS = Test-and-Verification -- Reservoir-related Studies</td>
</tr>
<tr>
<td>LTMP = Long Term Monitoring Plan</td>
<td>WQMMP = Water Quality Management and Monitoring Plan</td>
</tr>
<tr>
<td>ODFW-SFT = ODFW adult fish trapping at Shari's Falls</td>
<td></td>
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</tbody>
</table>

NFMP = Native Fish Monitoring Plan
4.5.2. Evaluation and adjustment of the reintroduction effort.

The effort to reestablish self-sustaining and harvestable runs of anadromous fish in the drainage basin above PRB will be guided by a detailed monitoring program, as outlined above (see also PGE and CTWSRO 2004, as well as ODFW 2007) Throughout the reintroduction effort, the Fish Managers and the Fish Committee will consider a number of questions during the annual Fish Passage Work Plan and AOP processes (see Appendix B). Questions addressed may include, but will not necessarily be limited to:

- broodstock (availability, fecundity, life history timing, disease issues, performance);
- fish collection, rearing and release strategies, types, numbers, and locations;
- near- and long-term habitat conditions above Round Butte Dam;
- fish performance in the habitat above Round Butte Dam;
- fish performance in the hatchery (survival, incidence of disease, etc.);
- fish passage efficacy through LBC and the SWW facility;
- whether reintroduction strategies or tactics should be modified; and
- when to stop or reinitiate hatchery support of specific upper basin fish runs.

Consideration of these issues will be informed by a number of metrics to be monitored as part of the fish passage and reintroduction effort. Some of the more important of these metrics, identified below, will be measured or estimated on an annual basis early in the reintroduction effort to assess trends in the development of self-sustaining runs of fish:

- hatchery releases of fish, by lifestage, species, stock, and location;
- natural production and emigration timing of parr and smolts, by species and subbasin;
- life history characteristics in the naturalized populations;
- smolt collection efficacy (at the SWW facility), by species and subbasin;
- smolt migration timing and counts at the SWW facility, by species;
- smolt condition at the SWW facility, by species;
- smolts produced per adult female (or per egg or released fry), by species and subbasin;
- smolts collected per adult female (or per egg or released fry), by species and subbasin;
- smolt-to-adult return rates;
- harvest rates on upper basin runs;
- counts of returning adults, by species and sex, at Round Butte Dam;
- spawn timing and success (redd counts), by species and subbasin; and
adult recruits per spawner.

Collection and compilation of data on some of the performance metrics just identified may become less frequent through time. In accordance with the license, the Licensees have committed to annual development of this type of information during the first ten years of the reintroduction effort. Annual smolt and adult counts at Round Butte Dam will continue for as long as anadromous fish are passing PRB. Current agreements call for collection and compilation of some of the other types of monitoring data on a less than annual basis after the first ten years of fish reintroduction (see PGE and CTWSRO 2004).

4.5.3. Additional monitoring and evaluation information

The monitoring and evaluation program outlined earlier in Section 4 includes a variety of elements that are operating requirements for PRB Licensees, plus additional enhancements that are not necessarily essential to moving the fish reintroduction effort forward but that might help reduce uncertainties related to this effort. Though agency responsibilities and sources of funding for implementation of most of these monitoring enhancements are currently unresolved (note the open circles in Table 4-4), it does not reduce their potential importance to the Fish Managers or to members of the Fish Committee. Examples of these items include but may not be limited to:

- **Real-time screening of wild steelhead from the lower basin as part of the broodstock collection effort for this species.** High proportions of out-of-basin hatchery strays are present at locations where wild adult summer steelhead might be collected in the lower basin, and out-of-basin wild fish may be present as well. Unless collection sites lack out-of-basin wild fish, real-time screening to remove these strays will be important to the use of wild Deschutes River Basin summer steelhead as broodstock for the reintroduction effort. Without this screening capability, the reintroduction program may be entirely reliant on hatchery fish from RBH as broodstock.

- **Morphometric or other monitoring and discrimination of migratory resident versus anadromous rainbow trout collected by trapping operations in each of the three major drainage basins tributary to LBC.** Discriminating between fluvial/adfluvial rainbow trout and summer steelhead may be important to fish passage tests using naturally-reared smolts and to monitoring subbasin-specific smolt production. If non-anadromous rainbow trout are tagged for fish passage tests they are almost certain to lead to underestimates of summer steelhead passage performance through LBC. If non-anadromous rainbow trout are not discriminated at traps, they will also inflate estimates of summer steelhead survival and production in LBC tributaries.
- Geographically dispersed monitoring of juvenile anadromous salmonid production in LBC tributaries. Current plans for monitoring juveniles in the tributaries are focused on a few sites and on resident-anadromous fish interactions. More dispersed monitoring of juvenile salmonid production in LBC tributaries would help identify areas whose abilities to produce anadromous fish are substantially different than initially predicted. Such information would inform adjustments in the distribution and magnitude of juvenile fish releases during the hatchery supplementation effort.

- Juvenile trapping that extends beyond the primary smolt migration period in each of the three major drainage basins tributary to LBC (if only migrations of spring smolts are to be trapped otherwise). Juvenile anadromous salmonids will migrate downstream toward LBC outside the spring migration period. It will be important to know the magnitude of these non-spring migrations in order to understand the life-history patterns of developing fish runs and to avoid drawing potentially false conclusions about fish performance in the upper basin.

- The development of stock-recruitment functions for developing salmon and steelhead runs, based on monitoring data already being collected under the Fish Passage Plan. Information of this sort is important to managers of anadromous fish runs. Data needed for the development of stock-recruitment functions for the aggregate run of each species reintroduced will be or could be collected at Round Butte Dam. Discrimination of potential differences in fish performance among the subbasins tributary to LBC would require additional data collection and analysis.

- Predation monitoring in LBC tributaries. Information for management of predation may be necessary for reintroduction.

4.5.4. Moving to upstream passage of all unmarked fish arriving at the base of PRB.

Preliminary escapement goals established by the Fish Managers are to achieve returns to the Pelton Trap of 434 summer steelhead and 450 spring Chinook salmon in three consecutive years, based on recent estimates of fish production potentials above PRB as described in ODFW’s plan for managing anadromous fish and bull trout in the upper basin (Marx 2003). Runs of this magnitude would represent approximately a third of the production capacity that recent modeling suggests is present above PRB for summer steelhead, and about half that present for spring Chinook salmon. The escapement goals for these two species are also within the range of spawning adult abundance observed in the upper basin just prior to the construction of PRB. Preliminary escapement goals for sockeye are to achieve returns of 1,000 adults in three consecutive years, although such numbers are thought to be far below the production potential of the system.
Once the identified escapement target has been reached for a given species, a population-level review will be completed to assess population distribution, abundance, and passage efficiencies by species. Information generated during the review will be used to determine population status with respect to sustainability, the ratio of recruits per spawner, and whether to continue selective passage of upper basin fish at PRB or to allow any unmarked adult of that species arriving at the Pelton Trap to pass upstream. Smolts may also be allowed to move downstream past PRB without marking. The assessment of population status will consider effects of environmental variation on long-term abundance trends and may lead to a determination that the populations are not yet self-sustaining. If so, actions may include continued observation to see whether a population that is not supplemented will become stronger, additional supplementation in under-seeded habitats, or some other measure consistent with management goals and this Reintroduction Plan.
5. SPECIES-SPECIFIC REINTRODUCTION EFFORTS

Anadromous fish reintroduction efforts will begin with a primary emphasis on testing the SWW facilities, evaluating how well summer steelhead, spring Chinook salmon, and sockeye salmon smolts move downstream through LBC and into the facilities, and on beginning to verify assumptions about the production potentials and ecology of these species when reintroduced to areas above PRB. These early efforts will transition into an anadromous fish run-building phase once smolt passage efficacy downstream through LBC and past PRB meet agreed-upon measures of success. The basic structure and elements of the transition from Phase 1 to Phase 2 of the reintroduction effort are outlined in Figure 5-1.

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**Figure 5-1. General phases of anadromous fish reintroduction above PRB.**

Movement to Phase 2, which includes selective passage of adult fish from the lower basin into the area above PRB, will occur when there is a determination that smolt passage downstream through LBC and into the new SWW fish collection facility meets agreed-upon measures of success.
5.1. ANADROMOUS FISH SPECIES LINKED TO UPSTREAM PASSAGE DECISIONS

Success in re-establishing runs of summer steelhead and spring Chinook salmon above PRB will depend substantially on the degree to which the new SWW and fish collection facility enables the smolts of these species to migrate effectively from the mouths of tributary streams and past LBC during their journey seaward. Adaptive fish management and improvements to altered streams above LBC will both be important, but fish passage through the reservoir that is at least reasonably effective will be a necessary prerequisite to any success in establishing runs that can sustain themselves. With this in mind, reintroductions of these fish will pass through two phases. Phase 1 will emphasize introductions of pathogen-screened juveniles of these species above PRB, to test the ability of the new SWW facility to change surface currents in LBC and collect outmigrant smolts. Actions taken during Phase 1 will also (1) begin to test recent estimates of fish production potential in habitat above PRB, (2) examine fish stock performance in the available habitat, (3) continue rehabilitating altered habitats, and (4) produce modest returns of adult fish. When smolt passage through LBC and into the fish collection facility meets agreed-upon measures of success\(^4\), the reintroduction program will transition into Phase 2 in which adults returning to the upper basin (i.e., after rearing as juveniles above Round Butte Dam) are passed upstream and continued releases of pathogen-screened juveniles into the upper basin will use fish of the fittest lineages available. The exact timing and/or duration of shifts toward more or less intense releases of juvenile fish during this second phase of the reintroduction effort may well differ among species or subbasins.

Reintroduction Phase 1. During Phase 1 of the reintroduction effort for a given species, the numbers of fish released into specific upper basin streams will be based on interactions between statistical needs of fish passage studies (Skalski and Townsend 2007), habitat capability (Cramer and Beamesderfer 2006; Lovtang 2005; Oosterhout 1999; Lindsay et al. 1989), and realistic assumptions about the opportunity to trap smolts after they have been produced in habitats above the reservoir. In the major subbasins (Upper Deschutes, Metolius, and/or Crooked) where it is reasonable to expect that adequate numbers of naturally-reared smolts could be produced, trapped, and marked prior to entering LBC, fry releases will meet or exceed those estimated to be

\(^4\) Measures of success include changes in reservoir surface currents, effective migration patterns of radio-tagged smolts (a biological response to the currents), and passage efficacy of about 50 percent for one or more species from one or more arms of the reservoir. The 50 percent reservoir survival target identified in the Settlement Agreement and in Table 4-1 of this Plan was originally intended to be a trigger for constructing permanent downstream passage facilities at Round Butte Dam, not as the single determining factor for permitting upstream adult passage at PRB. Consistent with adaptive management provisions included in the Settlement Agreement the decision to make the transition to upstream adult passage of known-origin fish will be based on numerous indicators and mitigating factors, and will be well-founded on sound biological principles. The indicators will include the 50 percent survival value, a value that modeling by Oosterhout (1999) and Beamesderfer (2002) suggested was an approximate threshold for population sustainability.
needed to produce the required numbers of marked naturally produced smolts for reservoir passage tests. Where fry releases into a particular major subbasin appear unlikely to provide enough naturally produced smolts to meet the statistical demands of fish passage tests, releases will be less intense but sufficient to begin testing habitat suitability, begin getting a sense of fish performance, and (potentially) to produce small numbers of returning adults.

During Phase I there will also be direct releases into the upper basin of tagged hatchery-produced smolts that have been pathogen-screened. These fish will be given adipose fin clips and tags that can be distinguished from those given naturally reared smolts, and released in numbers that will be large enough to meet the statistical demands of reservoir passage tests for smolts leaving each of the three major subbasins tributary to LBC. Releases of hatchery smolts for reservoir passage tests will either provide information supplemental to that obtained from tests of naturally reared smolts or enable statistically meaningful passage tests where they would otherwise be infeasible. Spring Chinook salmon smolts will be released during this phase into the Metolius, Upper Deschutes, and Crooked subbasins. Summer steelhead smolts will be released into the later two subbasins, but not into the Metolius River subbasin because it is considered to have very little production potential for the species.

Each naturally-reared smolt that successfully negotiates LBC and leaves the upper basin via the SWW facility during Phase 1 will either be given a PIT-tag and left without any additional external marks or will be marked with unique fin clips. The PIT-tags will allow additional data collection on fish as they migrate to and from the ocean. The tag or unique fin clips will allow managers to assure that the fish will (1) avoid directed harvest and therefore experience lower harvest rates as they pass through fisheries when returning as adults, and (2) be identified as having upper basin origins when some of them arrive as adults at the Pelton Trap. Naturally reared returnees arriving at the trap will be passed upstream during Phase 2.

**Reintroduction Phase 2.** When the effort to improve smolt passage through Lake Billy Chinook and into the SWW fish collection facility shows the necessary signs of success, the reintroduction program will transition into Phase 2. In this phase adult fish returning to the Pelton Trap after having reared as juveniles above PRB will be passed into the upper basin, including those fish that reared in the upper basin during Phase 1, unless the goals of this Reintroduction Plan will be better served if a small fraction of the returnees are used as broodstock. For each species, brood-lines during Phase 2 will use wild fish where possible. However, it should be noted that fish availability may be influenced by stock status below PRB at the time of transition, and possibly by whatever efforts have been undertaken to develop salmon or summer steelhead brood-lines specifically for the reintroduction program (see sections
Fish releases above Round Butte Dam during this phase of the program will be intended to develop locally adapted populations, with the numbers of young fish released into specific upper basin areas reflecting information acquired on the developing anadromous runs. As an early approximation, releases of fry during the first fish generation of Phase 2 for a given species’ reintroduction will be of magnitudes estimated to be sufficient by themselves to produce about 50 percent of the maximum smolt carrying capacity of a particular stream unless the number of returning adults and the anticipated progeny exceeds expectations, in which case the percentage of fry released will be reduced. This first cycle of fry releases during Phase 2 will also be supplemented with releases of hatchery smolts produced from wild broodstock (which will leave the system quickly and not be significant competitors until they return as adults), if and only if such fish can be produced from an appropriate group of parents. Fry releases after the first fish generation of this phase will diminish as rapidly as can be justified, to avoid a situation in which an extended hatchery supplementation program works against natural selection processes.

During Phase 2 of the reintroduction effort, fish releases into the upper basin will be consistent with what is known at the time about the suitability and productive capability of available habitat. If habitat in a particular area proves to be more capable than initially predicted, fish releases there might be adjusted upwards, depending on broodstock availability. If habitat proves less capable, greater emphasis will be placed in the near term on habitat rehabilitation efforts and fish releases may be adjusted downward until habitat improves.

Marking of smolts at the SWW facility will continue until disease or other concerns have been addressed sufficiently to allow all adult fish arriving unmarked at the Pelton Trap (those wild fish that are either returning to the upper basin or migrating toward areas other than the spawning locations of their parents) to be passed upstream.

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5 The use of wild fish, within defined limits, seems likely in the reintroduction of summer steelhead, summer-fall Chinook, and sockeye salmon to areas above LBC. Wild spring Chinook may be used for reintroduction, but this seems less certain. Brood-lines for use in the reintroduction effort might be developed at Round Butte Fish Hatchery using wild fish from the lower basin, as a way to expand the demographic boost that could be given to developing upper basin runs early in Phase 2.
5.1.1. Summer steelhead.

Summer steelhead that are native to the Deschutes River system, including the RBH stock, are federally listed as “Threatened” under the ESA. Wild populations of these fish are at-risk due primarily to habitat declines and the presence of high-levels of out-of-basin hatchery fish that are straying into their spawning areas (Carmichael 2006). Two wild populations have been identified in the lower basin, the Deschutes River Eastside, which accounts for fish native to that portion of the basin below and including Trout Creek, and the Deschutes River Westside, which includes fish native to the remaining accessible areas below PRB. The Westside population inhabits rivers and streams originating on the CTWSRO Reservation, including the Warm Springs River system, multiple smaller tributaries, and the mainstem Deschutes River from Trout Creek up to the PRB Reregulating Dam.

The ESA status of the wild fish in the basin must be considered in any proposal to introduce fish from one or more of the existing populations to areas above the hydroelectric project, or to use their offspring as part of the reintroduction effort. It will thus be necessary to obtain appropriate permits through NOAA Fisheries prior to initiating any efforts to collect adults as part of the upper basin reintroduction effort.

Initial efforts to reintroduce summer steelhead to areas above PRB will focus most strongly on productive habitats along Whychus Creek in the Upper Deschutes River subbasin and in McKay Creek within the Crooked River subbasin. Whychus Creek once supported summer steelhead runs in the range of about 500-1,000 adults, and was by far the strongest producer of these fish when passage efforts at Round Butte were abandoned in the late-1960s. McKay Creek contains some of the better summer steelhead habitat in the lower Crooked River subbasin (i.e., below Bowman Dam). As has been indicated earlier in this Reintroduction Plan, habitat available in most of the mainstem Deschutes River above LBC and in the Metolius River subbasin is thought to be better suited to resident rainbow trout than to summer steelhead.

The relatively narrow geographic focus of initial reintroduction efforts in the lower Crooked River subbasin reflects an attempt to better understand how summer steelhead will respond as reintroduction efforts expand, fish passage impediments are remedied, and habitat rehabilitation efforts continue. It does not, however, imply that habitat conditions in portions of the lower basin outside McKay Creek are unsuitable for the species. Nor is it an indication that reestablishing summer steelhead in the lower Crooked River subbasin is not important to the species. On the contrary, modeling by Cramer and Beamesderfer (2006) and Ackerman et al. (2007) suggests that even in a degraded state, the aggregate potential of habitat in the lower Crooked River subbasin to produce summer steelhead may be greater than that of Whychus Creek.
5.1.1.1. **Stock selection.**

There are at present three recognized populations, or stocks, of summer steelhead that might be considered for use in the effort to reintroduce the species to historic habitats above PRB. These include fish from the Deschutes River Eastside population, fish from the Deschutes River Westside population, and the RBH hatchery stock. Wild fish from the Deschutes Eastside and Deschutes Westside populations are assumed to be genetically “fit” in their natural environments, though there have been concerns expressed about the potential cumulative effects of high percentages of out-of-basin spawners in many of their natal streams during the last several summer steelhead generations (Carmichael 2006).

The RBH hatchery stock was developed from fish native to Deschutes River basin streams both above and below PRB (Ratliff and Schulz 1999), and is thus assumed to be closely related genetically to the wild summer steelhead that historically spawned above PRB. Given recent high abundances of out-of-basin stray summer steelhead in most of the lower Deschutes River basin, it may also be one of the area’s few summer steelhead spawning groups not to have experienced recent major inputs of foreign genetic material. However, the RBH stock has been domesticated for several decades and has reduced fitness and capacity for survival in the wild. This is true despite modest infusions of wild broodstock that continued until concerns about unmarked out-of-basin strays at the Pelton Trap put an end to the practice. For example, Riesenbichler and McIntyre (1977) found that the stock survived from fry to yearling in streams at somewhat less than 90 percent the rate of their wild Deschutes River basin relatives back when the hatchery stock was only two summer steelhead generations removed from the wild. Studies (e.g., Leider et al. 1990, Araki et al. 2006) and reviews of the science (e.g., Berejekian and Ford 2004, Salmon Recovery Science Review Panel 2004) indicate that survival rates in nature for summer steelhead from long-cultured hatchery stocks can be quite low, well below half that of wild fish, with a large portion of the survival reduction expressed during the egg through the smolt lifestage.

Wild fish in the Deschutes River Eastside summer steelhead population generally inhabit streams that have flow patterns similar to those found naturally in the Crooked River subbasin. Wild fish from the Deschutes River Westside population are found predominantly in spring-influenced streams that drain snowmelt from the Cascade Mountain Range, and are therefore believed to be a best-match for summer steelhead reintroductions to Whychus Creek.

The goal of this Reintroduction Plan and the program it outlines is to establish self-sustaining and harvestable runs of native summer steelhead upstream of PRB. It will therefore be important to release fish that will adapt to upper basin habitats and passage conditions in as few generations as possible. This makes summer steelhead from the Deschutes River Eastside and Deschutes River Westside populations logical choices for use in fish reintroduction to specific areas above
PRB, at least to the degree that they are available to the program. However, concerns about the status of the basin’s wild summer steelhead populations make it a certainty that they will be less available to the program than would be desirable if the success of the reintroduction effort were one’s only concern. Given this fact, initial priorities for use as summer steelhead broodstock in the reintroduction effort are as follows:

Priority 1) Wild summer steelhead from the Deschutes River Eastside and Deschutes River Westside populations;
Priority 2) First-generation hatchery summer steelhead with parental origins as identified above;
Priority 3) Mixed crosses of RBH hatchery stock summer steelhead with fish having one or the other of the parental origins given above; and
Priority 4) RBH hatchery stock, to be used if or where higher priority stocks are not appropriate or are unavailable.

Specific plans for managing the genetic makeup of the fish to be released into the upper basin during the summer steelhead reintroduction effort are still under development by ODFW and should be informed by one or more professional geneticists. As they are refined, and certainly before wild-origin summer steelhead are used as broodstock, these plans will be incorporated into one or more HGMPs for reintroduction-related hatchery operations, as indicated in Section 4.4.1.2.

5.1.1.2. Fish reintroduction.
The general characteristics of Phases 1 and 2 of the reintroduction effort above PRB have already been described. Additional details specific to summer steelhead are given here.

- **Phase 1.** The reintroduction of summer steelhead will begin with pathogen-screened releases of three types of hatchery-reared fish, each with a specific purpose. These releases will include early fry of RBH stock (possibly using eggs and streamside incubators for releases at some locations), smolts of RBH stock, and, as soon as possible, hatchery-reared smolts whose wild-origin parents were collected in the lower Deschutes subbasin.

Phase 1 releases of fry will occur along Whychus Creek in the Deschutes River subbasin and the Crooked River subbasin (Table 5-1). Annual releases into Whychus Creek between the mouth and the Three Sisters Irrigation District (“TSID”) diversion dam will be 286,000 fry. This number is about 20 percent larger than modeling efforts suggest will yield enough smolts for statistically rigorous passage efficacy tests through LBC if 10 percent of the smolts produced can be trapped and tagged above the reservoir as is

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6 A “statistically rigorous” test would, in this case, be one capable of yielding estimates within +5 percent of true passage efficacy if that efficacy was 50 percent.
expected. Releases of RBH stock fry into McKay Creek during Phase 1 will therefore be large enough (127,000 fish) to produce what recent modeling suggests will be about 50 percent of the stream’s maximum number of smolts, a level of production that should provide a significant test of the habitat available in the stream.

Releases of summer steelhead fry into the Crooked River subbasin below Bowman Dam and Ochoco Creek during Phase 1 will be determined through efficacy of trapping facilities capturing naturally reared smolts at the Crooked River Central dam site at river mile 44 and progress in installing fish screens on the larger irrigation diversions. Preliminary calculations suggest that strategic Phase 1 releases of 288,000-708,000 well-dispersed RBH summer steelhead fry upstream of such a site might yield enough marked, naturally-produced smolts for statistically meaningful fish passage tests if smolt collection efficiencies at the trap reach or exceed 20-25 percent. Annual releases into the Crooked River subbasin during Phase 1 will be determined in consideration of the above criteria.

From an ecological and a testing standpoint, all of the fry releases during the reintroduction program should be matched in time and location to what is anticipated for natural summer steelhead populations above PRB. The fry releases each year during Phase 1 will be well distributed along each of the target streams and in direct proportion to the smolt production capacities of specific stream segments as estimated by Ackerman et al. (2007). Summer steelhead production in each stream will be monitored post-release.

The fry release estimates given in Table 5-1 were based on modeling, multiple assumptions, and logic outlined in Appendix D. Included among the assumptions is that fry-to-smolt survival of RBH hatchery (H) stock will be half that of fry from wild or near-wild parents (W; broodstock priorities 1 or 2), and that the survival of fry with mixed parental lineages (M) will be intermediate to that of fry of the previous two types. These and other assumptions behind the estimates are reasonable but uncertain, making it possible that releases of the magnitudes indicated will not meet objectives. Refinement of the numbers and allocations of fry to be released during Phase 1 may be necessary following evaluation of initial releases.

Releases of tagged RBH stock summer steelhead smolts into Whychus Creek and the Crooked River subbasin during Phase 1 (a combined 12,500 annually; Table 5-1) are intended to be large enough to ensure that studies downstream yield estimates of percent survival through LBC and into the SWW collector with estimation errors no greater than ±5 percent. The smolts will be acclimated prior to release in temporary holding ponds that allow volitional emigration (see Section 4.4.1.3) if funding for such ponds can be secured, to encourage natural migratory behaviors. However, the possibility that the behavior of these hatchery-reared fish may be somewhat unnatural, regardless of release protocols, will need to be taken into account when test results are evaluated.
Table 5-1. Initial estimates of annual releases of summer steelhead to occur within specific areas of the drainage basin upstream of PRB as the reintroduction effort moves forward. Parental origin (brood) is identified as being Hatchery (H), Mixed (M), or Wild (W; this category includes steelhead parents that are the first-generation, hatchery-reared offspring of wild fish).

<table>
<thead>
<tr>
<th>Species</th>
<th>Phase of reintroduction</th>
<th>Stream area</th>
<th>Fry</th>
<th>Smolts</th>
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<td></td>
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<td>Brood Number</td>
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<td>Summer steelhead</td>
<td>Phase 1</td>
<td>Deschutes R.</td>
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<tr>
<td></td>
<td></td>
<td>Whychus Cr.</td>
<td>H</td>
<td>286,000&lt;sup&gt;b&lt;/sup&gt;</td>
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<td></td>
<td></td>
<td>Crooked R. system</td>
<td>H</td>
<td>288,000 – 708,000</td>
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<td></td>
<td></td>
<td>All</td>
<td>H</td>
<td>574,000 – 994,000</td>
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<td>Phase 2</td>
<td>Deschutes R.</td>
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<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
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<td>Whychus Cr.</td>
<td>W, M, H</td>
<td>100,000-596,000&lt;sup&gt;d&lt;/sup&gt;</td>
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<td></td>
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<td>Crooked R. system</td>
<td>W, M, H</td>
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<td></td>
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<td>All</td>
<td>W, M, H</td>
<td>322,000 - 2,013,000</td>
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<sup>a</sup> There will be no releases of steelhead directly into the Deschutes R., nor into the Metolius R. system. Habitat in these areas is believed to be better suited to resident than anadromous rainbow trout production (Cramer and Beamesderfer 2006), and colonization of this habitat by steelhead, should it occur, will be a consequence of straying by naturally produced fish.

<sup>b</sup> Initial annual releases into Whychus Cr. will be intended to supply enough marked smolts (both naturally produced and hatchery produced) to test fish passage effectiveness downstream through LBC and into the SWW fish collection facility. The releases of fry assume 10 percent of the smolts naturally produced in the stream will be trapped and reach the head of the reservoir bearing detectible marks, and have been increased by 20 percent above the minimum number estimated to be needed for adequate statistical precision in the fish passage tests (238,000). Initial fry releases will also test fish performance in the habitat above PRB and produce the first generation of adult steelhead to have reared as juveniles in that habitat for about 40 years. Numbers of fry to be released assume smolt production only in suitable habitat below the TSID diversion dam and not above that dam.

<sup>c</sup> Initial annual releases into the Crooked R. system below Prineville will be intended to supply enough marked hatchery smolts to test fish passage effectiveness downstream, and to provide naturally produced smolts that can be marked and pooled with those from Whychus Cr. to potentially make fish passage tests based on naturally produced smolts more robust. The releases of fry will also be intended to help test fish performance in the habitat above PRB and to produce returning adults that reared as juveniles in that habitat. As currently envisioned, the scope of steelhead fry releases during Phase 1 will be relatively limited.

<sup>d</sup> Annual releases during Phase 2 will supplement natural fish production associated with returns of adult steelhead that reared as juveniles above PRB. Releases of fry will initially be of a magnitude estimated to be sufficient by themselves to produce about 50 percent of the maximum number of smolts, including that in areas of Whychus Cr. above the TSID diversion dam, and will diminish through time (note: the percentage will be reduced very early in Phase 2 if the number of returning adults exceeds expectations and there is a potential that fry outplants might otherwise overwhelm the offspring of these adults). There may be exceptions to this basic pattern in the Crooked R.
system, however. Actual annual releases of fry will depend on broodstock availability and, in the Crooked R. system early in Phase 2, anticipated post-release environmental conditions. Hatchery produced smolts derived from disease-screened wild parents collected below PRB will also be released into these areas for a 5-year period, if available, in numbers equivalent to 50 percent of maximum natural smolt production, so that adults returning from the releases can also begin to supplement the developing natural runs. Hatchery support of the natural runs will diminish through time and end as soon as the runs can sustain themselves. Barring unforeseen circumstances, it will not continue for more than three fish generations in a given subbasin before the fish are given an opportunity to sustain themselves without artificial support.
Annual releases into the lower Deschutes River subbasin immediately below PRB of 10,000 pathogen-screened hatchery smolts produced from wild parents (not shown in Table 5-1) will begin as early in Phase 1 as possible and continue for a full generation of summer steelhead broods. These fish will be given coded-wire tags but no fin marks prior to release (to avoid targeted harvest). When they return to the Pelton Trap as adults, these fish will be identified and targeted for use as broodstock. Adult returns in excess of broodstock needs, should they occur, could be allowed to pass into the upper basin during Phase 2 or used to enhance the genetics of the general RBH stock. Initiation of this program will be dependent upon the ability to perform timely genetic analysis confirming the origin of unmarked adult summer steelhead captured at the Pelton Trap. The potential of incorporating unmarked hatchery or wild stray summer steelhead into the broodstock program presents an unacceptably high genetic risk.

**Phase 2.** Phase 2 will begin when applicable downstream passage goals have been met at PRB, and adult summer steelhead returning to Pelton Trap after having reared as juveniles above PRB are passed back up into the upper basin. Initially, these adults will be summer steelhead that reared as juveniles in the upper basin during Phase 1. Passing the adults will allow the aggregate upper basin summer steelhead population to begin completing lifecycles and adapting to upper basin environments.

Annual releases of summer steelhead fry during Phase 2 will supplement natural fish production associated with returns of adult fish that reared as juveniles above PRB, and will be made using the fittest lineages of summer steelhead available to the program. The fry releases will initially be of magnitudes estimated to be sufficient by themselves to produce 50 percent of the maximum number of smolts in Whychus Creek (including areas above the TSID diversion dam), and will diminish through time. A similar pattern is anticipated for releases into the lower Crooked River subbasin, but fish passage conditions and annually variable environmental conditions within that subbasin may make changes to this basic pattern important during early years in Phase 2. Actual annual releases will depend on broodstock availability, and, in the Crooked River subbasin during the early years just mentioned, annual assessments of fish passage conditions, water year types, and anticipated post-release environmental conditions.

Initial estimates for the numbers of summer steelhead fry to be released annually during Phase 2 were given in Table 5-1. Peak numbers of fry released could be as high as 596,000 into Whychus Creek and more than 1,417,000 into the lower Crooked River subbasin, depending on the broodstock used. Use of high priority broodstock will lower
the size of releases, due to the effect that fish fitness will have on fry-to-smolt survival rates.

The summer steelhead fry release estimates for Phase 2, both the potential peak (50 percent of maximum smolt production) releases and the reduced (25 percent) releases are based upon the same basic information used to develop fry release numbers for Phase 1 (see Appendix D). As indicated earlier, such estimates can be built upon reasonable assumptions and still have potential for significant error. Refinement of the numbers and allocations of fry to be released may be necessary following evaluation of whether initial Phase 2 releases are contributing as expected to smolt production.

Pathogen-screened, hatchery produced summer steelhead smolts whose parents were wild, or some combination of wild fish and the first-generation hatchery-reared offspring of wild fish, will be released into the summer steelhead streams above PRB each year during the first summer steelhead generation of Phase 2 unless such fish are unavailable to the program. These smolts will supplement other fish being passed or released into the upper basin, and will help increase the pace of early run building. Numbers of these wild or “near-wild” brood fish will be equivalent to about half the estimated smolt production capacity of summer steelhead habitat in Whychus Creek (7,700/15,325 smolts) and the lower Crooked River subbasin (13,000/25,703 smolts). The fish will be marked in the same fashion as smolts collected in the SWW facility, but prior to their release above LBC. This will allow them to contribute to ongoing studies above PRB as well as to be passed into the upper basin upon return as adults.

Fry release programs within Whychus Creek and the lower Crooked River subbasin will end when it is determined that the summer steelhead runs in these areas might be able to sustain themselves if given the opportunity. Once ended in a given geographic area, summer steelhead fry releases might be reinitiated if monitoring data suggest that the population in that area needs additional, temporary demographic support.

5.1.1.3. Broodstock needs and availability.

Estimates of the potential broodstock needs of the summer steelhead reintroduction program, based on the fry release estimates given in Table 5-1, an assumed fecundity of 5,200 eggs/adult female (recent observations have been as low as about 4,500 eggs), typical hatchery survival rates to the lifestages to be released, and likely rates of disease-related culling, are summarized in Table 5-2. Actual selection and use of summer steelhead broodstock will depend on genetic management protocols identified through the Annual Fish Passage Work Plan process or in a final HGMP for RBH, on broodstock availability (including the health of the lower basin’s
population of wild fish), and on how the reintroduction effort is shaped by adaptive program management. The numbers given in the table are thus not absolutes. Particularly for the Crooked River subbasin component of the effort during the early years of Phase 2, annual decisions made prior to and during the spring egg take period will strongly influence the parentage and numbers of fry to be released. Annual assessments of water year type and of probable environmental conditions in the receiving streams post-release may influence decisions as to where, how many, and what parental lineages of fry will be planted into streams of the lower Crooked River subbasin.

Table 5-2. Initial estimates of the potential broodstock needs for the reintroduction of summer steelhead into the drainage basin above PRB.

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>Potential need for broodstock (number of females)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase 1</td>
</tr>
<tr>
<td>---</td>
<td>20-25 wild(^1)</td>
</tr>
<tr>
<td>Upper Deschutes</td>
<td>78</td>
</tr>
<tr>
<td>Metolius</td>
<td>---</td>
</tr>
<tr>
<td>Crooked</td>
<td>37</td>
</tr>
<tr>
<td>Totals</td>
<td>119</td>
</tr>
</tbody>
</table>

\(^1\) These fish will be used in multiple ways, and would be smaller in number during Phase 1 were it not for the need to avoid a severe genetic bottleneck. Their numbers (excluding the female-equivalents used to produce hatchery smolts to be released below or above PRB) would come from numbers given lower in the table.

The reintroduction program’s need for summer steelhead broodstock has the potential to range as high as 550 adult females and 1,100 total adult fish during Phase 2 if only RBH broodstock (priority 4 stock) are used. Roughly 70 percent of these fish would be used to provide fry to the reintroduction program in the lower Crooked River subbasin. Smaller numbers of broodstock would likely be needed to meet smolt production objectives if wild broodstock (priority 1 stock) or their derivatives (priority 2 or 3 stock) were available to the program, due to higher fry-to-smolt survival rates anticipated for fish of these lineages (Appendix D).

Although exclusive reliance on RBH stock summer steelhead would be possible given that returns of these fish to the Pelton Trap have exceeded hatchery broodstock needs by an average of more than 1,500 fish per year since 1980, it is not the intent of the reintroduction program to do so. These fish will be strongly relied upon as broodstock in Phase 1 due to ESA-related concerns, then used only when there are not other options for producing sufficient fry to meet objectives during Phase 2.
Even with the constraint just identified, use of RBH summer steelhead as a dominant broodstock for fry releases, at least in some of the situations likely to arise during Phase 2, will be unavoidable unless large Phase 2 releases of fry do not begin until significant numbers of adults have started returning to Pelton Trap from lower river releases of hatchery smolts produced from wild parents. This is true because until that time there will not be a reliable large supply of priority 2 or priority 3 broodstock, and the at-risk wild fish in the lower basin (priority 1 stock) are not abundant enough to support the program by themselves. For example, if an effort was made to use only wild-origin summer steelhead to support peak Phase 2 fry releases that were to occur in the same year at all locations, 1,007,000 fry would need to be produced from broodstock consisting of about 228 wild females and an accompanying contingent of wild adult males. These numbers of adult fish would account for a significant fraction of the lower basin’s spawning populations of wild summer steelhead in many years (Figure 5-2), and would in actuality be unavailable to the reintroduction program other than in years of very large wild escapements. Focusing in on one of the specific areas where summer steelhead are to be reintroduced within the upper basin, it is estimated that releases of 298,000 wild fry would be required to by themselves achieve 50 percent of maximum smolt production in Whychus Creek (Appendix D). Production of these pathogen-screened fry using wild broodstock from the Deschutes River basin Westside summer steelhead population, the one whose habitats are thought to be most similar to those found in Whychus Creek, would require about 68 wild females from a population whose mean abundance from 1980-2005 was estimated at 468 fish (about 309 females) by Carmichael (2006). In an average year, 5-10 percent of this population, the maximum fraction that ODFW and NOAA Fisheries have suggested might pose a low risk if removed from the Deschutes River basin Westside population, would include only 15-31 females.
Figure. 5-2. Numbers of wild steelhead escaping to spawn in the lower Deschutes River Basin, as estimated by Carmichael (2006).

The need for potentially large numbers of broodstock in the reintroduction effort, combined with the at-risk status of the lower basin’s wild summer steelhead, makes it imperative that the reintroduction program’s use of wild lower basin fish is constrained and that the benefits derived from each wild fish that it uses are maximized. Strategic Phase 1 production of hatchery smolts from wild parents, so that these fish can be released into the lower river and be available as priority 2 broodstock when they arrive at the Pelton Trap during Phase 2 will be crucial. Similarly, short-term and well-designed approaches to crossing wild fish, or their first-generation derivatives (priority 2 broodstock), with a subset of the RBH hatchery stock, to produce one or more invigorated brood-lines (priority 3 broodstock) for the reintroduction effort, may be important.
Another consideration that may affect summer steelhead broodstock needs and whether the numbers of wild fish available to the program are sufficient to meet them is the possibility of geographic sequencing of the reintroduction effort so that the most intense Phase 2 supplementation efforts in Whychus Creek, within the Upper Deschutes River subbasin, do not occur in the same years as those on streams in the lower Crooked River subbasin. Alternatively, a greater reliance on the RBH hatchery stock to produce broods of fish bound for the lower Crooked River subbasin might allow a stronger focus on the use of wild brood-lines or their derivatives in Whychus Creek. These possibilities all raise questions that will need to be addressed as the reintroduction program proceeds.

Another consideration is the high level of straying that occurs in the lower basin, below PRB. Significant percentages of the hatchery summer steelhead found there (in excess of 70 percent in some years) are out-of-basin strays. The level of straying by wild (or unmarked) summer steelhead into the lower basin is uncertain but local biologists believe it may also be high. The possibility that existing wild runs do include frequent out-of-basin strays complicates the task of collecting wild Deschutes basin-origin broodstock for the reintroduction effort.

Specifics of wild broodstock collection have not been determined, but will focus on collecting a small proportion (not to exceed 5-10 percent, per NOAA Fisheries) of the wild adult summer steelhead at one or more collection sites and if possible using “real time” genetic analysis to confirm that the collected fish represent Deschutes River basin strain summer steelhead. The intent will be to screen unmarked fish so as to exclude out-of-basin strays from the reintroduction effort to the degree practicable. Such genetic screening will require better genetic profiling abilities than are available in the Deschutes River basin at present. It will also require a funding source, other than the Licensees, that has yet to be identified.

Genetic studies that may inform the broodstock collection effort have already been initiated, to better characterize Deschutes River basin summer steelhead, redband trout populations, and relationships between the two. Results from this work may be used to confirm or refine broodstock priorities, and to help Fish Managers distinguish Deschutes River basin strain unmarked summer steelhead from out-of-basin strays at broodstock collection sites in the lower basin. Genetic samples required for this effort were collected in 2005 from unmarked summer steelhead in major tributaries to the lower Deschutes River subbasin, in the mainstem, and from resident rainbow trout above PRB in Whychus Creek and the Crooked River subbasin. Analyses of the samples by ODFW are ongoing.

If distinct genetic profiles can be established for native Deschutes River basin summer steelhead, it is anticipated that all unmarked (likely wild) adult summer steelhead collected for broodstock
will be held for approximately three days to two weeks depending upon the genetic assessment technology applied for discrimination. If such profiles cannot be developed, something currently viewed as an unlikely but conceivable situation; the reintroduction program may have to rely entirely on abundant RBH hatchery fish as broodstock.

Protocols for collecting wild native summer steelhead from the lower basin, including collection sites, will be developed in full consideration of the information generated by ongoing genetic studies, coordinated among CTWSRO, ODFW, NOAA Fisheries, and the Fish Committee, and incorporated into an HGMP for RBH as described in Section 4.4.1.2. Potential wild broodstock collection sites include Trout Creek, Warm Springs River, the fish trap at Sherars Falls, or from unmarked adults returning to the Pelton Trap. Broodstock collection will be consistent with guidelines set by the Fish Hatchery Management Policy (ODFW 2007). Other options for broodstock collection such as alternative collection sites or kelt reconditioning may be investigated if sources of funding can be found and they appear to be viable options for improving success of reintroduction.

Egg, fry, or smolt production goals attributed to high priority broodstock might in some years of Phase 2 be offset by egg collections from returning adults that originated upstream of PRB, though this is something that would be avoided if there were any better options. Not more than 15 percent of returning male and 15 percent of returning female summer steelhead identified from upstream releases would be utilized as broodstock in any given run year. All adults not used as broodstock will be passed upstream to spawn naturally. All returning adults would be available for use as broodstock during the later portions of Phase 1 if it took an extended period of years to establish successful downstream fish passage at LBC.

5.1.1.4. Hatchery support.
ODFW, the CTWSRO, USFWS, and NOAA Fisheries will work with the Licensees to collect lower Deschutes basin summer steelhead. After collection, responsibility for holding these fish, screening them for disease, mating broodstock, managing the genetic composition of their offspring, and producing those offspring, will then shift to ODFW, RBH, and the Licensees. Eggs will be incubated as separate family groups reared in pathogen-free or disinfected water, to assist in managing fish health risks and to control the possible transfer of pathogens to areas of the upper basin. Disposition of eyed eggs from specific pathogen-positive parents will be determined by the Fish Health Specialist on the project. In recent history, there have been yearly outbreaks of IHN virus in summer steelhead at Round Butte Hatchery. It is possible though not likely that all or most of the adults in a given year could be positive for IHN virus. Biologists will work with Fish Health Services to outline management practices if pathogen- positive adults
are to be used in the reintroduction effort, and will incorporate descriptions of these practices into the HGMP(s) for facilities involved in their use.

RBH, perhaps with the assistance of other hatchery facilities (Wizard Falls, Oak Springs) in the production of smolts, will produce eggs, fry, and/or smolts as needed for the reintroduction program. Smolts produced for fish passage tests in LBC should be reared in ways that make them predator-conditioned. Multiple release strategies will be employed and their consequences monitored. Eggs from the hatchery will be introduced to upper basin streams via streamside incubators and possibly Vibert boxes in some cases. Fry will be direct released from strategic access points and if possible also dispersed by hand into suitable habitats more distant from these points. Smolts produced at the hatchery and acclimated at temporary ponds will be used to test fish passage efficacy through LBC during Phase 1 of the reintroduction program or to supplement run building efforts during the first fish generation of Phase 2.

Returning adults that reared as juveniles above PRB will be passed upstream to spawn naturally once the program enters Phase 2, but will be incorporated by hatchery managers into a supplementation broodstock if the summer steelhead reintroduction effort spends, as noted earlier, an extended period of time in Phase 1.

The intent of the summer steelhead reintroduction program is to establish self-sustaining, harvestable runs that are independent of hatchery support as soon as is feasible. As conceived, this means that the program will place a large number of pathogen-screened juvenile summer steelhead into the system in as small a number of fish generations as is practical, and then allow the developing fish runs to separate from hatchery support. Supplementation of adult runs that are able by themselves to spawn about 50 percent or more of the maximum number of smolts available habitat can produce should not occur, because it would likely work against the growth of a locally adapted population, both from a genetic standpoint and by causing density-dependent reductions in the survival of juveniles spawned by the natural run. Further run supplementation may be needed after a small number of summer steelhead generations separated from the hatchery, depending upon population performance, but we do not envision strong local adaptations and self-sustaining and harvestable runs developing if the fish are subject to substantial long-term hatchery influence.

Unless there is an unforeseen lack of broodstock, the initial supplementation effort for summer steelhead within each subbasin will not extend beyond three fish generations, the number the Hatchery Scientific Review Group (HSRG 2004) has suggested as an upper limit for conservation-focused hatchery programs. It is believed that this number of generations, at a maximum, would be sufficient to raise upper basin summer steelhead abundance to the point that
the fish should be given an opportunity to test their ability to sustain themselves without artificial support.

5.1.1.5. Vision of success.
The preliminary, long-term escapement goal that Fish Managers have suggested for a future run of upper basin summer steelhead is 955 adults above PRB annually with fish passage provided at Opal Springs Dam, per modeling by Beamesderfer (2002). However, it would seem quite optimistic to expect to see this number of adult fish returning to the upper basin on a consistent basis early in what is likely to be a long-term effort to rehabilitate habitats and build the run. Figure 5-3 summarizes output from a simplistic simulation of how a summer steelhead run into Whychus Creek might build during the first couple of decades of the reintroduction effort. Reestablishment of a reasonably stable run in Whychus Creek that contributed to non-consumptive in-basin fisheries without depending on hatchery support, accompanied by significant progress in rehabilitating habitat and restoring runs in the lower Crooked River subbasin, would be a significant accomplishment.

Over the long term, self-sustaining and harvestable natural runs of summer steelhead in the upper basin should contribute to all four elements of the viability of Deschutes River basin summer steelhead: abundance, productivity, genetic diversity, and geographic distribution. Any specific recovery objectives developed for summer steelhead in the upper basin by the Interior Columbia Technical Recovery Team will be incorporated into this Reintroduction Plan as part of the long term vision.
Figure 5-3. Simulation of fry release pattern, natural smolt production, and run building for summer steelhead in Whychus Creek, Upper Deschutes River subbasin, Oregon, assuming large, short-duration releases of juvenile fish consistent with this Reintroduction Plan.

This simulation is presented for illustrative purposes, not to indicate knowledge of the future for summer steelhead in Whychus Creek. “Wild-type” fry are produced from broodstock that are either wild steelhead or their first-generation offspring.
5.1.2. Spring Chinook salmon.

Spring Chinook salmon will be reintroduced into the drainage basin above PRB following the same general two-phased approach described earlier in this Reintroduction Plan, but with important distinctions in the areas of geographic emphasis, the numbers of fish involved, and the anticipated level of use of wild fish from the lower basin as broodstock. The intent will be to move to Phase 2 of the reintroduction, with selective upstream passage of adult fish, as quickly as possible after applicable downstream passage goals have been met at PRB. Passing adult fish and allowing them to complete and link full lifecycles that include upstream migration, spawning, egg incubation, emergence, juvenile rearing, and juvenile outmigration through LBC will enable the fish to become progressively better adapted to upper basin conditions.

Reintroduction efforts for spring Chinook salmon will initially focus most strongly on known suitable habitats in the Metolius River subbasin and on Whychus Creek in the Deschutes River subbasin. However, this does not mean that the mainstem Deschutes River subbasin between LBC and Steelhead Falls, nor the Crooked River subbasin, are necessarily unimportant to the future of the species above PRB. The segment of the mainstem Deschutes River subbasin below Steelhead Falls will produce spring Chinook salmon if the fish are not overwhelmed by the myxosporean parasite Ceratomyxa shasta, something that might occur given limited parasite resistance of the spring Chinook salmon stocks available for reintroduction (Ratliff 1981). Sentinel tests to be conducted early in Phase 1 of the reintroduction effort will answer this question, as well as clarifying whether the parasite’s distribution in the Crooked River subbasin is restricted to the mainstem river below Lone Pine Bridge (Mile 30), as suggested by preliminary tests in the early 1990s (A. Stuart, ODFW, pers comm.). As for the Crooked River subbasin, modeling by Oosterhout (1999) suggested that productive habitats for spring Chinook salmon may still be present in cooler areas below Bowman Dam. These will become accessible to adult spring Chinook salmon when fish passage issues are resolved at the Opal Springs hydroelectric project (Mile 0.5) and several water diversions farther upstream. Nearly half, or perhaps more (Beamesderfer 2002), of the potential spring Chinook salmon rearing habitat above PRB is found in the Crooked River subbasin between Opal Springs and Bowman Dam, although a substantial portion of this habitat is in need of restoration.

5.1.2.1. Stock selection.

There are three stocks of spring Chinook salmon potentially available as donor stock for reintroduction into the cooler waters of the system: Warm Springs River wild stock, Warm Springs hatchery stock cultured at Warm Springs National Fish Hatchery (“WSNFH”), and RBH stock. Each of the two hatchery stocks was founded from local-origin spring Chinook salmon and has had varying numbers of wild fish incorporated into annual broods. The WSNFH stock has been cultured since the late 1970s under an integrated program whose goal is to have, on a
10 year average, 10 percent of the hatchery broodstock of wild fish origin (USFWS & CTWS 2007). This practice is intended to maintain the hatchery stock’s genetic fitness. Recent unpublished studies suggest that juvenile fish of WSNFH stock survive from fry-to-smolt at about 90 percent the rate seen for juveniles of that river’s wild stock when placed in the same streams (S. Rubin, USGS, pers comm.). The RBH spring Chinook salmon stock, initiated in the early 1970s, has been cultured for more fish generations and with somewhat less attention to continual infusions of wild-origin broodstock than has been the practice for managing the WSNFH stock. Wild fish accounted for an average of about 5 percent of the adult spring Chinook salmon in the RBH broodstock into and through the 1990s (R. Madden, PGE, unpubl. data), but have rarely been included since that time due to a lack of availability at the Pelton Trap.

Because the reintroduction effort is aimed at developing a naturally produced, self-sustaining and harvestable population of Chinook salmon in the Metolius River subbasin, it is advisable to use the stock most adapted to the wild. Therefore, the order of preference of stocks for use in reintroduction of spring Chinook salmon above PRB is as follows:

1) Warm Springs Wild Spring Chinook salmon – if available;
2) Warm Springs Hatchery Spring Chinook salmon (WSNFH stock) – if available;
3) Round Butte Hatchery Spring Chinook salmon – if the other two stocks are not available.
4) First-generation hatchery produced fish with parental origins as identified above;
5) Mixed crosses of RBH stock with fish having one of the parental origins given above.

**5.1.2.2. Fish reintroduction.**

Phases 1 and 2 of the reintroduction of spring Chinook salmon above PRB have already been described in general terms. More specific details are given here.

**Phase 1.** The reintroduction of spring Chinook salmon will begin with releases of pathogen-screened, early fry (possibly using streamside incubators in some locations) into what are believed to be the most productive habitats for this form of Chinook salmon in the Metolius River subbasin system and in Whychus Creek. The fish used during Phase 1, before downstream fish passage efficacy is proven, will be derived from hatchery-origin parents, and releases of them will be of magnitudes that recent analyses (see Appendix D) suggest will be sufficient to provide enough naturally produced smolts for statistically precise passage efficacy tests of fish entering LBC from the Metolius and Deschutes River arms. The annual fry releases for these two areas (estimated to total 344,000 fish) were based on an assumed ability to trap, tag, and release 10 percent of the naturally produced smolts. They also assume that the fry will be released in a reasonably well-dispersed fashion into suitable streams in the Metolius River subbasin system (see
Table 4-2), and into Whychus Creek below Alder Springs and between the Three Sisters Irrigation Diversion (TSID) and the lower end of Camp Polk. As well, the release numbers assume that recent estimates of spring Chinook salmon smolt production potential for these streams (see Table 4-2, Oosterhout 1999, and Lovtang 2005) are accurate and that given these potentials, density-dependent juvenile Chinook salmon survival from early fry to smolt will be similar in each stream to rough estimates of that seen in the Warm Springs River subbasin. They are also based on an assumption that fry produced from hatchery-origin adults will be 90 percent as fit in the wild as are individuals in the natural population from the Warm Springs River subbasin. Each of these multiple assumptions is uncertain, and some of them will be evaluated using data collected during test-and-verification studies associated with the effort to pass fish at PRB. It is thus possible that releases of the magnitudes indicated will not meet objectives. Refinement of the numbers and allocations of fry to be released during Phase 1 may be necessary following evaluation of initial releases.

The numbers of early fry proposed for release annually into Whychus Creek (47,000; see Table 5-3) are estimated to be sufficient to yield enough tagged smolts to test LBC passage efficacy with at least a ±5 percent level of precision. The releases into the Metolius River subbasin (277,000 fry) will try to take full advantage of the relatively higher productive potential of the warmer tributaries in the Metolius River subbasin, including Lake Creek, and are intended to provide enough tagged naturally produced smolts that passage efficacy test results will have a high degree of precision. Releases for a higher level of precision appear to be possible in the Metolius River subbasin because it is estimated to have a considerably higher potential for producing spring Chinook salmon smolts. The releases for higher levels of study precision for Metolius River subbasin fish should allow for detailed evaluations of potential causes of smolt loss, if needed. They also provide an added buffer to smaller releases that were estimated as sufficient to provide ±5 percent precision in fish passage tests, in case it proves that existing estimates of smolt capacity or density-dependent fry-to-smolt survival in the stream are in error.
Table 5-3. Initial estimates of annual releases of spring Chinook salmon to occur within specific areas of the drainage basin upstream of PRB. Parental origin (brood) is identified as being hatchery (H), Mixed (M), or Wild (W).

<table>
<thead>
<tr>
<th>Species</th>
<th>Phase of reintroduction</th>
<th>Stream area</th>
<th>Fry</th>
<th>Smolts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brood Number</td>
<td>Brood Number</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H 277,000(^a)</td>
<td>H 5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H 500(^b)</td>
<td>H 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H 47,000(^b)</td>
<td>H 5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H 500-105,000(^b)</td>
<td>H 7,500</td>
</tr>
<tr>
<td>Metolius R. system</td>
<td>Phase 1</td>
<td>All</td>
<td>H 325,000-430,000</td>
<td>H 17,500</td>
</tr>
<tr>
<td>Deschutes R.</td>
<td>Phase 1</td>
<td>Metolius R. system</td>
<td>H, M, W</td>
<td>173,000-519,000(^c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deschutes R.</td>
<td>H, W</td>
<td>0(^d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Whychus Cr.</td>
<td>H, M, W</td>
<td>37,000-110,000(^c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crooked R.</td>
<td>H</td>
<td>0-109,000(^d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All</td>
<td>H, M, W</td>
<td>210,000-738,000</td>
</tr>
</tbody>
</table>

\(^a\) Initial annual releases into the Metolius R. system and Whychus Cr. will be intended to supply enough marked smolts (both naturally produced and hatchery produced) to test fish passage effectiveness downstream through Lake Billy Chinook and into the SWW fish collection facility. The releases of fry assume 10 percent of the smolts naturally produced in the stream will be trapped and reach the head of the reservoir bearing detectible marks, and are of magnitudes estimated as adequate to provide sufficient statistical precision to fish passage tests. The fry releases into the Metolius system are hoped to provide a high level of precision to results of the fish passage tests and allow for detailed evaluations of potential causes of smolt loss, if needed. Initial fry releases will also test fish performance in the habitat above PRB and ultimately produce the first adult Chinook in about 40 years to return from the ocean after having reared as juveniles above PRB.

\(^b\) Fry will be placed into the mainstem Deschutes and Crooked Rivers during sentinel tests and other investigations designed to assess the likelihood that spring Chinook of the stock(s) available might do well in these areas.

\(^c\) Annual releases of fry during Phase 2 will supplement natural fish production associated with returns of adult Chinook that reared as juveniles above PRB. Releases of fry will initially be of a magnitude estimated to be sufficient by themselves to produce 50 percent of the maximum number of smolts, including in Whychus Cr. above the TSID diversion dam, and will diminish through time (note: the percentage will be reduced very early in Phase 2 if the number of returning adults exceeds expectations and there is a potential that fry outplants might otherwise overwhelm the offspring of these adults). Actual annual releases will depend on broodstock availability and the abundance of naturally returning adults. Hatchery support of the developing natural runs will end as soon as the runs can sustain themselves, and barring unforeseen circumstances, will not continue beyond at most three fish generations before the fish are given an opportunity to sustain themselves without assistance.

\(^d\) There will be no direct releases of spring Chinook into the Deschutes R. unless sentinel studies and other evaluations during Phase 1 suggest these fish will do well here. Issues related to streamflow and temperature regimes, as well as fish resistance to the myxosporean parasite C. shasta, make it more likely that summer-fall Chinook will perform best in the Deschutes R and in lower portions of the Crooked R. However, Crooked R. from Bowman Dam down to the CRFC diversion, and possibly farther downstream if flows are augmented, may have significant potential for producing these fish. Such potential will be taken advantage of if present.
Smaller numbers of fry (500 per river) will be used in longitudinal studies (including sentinel tests) of *Ceratomyxa shasta* virulence and juvenile fish vulnerability to the parasite, along the mainstem Crooked River subbasin from LBC to Bowman Dam and along the upper Deschutes River subbasin from LBC to Big Falls. As indicated earlier, the upper Deschutes River and the Crooked River from about Lone Pine Bridge (River Mile 30) and downstream to the mouth are anticipated hotspots for the parasite. The intent of these tests will be to clarify the distribution of *C. shasta* as well as to assess the likelihood that spring Chinook salmon of the stocks available to the reintroduction program might do well in these rivers.

Releases of 35,500-105,000 spring Chinook salmon fry will occur along the Crooked River subbasin below Bowman Dam during Phase 1 if (1) sentinel tests show a limited risk of losses to *C. shasta* and (2) an effective way to trap naturally produced smolts for fish passage tests can be developed somewhere downriver of McKay Creek. Preliminary calculations suggest that fish releases of these magnitudes would yield enough marked, naturally-produced smolts to estimate fish passage effectiveness through LBC with errors no greater than ±5 percent if smolt collection efficiency at the trapping site in this area exceeded 20-25 percent (see Appendix D). Such releases would provide an early opportunity to work with interested subbasin stakeholders on reintroduction efforts for a non-listed species.

Releases of tagged spring Chinook salmon smolts into the Metolius River subbasin, Whychus Creek, and the Crooked River subbasin during Phase 1 (a combined 17,500 annually; Table 5-3) are intended to be large enough to ensure that studies downstream yield estimates of survival through LBC and into the SWW collector with estimation errors no greater than ±5 percent. The smolts will be acclimated in temporary holding ponds adjacent to the receiving streams prior to release, if such ponds are available (funding is still being sought, see Section 4.4.1.3), to allow volitional emigration and encourage natural migratory behaviors. There are concerns that the behaviors of these hatchery-reared fish may be somewhat unnatural. This is something that will be taken into account when test results are evaluated.

Early test-and-verification studies in the tributaries and LBC will contribute to an improved understanding of issues related to Chinook salmon reintroduction. From an ecological and testing standpoint, the early fry releases should be matched in time and location to what is anticipated for natural Chinook salmon populations above PRB. Initial fry releases will also test fish performance in the habitat above PRB and ultimately
produce the first adult Chinook salmon, since the late 1960s, to return from the ocean after having reared as juveniles above PRB.

- **Phase 2.** Annual releases of spring Chinook salmon fry, eggs, and or smolts during Phase 2 will supplement natural fish production associated with returns of adult fish that reared as juveniles above PRB. Releases of fry will initially be of a magnitude estimated to be sufficient by themselves to produce 25-50 percent of the maximum number of smolts, including in Whychus Creek above the TSID diversion dam, and will diminish through time. Actual annual releases will depend on broodstock availability, adult returns, and, in the Crooked River subbasin during the early years of Phase 2, annual assessments of fish passage conditions, water year types and anticipated post-release environmental conditions. Hatchery support of the developing natural runs will end as soon as the runs have reached the point that it is believed they may be able to sustain themselves if given the opportunity.

Estimates of the numbers of spring Chinook salmon fry that will need to be released during Phase 2 were given in Table 5-3, and may range as high as 827,000 fish in some years. They were calculated from the same information used to develop fry release estimates for Phase 1 of the reintroduction effort for this species, are built upon the same basic assumptions, and have the same uncertainties. It is thus possible that releases of the magnitudes indicated will not meet objectives. Refinement of the numbers and allocations of fry to be released during Phase 2 may be necessary following evaluation of initial releases.

Phase 2 fry releases for the streams with spring Chinook salmon production potential in the Metolius River subbasin system will go into those stream segments potentially accessible to adults (there are a few reaches with substantial potential that may be naturally inaccessible to spawners due to insufficient streamflow), and will in aggregate be in the range of 173,000 to 519,000 fish annually depending upon the level of supplemental production believed appropriate at the time. Releases into Whychus Creek above and below the TSID diversion will range between 37,000 and 110,000 fry assuming fish passage is installed at the TSID diversion. In all cases, fry releases within a given system, stream, or segment of stream will be in direct proportion to the distribution of estimated smolt production potential.

There will be no direct releases of spring Chinook salmon into the upper Deschutes River subbasin, or into the Crooked River subbasin between the Lone Pine Bridge and LBC, unless sentinel studies and other evaluations during Phase 1 suggest these fish will do
well in one or both of these areas. Issues related to streamflow and temperature regimes, as well as fish resistance to the myxosporean parasite *C. shasta*, make it more likely that summer-fall Chinook salmon will perform best in the upper Deschutes River subbasin and in lower portions of the Crooked River subbasin. However, Crooked River from Bowman Dam down to a point about 4-5 miles below the CRFC diversion, and farther downstream if flows are augmented, may have significant potential for producing spring Chinook salmon. Annual fry releases of 109,000 or more may be released into the Crooked River subbasin from Bowman Dam downstream to approximately the People’s Irrigation District diversion dam if tests during Phase 1 confirm that juvenile spring Chinook salmon do well there. Such releases are estimated as likely to be sufficient to yield approximately 50 percent of maximum smolt production from this area. Additional releases of fry into the Crooked River, farther downstream, may be considered depending on the results of the Phase 1 studies and the status of fish passage conditions along the river. No Phase 2 releases of spring Chinook salmon fry will be made into the mainstem Deschutes River above LBC unless the results of *C. shasta* sentinel tests are contrary to expectations.

### 5.1.2.3. Broodstock needs and availability.
Potential broodstock needs for the phased reintroduction program just outlined, based on an assumed fecundity of 3,300 eggs/female spring Chinook salmon, typical hatchery survival rates, and pathogen-related culling, are summarized in Table 5-4. Actual use of spring Chinook salmon broodstock will depend on availability and on how the reintroduction effort is shaped by adaptive program management.

#### Table 5-4. Initial estimates of the potential broodstock needs for the reintroduction of spring Chinook salmon into the drainage basin above PRB.

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>Potential need for broodstock (number of females)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase 1</td>
</tr>
<tr>
<td>Upper Deschutes</td>
<td>22</td>
</tr>
<tr>
<td>Metolius</td>
<td>126</td>
</tr>
<tr>
<td>Crooked</td>
<td>1 - 47</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>149-195</strong></td>
</tr>
</tbody>
</table>

The reintroduction program’s potential need for spring Chinook salmon broodstock has been estimated to range as high as 331 adult females and a total of 662 adult fish during Phase 2 if matrix spawning and a 1:1 sex ratio are assumed. These numbers of adult fish, already factored upward to account for pathogen-related culling, are significant in relation to the numbers of lower basin spring Chinook salmon that have returned annually to potential collection points.
during the last 20-25 years (Figure 5-4). From 1985 through 2005, average annual adult returns to collection points above fisheries were 1,215, 1,754, and 1,463, for the Warm Springs River wild, WSNFH, and RBH stocks, respectively. Context for these numbers comes from a spawning escapement goal of 1300 adults for Warm Springs River wild spring Chinook salmon, and existing broodstock collection goals of 630 adults for WSNFH and 600 adults for RBH. Since 1985, RBH by itself had returns large enough to have provided 331 adult females in 11 of 21 years after first meeting its preexisting broodstock collection goal. All three stocks combined had returns large enough to have provided 331 adult females in 14 of 21 years after first meeting their respective spawning escapement or broodstock collection goals.

![Adult spring Chinook salmon reaching potential collection sites](chart)

**Figure 5-4. Adult spring Chinook salmon reaching the Warm Springs weir (Warm Springs River wild and Warm Springs National Fish Hatchery stocks) and the Pelton Trap (primarily RBH stock), 1980-2005.**

Clearly, there is a sizeable probability that the reintroduction effort for spring Chinook salmon will be broodstock limited in one or more years. During any such years, thoughtful use of available broodstock, and careful planning, will be required. Adjustments to fish release numbers or locations in response to broodstock limitations will occur through the coordinated efforts of the Fish Managers and the Fish Committee.
The RBH stock will be used during Phase 1 of the spring Chinook salmon reintroduction program, contingent on having adequate excess broodstock available after meeting production goals necessary for PRB’s mitigation requirements in the lower Deschutes River. There are essentially no wild spawners available at RBH. However, due to low adult returns in 2004 approximately 50 percent of the RBH brood was obtained from the WSNFH, potentially invigorating the stock. Adult fish returning from releases of this component of RBH’s 2004 brood, if available, would be desirable for use as broodstock to assist with reintroduction. In general, Chinook salmon will be collected from across the run to mimic natural run timing of the population.

During Phase 2, requests from the Fish Committee to the CTWSRO and WSNFH to obtain Warm Springs River wild and/or Warm Springs River hatchery spring Chinook salmon broodstock would be considered if it is determined that those stocks would assist in expediting reintroduction success. Use of RBH stock will be used to supplement unmet production goals if eggs from Warm Springs wild or WSNFH stocks are limited or unavailable.

5.1.2.4. Hatchery support.
Lower basin hatcheries will collect, hold, and screen spring Chinook salmon for disease, and manage broodstock mating and the genetic composition of pathogen-screened fry (or eggs) that will be introduced into the upper basin. RBH, perhaps with the assistance of another facility, will produce smolts that will be used to test fish passage efficacy through LBC during Phase 1 of the program for this species or to supplement run building efforts during the first fish generation of Phase 2. Returning adults that reared as juveniles above PRB will be passed upstream to spawn naturally once the program enters Phase 2, but will be incorporated by hatchery managers into a supplementation broodstock if the spring Chinook salmon reintroduction effort experiences an extended Phase 1. Unless there are severe broodstock shortfalls during Phase 2, all returning adults will be allowed to spawn upstream of PRB. If there are such shortfalls, no more than 15 percent of returning male and 15 percent of returning female spring Chinook salmon identified from upstream releases would be utilized as supplementation broodstock in any given run year.

The intent of the spring Chinook salmon reintroduction program will be to establish self-sustaining, harvestable runs that are independent of hatchery support as soon as is feasible. As conceived, this means that the program will place a large number of pathogen-screened juvenile fish into the system in as small a number of fish generations as is practical, and then allow the developing fish runs to separate from hatchery support. Supplementation of adult runs that are able by themselves to spawn about 50 percent or more of the maximum number of smolts
available habitat can produce should not occur because this would likely work against the growth of a locally adapted population, both from a genetic standpoint and by causing density-dependent reductions in the survival of juveniles spawned by the natural run. Further supplementation after a small number of fish generations may be necessary at some point, depending upon fish performance; however, if the runs are subject to substantial long-term hatchery influence, it is anticipated that strong local adaptations and self-sustaining and harvestable runs will not develop.

Unless there is an unforeseen lack of broodstock, the initial supplementation effort for spring Chinook salmon within each subbasin will not extend beyond three fish generations, the number the HSRG (2004) has suggested as an upper limit for conservation-focused hatchery programs. It is believed that this number of generations, at a maximum, will be sufficient to raise upper basin spring Chinook salmon abundance to the point that the fish should be given an opportunity to test their ability to sustain themselves without artificial support.

5.1.2.5. Vision of success.
The preliminary escapement goal that Fish Managers have suggested for a future run of upper basin spring Chinook salmon is 1000 adults above PRB annually, with fish passage provided at Opal Springs Dam. However, it would seem quite optimistic to expect to see this number of adult fish returning on a consistent basis early in what is likely to be a long-term effort to rehabilitate habitats and build the run. Figure 5-5 summarizes output from a simplistic simulation of how a spring Chinook salmon run into the Metolius River subbasin might build during the first couple of decades of the reintroduction effort. Reestablishment of a reasonably stable run in the Metolius River subbasin that was not dependent on hatchery support while contributing to in-basin fisheries downstream, accompanied by significant progress in rehabilitating habitat and restoring runs elsewhere in the upper basin, would be a significant accomplishment.
Figure 5-5. Simulation of fry release pattern, natural smolt production, and run building for spring Chinook salmon in the Metolius River subbasin, assuming large, short-duration releases of juvenile fish consistent with this Reintroduction Plan.

This simulation is presented for illustrative purposes, not to indicate knowledge of the future for spring Chinook salmon in the Metolius River subbasin.
5.2. SOCKEYE SALMON

A more refined and specific plan for this species is under development by the Fish Managers in coordination with members of the Fish Committee. Greater specificity on future efforts to reintroduce sockeye to areas above PRB will be provided in a Second Edition of the Reintroduction Plan.

5.2.1. Stock selection.
Sockeye salmon historically migrated up the Deschutes and Metolius River subbasins, and then Lake Creek and through Suttle Lake to spawn in Link Creek. The anadromous portion of this stock was lost early in the century due to small dams on Lake Creek (Nehlsen 1995). With the creation of LBC in 1964, *O. nerka* quickly colonized this reservoir. Some anadromous *O. nerka* enter the Pelton Trap most years. Otolith microchemistry indicates that the maternal parent of some of these were kokanee (Zimmerman and Ratliff 1999) suggesting that these are kokanee migrants that survived turbine passage. The Fish Committee and management agencies have indicated that with fish passage at Lake Billy Chinook, it will be desirable to attempt to develop an anadromous run of sockeye from the native *O. nerka* that have evolved within the Deschutes River Basin. Therefore, attempts will be made to develop a sockeye run from kokanee within the system.

5.2.2. Fish reintroduction.
The large numbers of kokanee fry annually rearing in LBC (Thiede et al. 2002), provide an excellent opportunity to restore a sockeye population in original habitats of Suttle Lake and Link Creek and in new habitat created by LBC. Juvenile kokanee that exhibit migratory behavior and enter downstream collection facilities will be marked and released downstream from PRB into the Deschutes River. Marked adults returning to the Pelton Fish Trap known to have originated from the upper Deschutes River subbasin could then be passed upstream to spawn naturally or moved to Round Butte Hatchery for propagation, and subsequent juveniles released upstream.

Applying principles of adaptive management will be critical to understanding and responding to reservoir and population changes in order to achieve long term management goals for kokanee and sockeye. Options may include restricting *O. nerka* numbers passed downstream, and altering total annual mortality by addressing natural and harvest mortality.
5.3 OTHER ANADROMOUS SPECIES

5.3.1. Summer/fall Chinook salmon.
With the exception of a few years in the mid-1970s, summer/fall Chinook salmon have never been reared in Deschutes River Basin hatcheries. The summer/fall run enters the lower Deschutes River from June through December, with most fish spawning from mid-October through November. The early portion of this run moves up over Sherars Falls early in the summer, and some fish enter the Pelton Fish Trap during June and July. These fish may be related to summer/fall Chinook salmon that historically spawned in mainstem reaches at and upstream of PRB. If it is decided to reintroduce summer/fall Chinook salmon above PRB, these early-run wild Chinook salmon entering the Pelton Fish Trap during June and July should be the priority for brood stock.

Summer-fall Chinook salmon will be included in Phase 1 sentinel studies along the mainstem Deschutes and Crooked Rivers above LBC in order to assess possible vulnerability to *C.shasta* and other effects.

5.3.2 Pacific lamprey.
Pacific lamprey currently ascend the Deschutes River, and are known to spawn in Shitike Creek and the Warm Springs River (Graham and Brun 2003). Some Pacific lamprey historically moved upstream above PRB, but the number is unknown. No lamprey have been captured in the Pelton Fish Trap, or observed in the Deschutes River between the Reregulating Dam and Shitike Creek, since the early 1970s.

Pacific lamprey are a culturally significant resource for the CTWSRO and it is anticipated that the native Deschutes population of the species will be enhanced, and potentially reintroduced upstream of PRB. However, at this time there are many uncertainties remaining about the lamprey’s status within the basin and its potential for reintroduction. Given these uncertainties, a first step toward deciding whether or how to reintroduce the species above PRB is to build the knowledge base.

A plan is now under development to: (1) increase the knowledge base for Deschutes lamprey; (2) study and inventory potential habitat for Pacific lamprey both upstream and downstream of PRB; and (3) develop and implement a reintroduction and passage program if results of studies indicated passage of Pacific lamprey could be successful; or (4) trigger alternative mitigation if studies indicated that Pacific lamprey passage at PRB would not be successful. Relevant components of that plan will be incorporated into this Reintroduction Plan when available.
6. SCHEDULE

Under the present schedule, the first large-scale summer steelhead fry and smolt releases will occur in 2007 and 2009, respectively. Large-scale Chinook salmon egg collection and fry releases will first begin in fall 2007 and winter 2008 respectively, with smolt releases in 2009. All of these releases will be made in anticipation that the new surface intake and fish collection and handling facilities at Round Butte Dam will be operational in the spring of 2009.

7. FUTURE EDITIONS AND REVISIONS OF THIS PLAN

This edition of the Reintroduction Plan focuses on the initial procedures, stocks, and release numbers of spring Chinook salmon and summer steelhead for initiating runs of these two species upstream of PRB. Principles of adaptive management will be used to evaluate the success of these releases, and to make any changes necessary to enhance the development of these populations to sustainable and harvestable levels, as described in the Fish Passage Plan. More precise information on release reaches, numbers, and timing, will be proposed in the Annual Fish Passage Work Plan and documented in the Fish Passage Annual Report. Any substantial change in efforts that differs in a major way from this current plan for Chinook salmon and summer steelhead will be documented in a future edition of, or amendment to this plan.

A new edition or amendment is anticipated in the near future to describe plans to establish a population or populations of anadromous sockeye salmon that will use Suttle Lake, Lake Billy Chinook, and Lake Simtustus as fresh-water rearing areas, emigrate to the ocean from these water bodies through the downstream passage facilities at PRB, and return to spawn in the Metolius River subbasin. A future edition of this plan may also be produced that will describe efforts to establish populations of anadromous Summer-Fall Chinook salmon in main-stem habitats upstream of PRB. Also, multi-year studies of the habitat requirements and passage potential of Pacific Lamprey (PGE and Tribes 2006b) are currently underway. If these studies indicate that habitat exists for the reestablishment of Pacific Lamprey upstream of the Project,
and passage through the Project is possible, a future edition of this plan will detail this potential effort.
8. REFERENCES


Burke, J.L., K.K. Jones, and J.M. Dambacher. 2000. A summary compilation and rating of the channel habitat requirement of salmon and steelhead in the upper Deschutes River Basin. Aquatic Inventories Project, Oregon Department of Fish and Wildlife, Portland, OR.


ODFW and CTWSRO. 1990. The Deschutes River Subbasin Salmon and Steelhead Production Plan. Oregon Department of Fish and Wildlife. Portland, OR.


Settlement Agreement Concerning the Relicensing of the Pelton Round Butte Hydroelectric Project (FERC Project No. 2030)


Treaty with The Tribes of Middle Oregon 1855.


