OLYMPIC NATIONAL PARK

Elwha River Restoration Project

Bull Trout Protection and Restoration Plan

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This document outlines a strategy to protect bull trout during the removal of the two Elwha River dams, a project scheduled to begin in September, 2011. This is a watershed scale plan which identifies specific actions to be implemented for identified reaches of the Elwha River. This plan fulfills the requirements of RPM 1 of the USFWS 2000 Biological Opinion for the Elwha River Restoration Project.

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I. Introduction

Two dams on the Elwha River, Washington, (Figure 1) are scheduled for removal beginning in 2011 and continuing through 2013. Known as the Elwha River Restoration Project, or "Elwha Project", removal of the dams will restore anadromous fish passage to the Elwha River watershed and represents a major step in recovery efforts for a variety of fish stocks listed under the Endangered Species Act (ESA), including Puget Sound/Coastal bull trout (*Salvilinus confluentus)* (USFWS, 2004). The purpose of this paper is to describe the Elwha Project's plan to protect bull trout during dam removal. Specifically, this plan fulfills the requirement of the US Fish and Wildlife Service (USFWS) Biological Opinion (BiOp) for the Elwha Project (USFWS, 2000): "RPM 1. Develop and implement a bull trout rescue/removal plan that is acceptable to the FWS."

The USFWS completed the initial BiOp for the Project in 1996, covering bald eagle (*Haliaeetus leucocephalus*), marbled murrelet (*Brachyramphus marmoratus*), peregrine falcon (*Falco peregrines*), and spotted owl (*Strix occidentalis caurina*). On February 24, 2000, the USFWS issued a revised BiOp which addressed potential impacts of the project on bull trout (*Salvelinus confluentus*), which was listed as a threatened species in 1999. The revised BiOp was based upon information provided in a number of documents, including the project's environmental impact statements (EIS) (DOI, 1996a; DOI, 1996b), the USFWS's Biological Assessment (USFWS, 1996) and other relevant information. Olympic National Park (OLYM) reinitiated Section 7 consultation with the USFWS in 2006 based upon changes in actions which were evaluated in a supplemental EIS (DOI, 2005), but the USFWS determined that the changes in the project did not require an update in the original BiOp.

Elwha project description

The Elwha Dam, located at rkm 7.9, has blocked upstream fish passage for 100 years. Since 1910, when construction of the dam began, more than 110 km of mainstem and tributary habitat in the watershed (DOI et al. 1994) have been inaccessible to anadromous fish. In 1927 the Glines Canyon Dam was constructed 13.7 km upstream of the Elwha Dam. Like the Elwha Dam, the Glines Canyon Dam was built without fish passage capability. In combination, the two dams disrupt the migrational pathways for the resident, migratory, and anadromous fish populations of the Elwha River.

The two Elwha River dams not only block passage of fish but also have interrupted the natural function of the river ecosystem. Nearly 14 million cubic meters of sediment have been captured in the two reservoirs (DOI et al 1995), altering spawning habitat and channel morphology in the lower river system, as well as the estuary and nearshore environment to the east and west of the river mouth—an area that extends from Ediz Hook to Crescent Bay (Clallam County MRC 2004). The recruitment of large woody debris (LWD) from the upper watershed has been

virtually eliminated and the two reservoirs serve as "heat sinks" during the summer, dramatically increasing water temperature. Consequently, the cumulative effects of the two dams leave the freshwater and marine habitat available to salmon below the Elwha Dam severely degraded. The presence of these two dams has been identified as the single largest factor limiting Elwha River salmon production (WSCC 2000), including Chinook salmon, steelhead trout, and bull trout, which are all listed as threatened under the ESA.

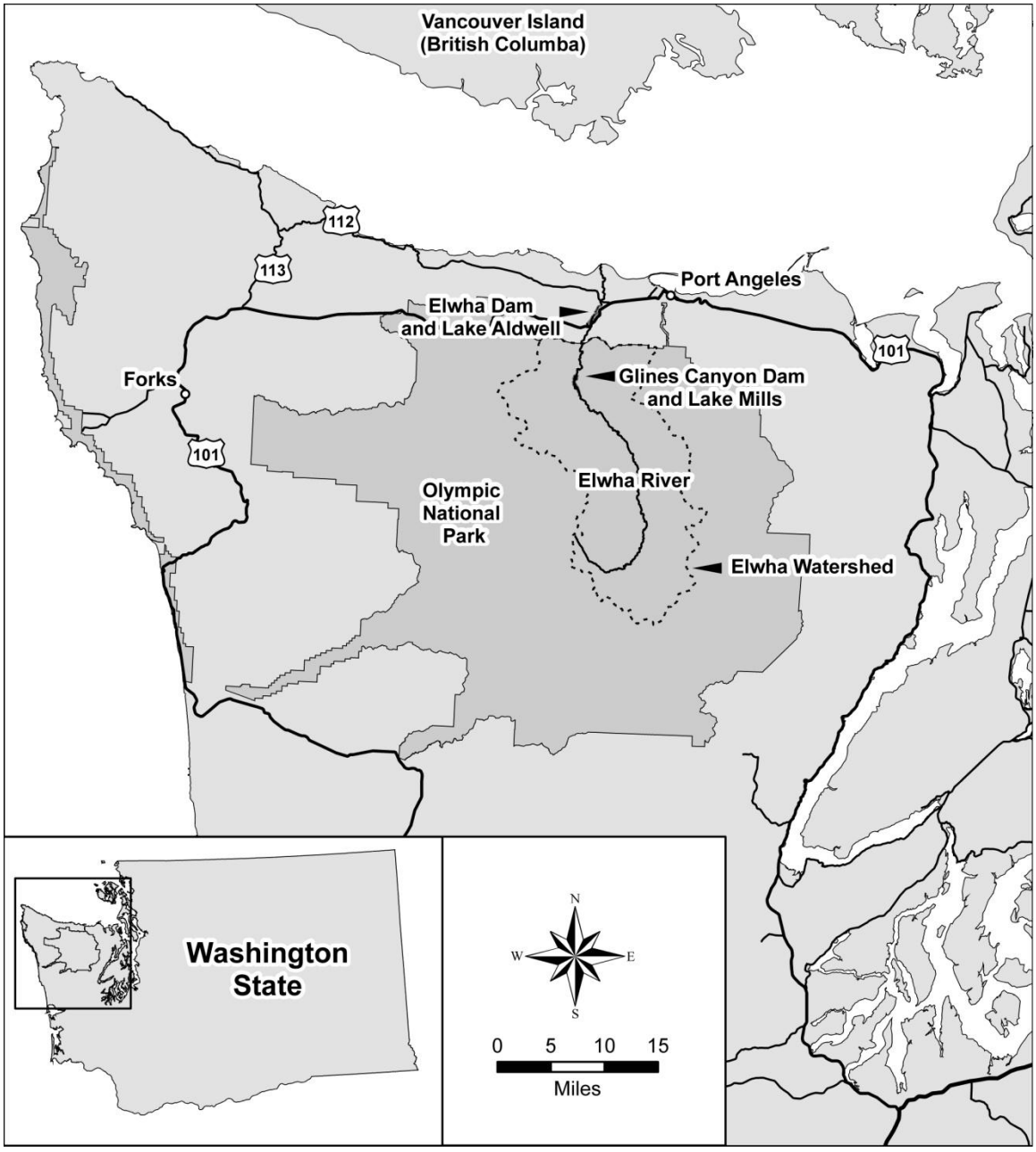

Figure 1. Elwha Watershed.

Removal of both dams is scheduled to begin in 2011. Demolition of both structures will occur simultaneously over a two to three year period, although the strategy for removal will differ for each site. The Elwha River will be routed around the Elwha Dam through a diversion channel so that the dam structure, facilities, and rubble upstream of the dam can be removed "in the dry". Flow will be returned to the original channel once dam removal is completed. Conversely, the Glines Canyon Dam will be removed in sections, with stream flow allowed to pass over the dam. The reservoir will be drained approximately 25 meters through the existing penstock and the upper 25 meters of the structure will be removed. Then, the dam will be sequentially notched using either a diamond saw or controlled explosives. With each notch, the reservoir will drain to the elevation of the notch, resulting in a pulse of increased flow.

As the two reservoirs drain, delta materials at the head of the reservoirs will be eroded by the river. Fine sediments in the delta will be suspended and moved through the reservoir while the courser materials will be eroded and then redeposited along the lake floor. It is anticipated that the remnant Lake Mills reservoir will be fully filled with sediment when about 10 meters of the Glines Canyon Dam structure is remaining. This courser sediment may be released in a single event when the structure is fully removed.

During the period of delta erosion, it is anticipated that turbidity will exceed 1,000 parts per million (ppm) for extended periods of time and will periodically exceed 10,000 ppm (Figure 2). Following dam removal, turbidity may exceed 30,000 ppm for short durations (BOR 1996), although most of the finer material will be flushed out of the system after the first high flow.

At relatively low levels of suspended sediment loading (50 – 100 ppm) which occur naturally in the Elwha River, fish may stop feeding, suffer from gill abrasion, and suffer a loss of fitness due to stress (Cook-Tabor, 1995). At higher levels of turbidity more serious affects on fish health are observed, including mortality directly associated with turbidity levels higher than 1,000 ppm for extended periods of time (Cook-Tabor, 1995). For planning purposes, it has been assumed that most fish rearing in the mainstem Elwha River below Glines Canyon Dam may die due to exposure to extreme levels of turbidity. Therefore, a high priority has been placed on maintaining access to high quality tributary and off-channel habitat which can serve as refugia.

In addition to refugia habitat, the demolition schedule for the two dams has built-in "fish windows" when construction will stop (Ward et al, 2008). During these periods, the river will clear to near background levels, facilitating natural migration, spawning, and collection of broodstock in the lower river. These fish windows will occur at least three times each year: 1 November to 31 December for coho and chum salmon entry timing, 1 May to 30 June for hatchery reared juvenile emigration and native steelhead entry timing, and 1 August to 14 September for Chinook and pink salmon entry (Figure 3). Additionally, construction may be periodically halted at higher flows for safety reasons.

Courser sediment will move downstream for a period of years, with elevated bedloads anticipated for up to 10 years (BOR 1996). Significant aggradation is expected in some areas, with permanent increases of up to 1 meter in bed elevation in lower gradient areas. The river channel in some reaches below the dam may destabilize during this time, resulting in temporary decreases in the quality of natural fish habitat.

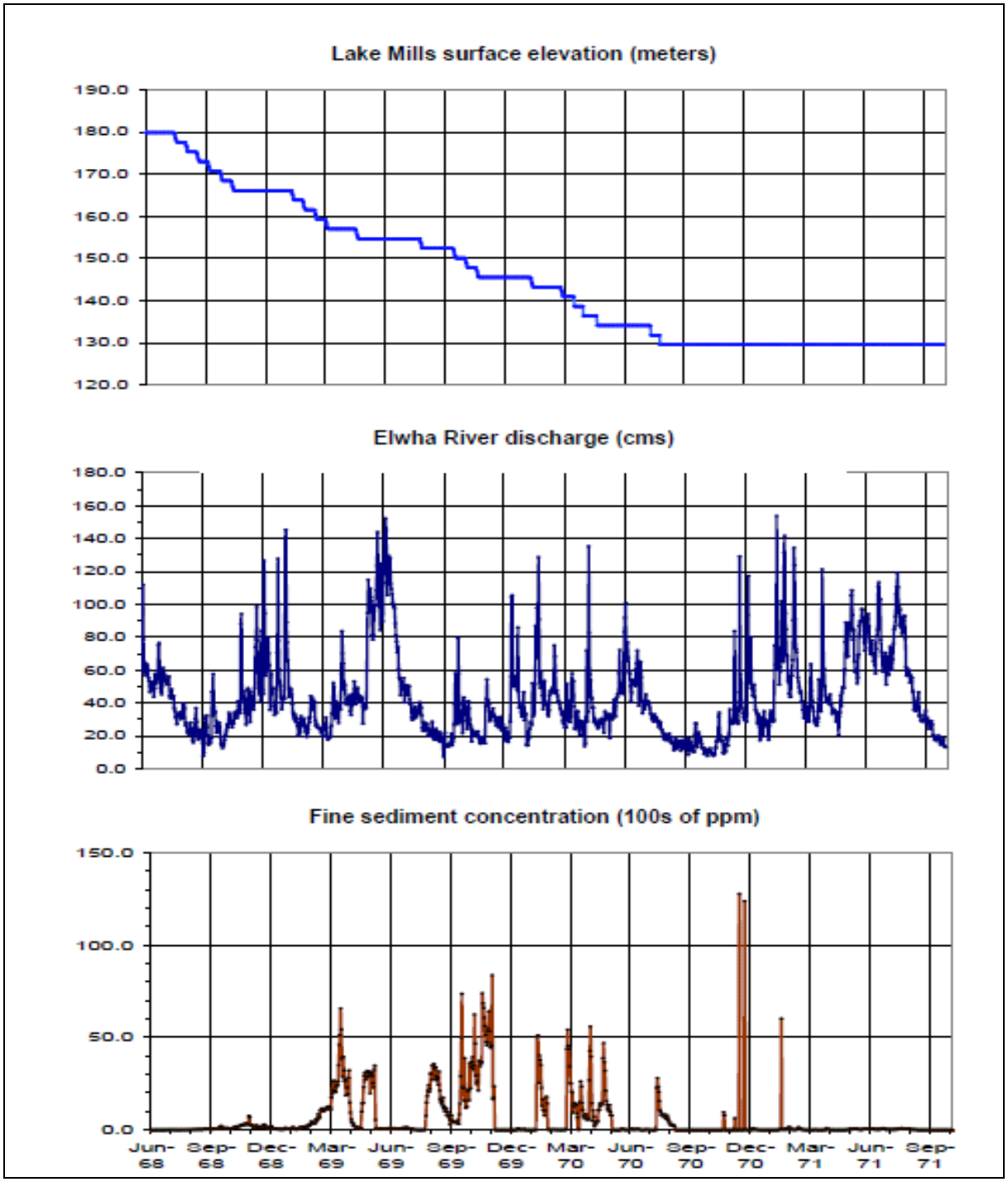

Figure 2. Modeled Lake Mills surface elevations, Elwha River discharge, and suspended sediment concentrations: 1968–1971 flow scenario (BOR 1996).

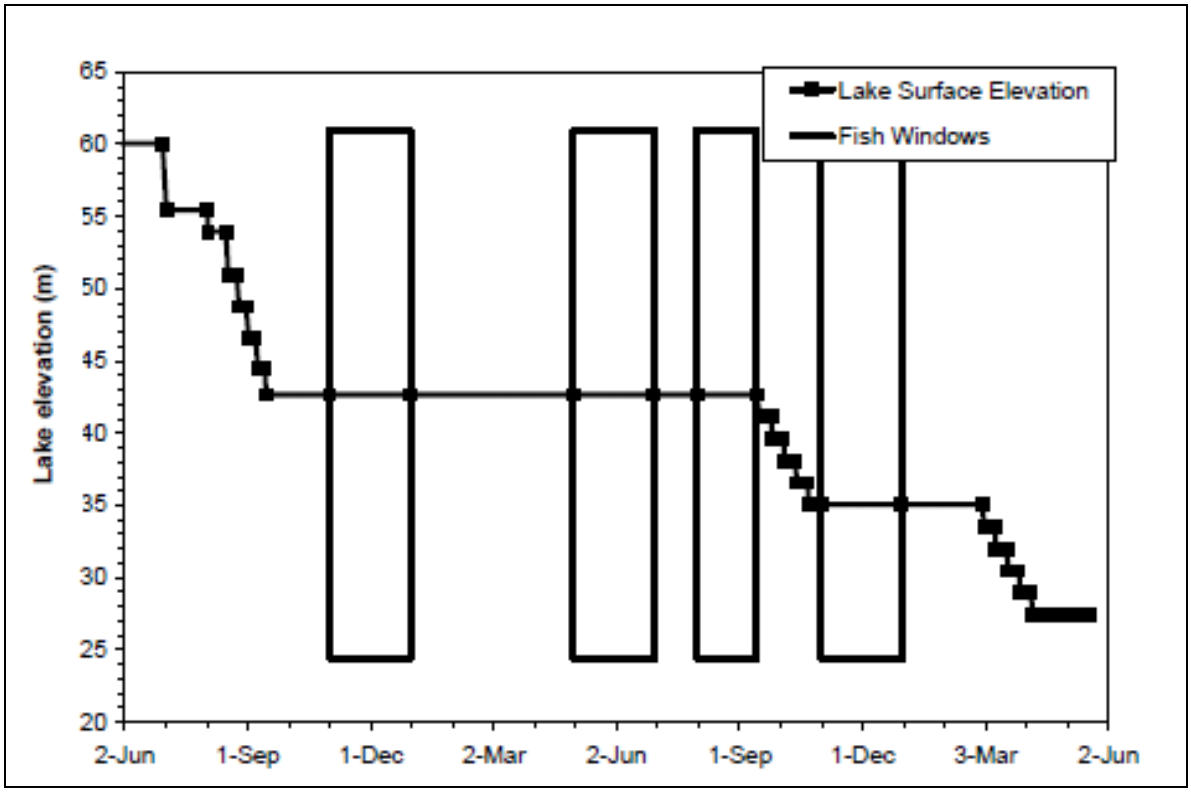

Figure 3. Elwha River drawdown schedule with fish windows.

II. Bull Trout Populations in the Elwha River

Current distributions and life histories

Bull trout are distributed in the Elwha River from the mouth to approximately rkm 69, near the headwaters (Glasgow, 2000). Bull trout have also been observed in 12 tributaries to the river (Brenkman et al, 2008) and may be present in others. Elwha River bull trout exhibit fluvial and adfluvial life history strategies and may be anadromous below Elwha Dam. At least one bull trout has been captured in the estuary at the mouth of the Elwha (Anne Shaeffer, pers. com.). There also appears to be a resident population comprised of small sized bull trout in the headwaters above Carlson Canyon (DeHaan et al, 2010).

From 2005 to 2008, OLYM tagged 53 adult (>400 mm) and 46 sub-adult bull trout (<400 mm) in the Elwha watershed with Lotek radio tags. Fish were tagged in a number of locations in the watershed, including areas above Grand Canyon, between Rica Canyon and Grand Canyon, Lake Mills, the area of the river between the dams, and below Elwha Dam (Figure 4). Fish movement was tracked using a combination of fixed telemetry stations, aerial surveys, and foot surveys.

Tagged fish exhibited a diversity of migration patterns, depending upon their location in the watershed (Figure 5). A few tagged fish located above Grand Canyon and between the two dams tended to display a fluvial migration, moving upstream in the fall in an apparent spawning migration. Fish located in Lake Mills displayed a clear adfluvial migration, moving out of the lake and into the lower reaches of Rica Canyon to spawn in the fall. These fish then moved back down into the lake to rear. Several fish tagged above Rica Canyon were observed to move downstream through the canyon and into the lake, but did not appear to migrate back upstream. A total of 23 (of 96) bull trout were observed to pass over a dam. Thirteen adult and seven sub-adults were observed to pass over the Glines Canyon Dam while 1 adult and two sub-adults passed over Elwha Dam (Figure 6). One sub-adult fish was observed to pass over both dams. Movement over the dams corresponded with high winter flow events. Fish below Elwha Dam moved short distances in the lower river.

No upstream movements of bull trout through Rica Canyon, Grand Canyon, or Carlson Canyon were observed, although habitat assessments conducted in 1987 (Hosey and Associates, 1988) did not identify the canyons as barriers to salmonid migrations. Radio tagged adult summer steelhead were observed to move upstream through both Rica Canyon and Grand Canyon (Wampler, 1984). However, none of the steelhead tagged in that study were observed to move upstream through Carlson Canyon.

Four adult bull trout were captured in early September (2007) below Glines Canyon Dam and relocated into Lake Mills. All of the relocated fish appeared to stay in Lake Mills into the spawning season (October). Two fish then fell back over the dam while the other two remained in the Rica Canyon area.

One spawning area in the main stem Elwha River was identified. This spawning aggregation is located in the lower reaches of Rica Canyon, immediately upstream from Lake Mills based on

redd surveys. A second presumed spawning location may be located near the confluence of Hayes River. Spawning has not actually been observed near Hayes River, but an individual radio-tagged fish was observed to make two upstream migrations to the area during the spawning season (October) in successive years. Bull trout are known to spawn in the Hughes Creek, a tributary between the Glines Canyon Dam and Lake Aldwell, while young-of-the-year bull trout have been observed in Boulder Creek (Lake Mills tributary), and juveniles have been seen in Cat Creek (Lake Mills tributary) and Griff Creek (middle river tributary) (Brenkman et al, 2008).

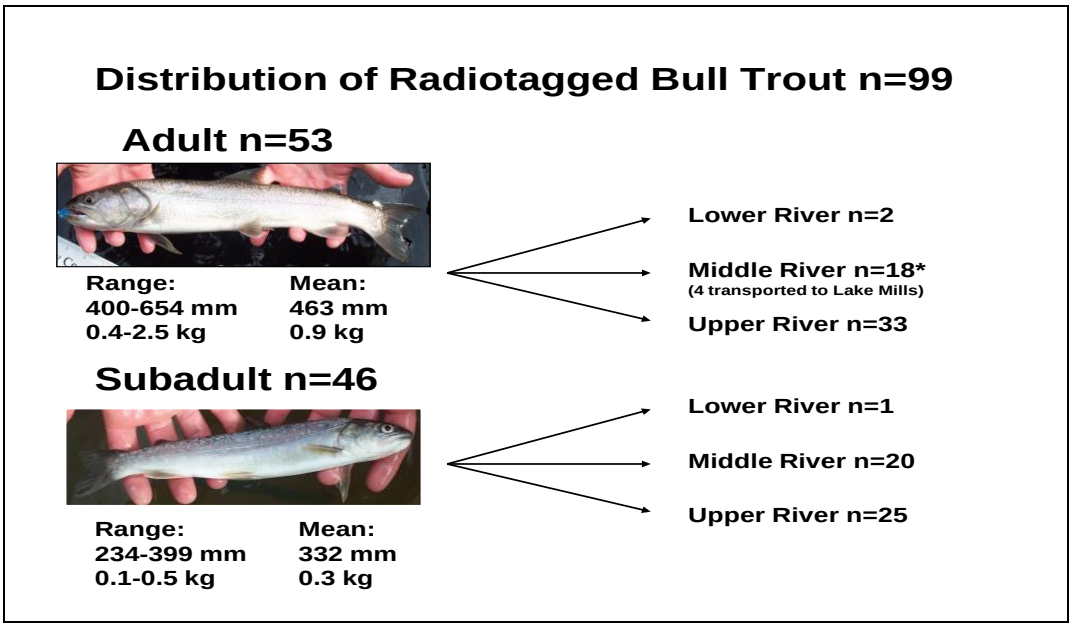

Figure 4. Distribution of Radiotagged Bull Trout.

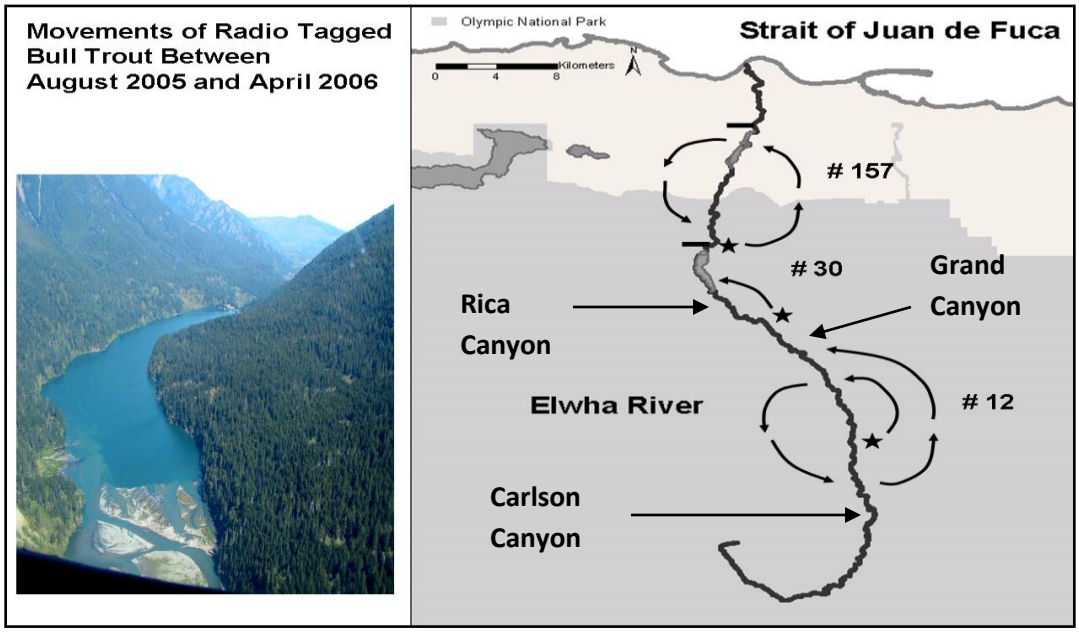

Figure 5. Movements of selected bull trout in the Elwha River (image by Steve Corbett).

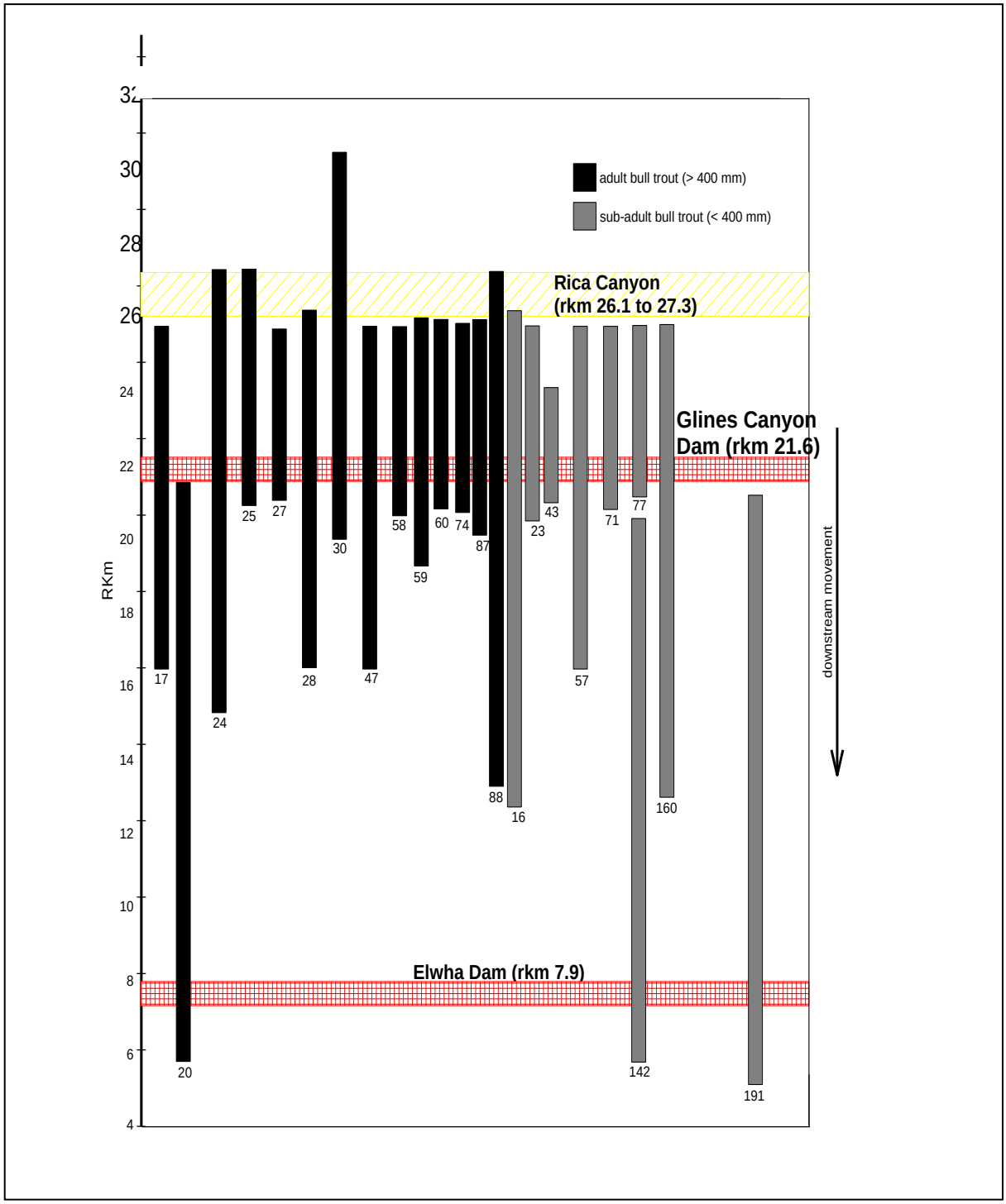

Figure 6. Movements of Elwha bull trout passed Glines Canyon and Elwha Dams.

Abundance and Productivity

Detailed riverscape snorkel surveys were conducted in the entire main stem river from the headwaters to the mouth for two successive years (2007 and 2008). More than 20 fisheries biologists participated in the surveys each year. These surveys occurred during a one week period in the late summer, and therefore represent a snapshot in time of relative abundance and distribution of fish. Divers did not survey Lake Mills and Lake Aldwell, and were unable to survey Rica and Grand Canyons in 2007 and 2008. Additionally, in 2008, we did not sample two sections (rkm 40 and 44-47) due to safety concerns and poor water visibility.

The snorkel surveys confirmed that bull trout were found throughout the watershed, though they were relatively sparse (215 fish in 2007; 118 bull trout in 2008). From a riverscape perspective, rainbow/cutthroat trout were the dominant fish and comprised 89% and 88% of the total fish assemblage in 2007 and 2008, respectively. Bull trout comprised 3% of the fish assemblage in both years (Figure 7).

The highest abundances of bull trout were observed immediately upstream of Lake Mills and near the headwaters of the river in both years (Figure 7). Of the total numbers of bull trout observed in 2007 and 2008, 60% and 69% respectively were observed from Rica Canyon downstream to the river mouth in the area that will be influenced by dam removal. We believe that a number of fish also reside in Lake Mills and Lake Aldwell.

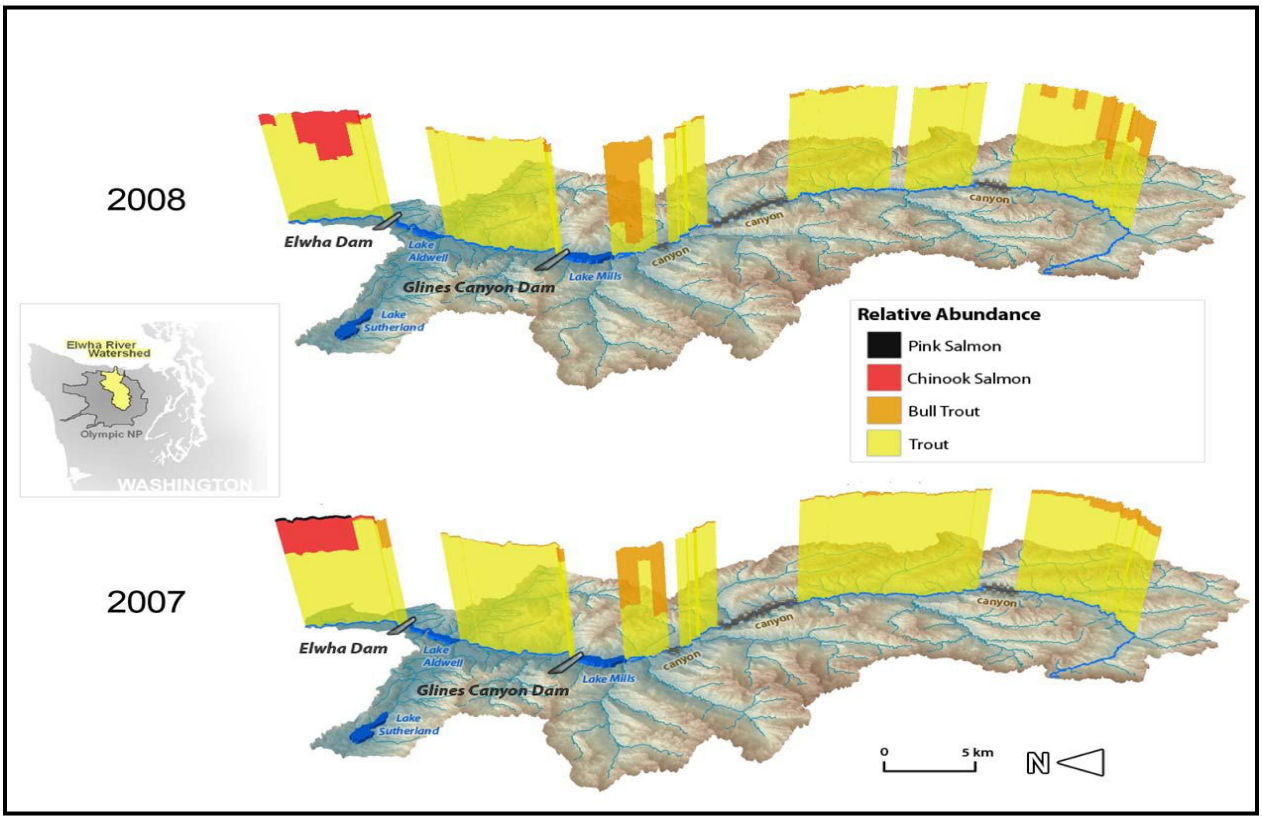

Figure 7. Relative abundances of salmonids in the Elwha watershed – 2007 and 2008 (image by Ethan Welty).

Hydroacoustic surveys were conducted in Lake Mills and Lake Aldwell in the summer, 2010 in an attempt to enumerate fish abundances in the two reservoirs. Unfortunately, the large amount of standing timber remaining in the two reservoirs interfered with the ability of the acoustic gear and associated software to distinguish individual targets (personal communication, Jeff Duda, USGS). Abundance estimates for Lake Mills ranged from a low of 62 fish (>25 cm) to a high of 711 fish (>25 cm) while estimates from Lake Aldwell ranged from 42 to 365 fish (>25 cm) (Provisional Data from the USGS Western Fisheries Research Center, provided by Jeff Duda, 11/3/2010). This information was further complicated by the inherent inability of acoustic gear to differentiate between species. Hook-and-line sampling in Lake Mills conducted in conjunction with the acoustic surveys collected 5 bull trout and 29 rainbow trout in 13.75 angler hours, so one might conclude a 6:1 ratio of rainbow to bull trout. It is unknown if catchability coefficients for the two species are equivalent in the lake.

Both the snorkel surveys and the radio telemetry project provided an opportunity to observe size characteristics of the Elwha bull trout population. The headwaters population had a noticeably reduced body size in relationship to the rest of the river, and may represent a "resident" population. Throughout the watershed, Elwha River bull trout were found to be of poor fitness, being uniformly lighter at any given length than populations found in other river systems (Figure 8). This poor fitness is likely the result of a limited food supply due to the elimination of anadromous salmonids from the watershed.

Figure 8. Top – Elwha River bull trout. Bottom – Hoh River bull trout.

It has been difficult to assess the reproductive success of bull trout in the Elwha River, as juvenile bull trout tend to be difficult to detect. Systematic snorkel surveys conducted in 2009 (Dunham et al, 2009) identified small bull trout in only 1 of 41 sites (2%). Juvenile bull trout were collected in higher numbers via electro-fishing (22% of the sampled sites) and yet larger bull trout were observed in 34% of the snorkel sites. Brenkman et al (2008) documented young-of-the-year bull trout in only two tributaries below Rica Canyon (Hughes Creek and Boulder Creek) while juveniles (50-200 mm) were reported in Hughes, Griff, Boulder, Cat, Long, Stony, Godkin and Buckinghorse Creeks and Lake Mills.

Genetic diversity and relationship to adjacent populations

Tissue samples from Elwha River bull trout have been analyzed by the Conservation Genetics Lab at the USFWS Abernathy Fish Technology Center to determine the genetic relationship of fish within the watershed as well as the relationship of Elwha fish to the Dungeness River. Fish collected from the upper river (Lake Mills to Hayes River) (n=25), middle river between the two dams (n = 36), and lower river (n=21; excluding headwater fish) were genetically indistinguishable from each other (DeHaan et al, 2010).

Analysis of tissue samples (n=17) collected from the char which inhabit the headwaters confirmed that they were bull trout and not the closely related Dolly Varden. However, it was found that the headwater fish, though similar to the remainder of the basin, were identifiable as a discrete sub-population (DeHaan et al, 2010).

There was no evidence of depressed allelic richness or gene diversity (Winans et al, 2008). Evidence from the radio-telemetry study suggested that current genetic exchange between different sub-areas of the river may be a "one-way street", as no migration was observed upstream through several canyons or, obviously, over the two dams. This is largely supported by the genetic data, although it does appear that some upstream gene flow through Carlson Canyon does occur. Six of 17 fish collected in the Elwha headwaters were more similar to fish from the lower river than they were to the headwaters (DeHaan et al, 2010) (Figure 9).

Elwha River bull trout were compared to Dungeness River bull trout, as well as other bull trout populations in western Washington State, and found to be genetically distinct (Figure 10) (Winans et al, 2008; DeHaan, 2010). There had been some disagreement as to whether methods used to analyze tissue samples from the two basins were compatible. Tissue samples from the Dungeness River were collected by the USFS (Larry Ogg) and analyzed by Paul Spruell. Elwha River tissues samples were collected by OLYM and analyzed by Pat DeHaan (USFWS). Replicate sampling by the USFWS Abernathy Lab confirmed the initial finding (DeHaan, 2010).

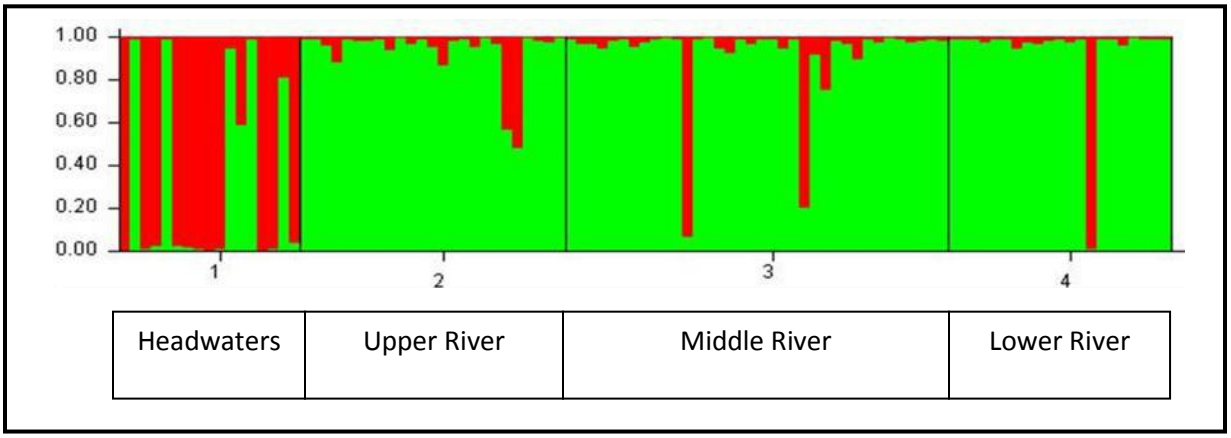

Figure 9. Elwha Bull Trout Genotypes. Each vertical bar represents an individual fish. Colors represent portion of each individual's genotype that originated from each of two population clusters. (Copied with permission from DeHaan et al, 2010.)

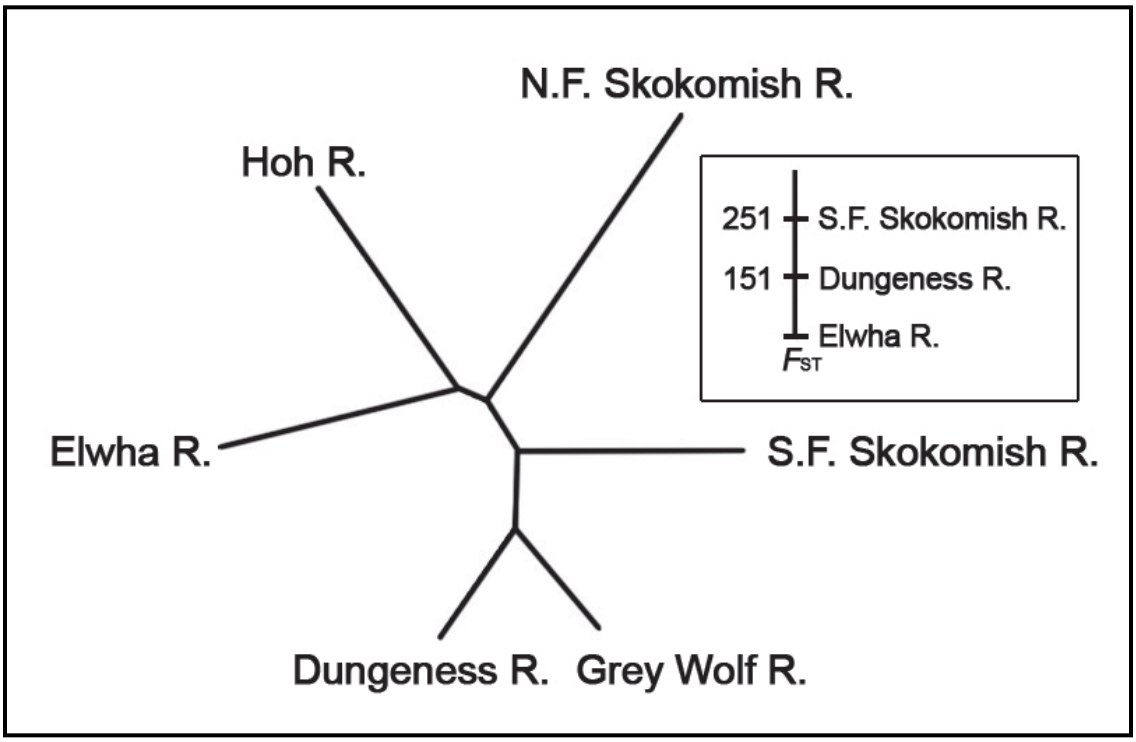

Figure 10. (Copied with permission from Winans et al, 2008). Consensus neighbor-joining tree of CSE chord distances between bull trout collections based on 6 mSAT variability. Bootstrap values at the nodes are not available. F_{ST} values (x 1000) for select comparisons against the principle Elwha collection are statistically significant.

III. Plan Goals and Objectives

Goals and objectives have been identified to minimize ESA take of bull trout during dam removal, and to facilitate restoration. The goals and objectives are targeted to discrete sections of the river based upon our understanding of the river's bull trout population, the relative impact of dam removal on each section, and the long term restoration objective for bull trout (Table1).

For the purposes of this plan, goals are defined as specific, measurable, time-targeted aims to be achieved by the actions described. Objectives are positive strategic actions which, if implemented, will lead to the achievement of the identified goals. These objectives generally address anticipated threats associated with dam removal, including (in order of importance):

1) Mortality associated with increased turbidity from Lake Mills to the mouth during and shortly following dam removal;
2) Mortality associated with entrainment at each dam site;
3) Stranding of multiple life history stages during reservoir draw down;
4) Loss of current bull trout spawning and rearing habitat in impacted reaches;
5) Threats associated with recolonization of hatchery and wild Pacific salmonids (e.g. introduction of pathogens, predation, competition, etc.);
6) Risk of barriers/loss of connectivity upstream of Lake Mills during reservoir drawdown;
7) Mortality following dam removal associated with redistribution of course sediment below Glines Canyon Dam (stranding or mechanical grinding of eggs).
8) Genetic introgression with non-native Eastern brook trout;

This plan considers the Elwha River as five discrete sections: the Headwaters (Carlson Canyon upstream to the headwaters); the Upper River (Above Rica Canyon upstream to Carlson Canyon), the Lake Mills area (Rica Canyon downstream to Glines Canyon Dam), the Middle River (Glines Canyon Dam downstream to the Elwha Dam), and the Lower River (Elwha Dam downstream to the mouth). Approximately 40% of the Elwha River bull trout population resides above Rica Canyon excluding the reservoirs and canyon reaches. The highest concentration (>25% of the total population) of bull trout is found upstream of the Lake Mills inlet and in Rica Canyon based on riverscape snorkel surveys conducted in 2007 and 2008. This area additionally encompasses the largest identified spawning aggregation in the watershed.

There will be a shift in bull trout life history strategies associated with removal of the two Elwha River dams. Most importantly, the loss of the two reservoirs will immediately eliminate the prominent, although not historical, adfluvial strategy in the Lake Mills and Middle River areas, except as may be provided by Lake Sutherland after dam removal.

Bull trout are known to exhibit anadromous behavior on the Olympic Peninsula (Brenkman and Corbett 2005; Brenkman et al., 2007). Although anadromy has not been specifically observed in the Elwha River, it is believed that such a life history strategy will be expressed/re-expressed when regular access to saltwater is provided. Multiple radio-tagged bull trout were observed to pass over the Elwha Dam or Glines Canyon Dam, and at least one fish passed over both dams, indicating that significant downstream migration still occurs in the river. One bull trout has been captured in a beach seine sampling in the estuary (Shaffer, pers. com.).

Table 1. Goals and Objectives

River Section	Risk	Goals	Objectives	Action
Headwaters	1. Genetic introgression with downriver bull trout 2. Interaction with out-planted hatchery fish	1. Maintain or increase current abundance and distribution of the headwater population of bull trout. 2. Maintain the genetic integrity of the headwater population of bull trout.	1. Prevent introduction of bull trout from other areas. 2. Minimize or prevent mortality associated with stocking of hatchery salmon in the watershed.	1. Refrain from relocating any bull trout to the headwaters. 2. Closely adhere to hatchery fish health strategy. 3. Carefully consider hatchery stocking strategy, particularly with regards to Chinook salmon.
Upper River	1. Genetic introgression with non-local populations 2. Interaction with out-planted hatchery fish	1. Maintain or increase current abundance and distribution of the Elwha River bull trout population. 2. Maintain the genetic integrity of Elwha River bull trout.	1. Prevent introduction of non-local populations of bull trout (e.g. Dungeness). 2. Minimize or prevent mortality associated with stocking of hatchery salmon in the watershed.	1. Refrain from relocating Lower River bull trout to the Upper River. 2. Closely adhere to hatchery fish health strategy 3. Carefully factor in bull trout status with respect to hatchery stocking strategy
Lake Mills	1. Elevated turbidity 2. Stranding on Lake Mills delta 3. Barriers to migration 4. Interaction with out-planted hatchery fish.	1. Maintain the genetic integrity of Elwha River bull trout. 2. Protect access to clean water refugia in Lake Mills area. 3. Minimize direct take, to the extent possible.	1. Minimize mortality associated with high levels of turbidity. 2. Minimize stranding during reservoir drawdown and delta manipulation. 3. Ensure upstream passage into Rica Canyon, Cat Creek, and Boulder Creek. 4. Protect spawning habitat in Rica Canyon from scour from October to June, to the extent possible.	1. Relocate ~100 bull trout (~30 adults minimum) to the Upper River, prior to final drawdown. 2. Monitor for stranding and development of barriers during drawdown and delta work. 3. Relocate stranded fish to lower Rica Canyon or Cat Creek. 4. Correct barriers that develop as a result of dam removal, to the extent feasible. 5. Relocate stranded fish to Elwha Hatchery/Lower River (option). 6. Carefully factor in bull trout status with respect to hatchery stocking strategy/fish health.

Table 1 (cont.). Goals and Objectives

River Section	Risk	Goals	Objectives	Action
Middle River	1. Elevated turbidity 2. Barriers to migration into tributaries 3. Stranding on Lake Aldwell delta 4. Barriers to migration on Lake Aldwell delta 5. Interaction with out-planted hatchery 6. Genetic introgression with brook trout.	1. Maintain the genetic integrity of Elwha River bull trout. 2. Protect access to clean water refugia in the Middle River area. 3. Minimize direct take, to the extent possible.	1. Ensure upstream access into tributaries. 2. Ensure upstream access from Lake Aldwell into the Middle River. 3. Minimize stranding during reservoir drawdown.	1. Monitor bull trout use of tributary habitat. 2. Monitor passage through culverts 3. Monitor for stranding and development of barriers on Lake Aldwell delta. 4. Relocate stranded fish to Little River. 5. Control brook trout in Elwha Campground tributary and consider options for other areas. 6. Correct barriers that develop as a result of dam removal to the extent feasible. 7. Carefully factor in bull trout status with respect to hatchery stocking strategy/fish health.
Lower River	1. Elevated turbidity 2. Barriers to migration into off-channel and estuary habitat 3. Interaction with out-planted hatchery fish. 4. Genetic introgression with brook trout.	1. Maintain the genetic integrity of Elwha River bull trout. 2. Protect access to clean water refugia in the Lower River. 3. Protect access to salt water refugium. 4. Minimize direct take, to the extent possible.	1. Ensure access to off-channel freshwater habitat to serve as clean water refugia. 2. Ensure access to saltwater to serve as clean water refugia. 3. Prevent mortality during brood stock collection activities for other salmonid species.	1. Monitor bull trout use of off-channel and estuary habitat. 2. Monitor access to off-channel and estuary habitat 3. Monitor bull trout presence at weir. 4. Correct barriers to off-channel habitat, if feasible. 5. Carefully factor in bull trout status with respect to hatchery stocking strategy/fish health. 6. Consider options for controlling brook trout in the Lower River.

Challenges to Implementation

The Elwha Project is the largest dam removal project ever undertaken in the United States. Conceptual, computer, and physical models have been developed to predict delta erosion, sediment transport, sediment deposition, and suspended sediment concentrations during and following dam removal. However, it is unlikely that actual conditions during and following dam removal will exactly match modeled conditions. Careful monitoring of delta erosion and suspended sediment loading will be conducted which will inform the dam removal process as well as operation of the water treatment facilities below the Elwha Dam site. Decisions to proceed with dam removal will be made on a weekly basis. Any efforts to protect bull trout during dam removal will need to be coordinated with dam removal activities.

The Lake Mills and Lake Aldwell deltas have been found to support a proportionally higher abundance of bull trout than other areas of the river. The act of dam removal will cause relatively rapid changes to both the lake and the delta, ultimately resulting in the complete loss of these two habitat types. As lake levels recede, the lake and delta areas will become progressively more difficult to reach. Lake Mills is accessible by road at its north end, but the delta area is only accessible by boat or trail. The use of motorized vessels on both lakes may become unfeasible and/or unsafe relatively early in the removal process.

Capture, holding, and transport of bull trout from the delta area will be difficult once the deltas begin to erode. Drawdown studies conducted during the fall of 2010, 2001, and 1994 showed that the river channel on the delta was extremely unstable, avulsing across the nose of the delta in the matter of just days or hours. As the deltas erode, turbidity will increase while the distance to clean water refugia (e.g. Cat Creek, Rica Canyon, Boulder Creek, and Little River) will also increase.

During drawdown, visibility may be very poor, limiting options for monitoring bull trout response to changes in the deltas. The USGS found suspended sediment concentrations on the delta to be as high as 6,100 mg/l during the 1994 drawdown (USGS, 1999), although concurrent concentrations in Lake Mills and below Glines Canyon Dam were considerably lower (~100 mg/l and ~20 mg/l respectively). The 1994 drawdown study also found that that the channel incised 20 feet or more, making foot access from upland areas hazardous.

Rapid erosion of the lake delta is an important aspect of the dam removal process. If the deltas do not naturally erode as expected, mechanical manipulation of the channel and delta with heavy equipment may be required. Access to the deltas may be limited at times for safety purposes.

Figure 11. Bank Erosion on Lake Mills delta during 1994 drawdown.

IV. Action Plan

General Approach

The policies for the National Park Service (NPS, 2006) direct that natural resources be managed "*to preserve fundamental physical and biological processes*" (Section 4.1). In general, this is interpreted to mean utilizing the least invasive methods for achieving any given management objective. The 2006 NPS Management Policies also direct that the service shall act proactively to "*conserve* [ESA] *listed species and prevent detrimental effects to these species*". To the extent possible, we rely on natural processes in this plan to protect Elwha River bull trout during dam removal. We recognize that it will be necessary to intervene on occasion to minimize direct take addressed under the BiOp for the Elwha Project. Table 2 summarizes actions which will be taken to conserve and protect Elwha River bull trout during dam removal.

Nearly 37 km of the main stem Elwha River and its associated tributaries above Lake Mills will remain unaffected by dam removal (>60% of the available fish habitat). This area supports approximately 40% of the river's bull trout population, including representatives of both the headwaters and the main river genetic units. Additionally, over 18 km of accessible high quality tributary habitat, known to support bull trout, are located in the middle reaches of the river. We believe that even in the event of the catastrophic loss of all bull trout residing in the Elwha River from Lake Mills to the river mouth, recovery of the population following dam removal would occur through natural recolonization from the upper river and tributary refugia.

OLYM will hire a full time/term fisheries biologist who will be dedicated entirely to this action plan. Although we believe that it is possible to rely upon the unimpaired upper river and tributary areas to preserve bull trout during dam removal, it is incumbent upon the NPS to minimize direct take when and where feasible. The new fisheries biologist and a small seasonal field crew will be available to implement the targeted monitoring activities identified below, participate in the relocation of fish from areas at risk, and potentially control non-native brook trout in selected areas of the river. Other OLYM staff will also be periodically available, and it may be possible to employ park volunteers or personnel from other agencies on occasion.

This Action Plan is dynamic, requiring decisions regarding the disposition of fish to be made on the ground. To the extent possible, USFWS staff will be involved in the decision making process. However, final decisions will rest with the Chief Fisheries Biologists for the park and will be implemented by the OLYM fisheries staff.

Headwaters and Upper River

We do not anticipate that bull trout residing in the headwaters and upper river areas of the Elwha River will be directly affected by dam removal. However, secondary activities associated with the Elwha Project could risk the genetic integrity or viability of these relatively small aggregations.

The Elwha Fish Restoration Plan (Ward et al, 2008) considers the release of hatchery origin Chinook salmon smolts into the headwater and upper river areas through helicopter outplanting in order to facilitate recolonization of the watershed. It is not the intent of this bull trout plan to

evaluate the potential effects of this action, as the Elwha Fish Restoration Plan was considered in the BiOps for the Elwha Project. However, care should be taken to avoid introduction of pathogens into the headwater area in the course of any outplanting activities. This can be facilitated through strict adherence to the fish health policies of Washington State and the Hatchery Genetic Management Plan for the Elwha Channel. Additionally, any releases should be timed to avoid potential predation of young-of-the-year bull trout by stocked Chinook to the extent possible (i.e short residency period and consider outplanting size). In the case of the headwaters area, careful consideration should be given to not releasing hatchery fish at all in this location.

The conservation strategy for the Lake Mills area (below) considers removal of bull trout from Lake Mills and relocating these fish upstream of Grand Canyon (see Lake Mills discussion below). The headwater population of bull trout appears to be reproductively isolated above Carlson Canyon (~rkm 53), either due to migrational barriers in the canyon or the behavioral characteristics of a resident population. Any fish relocated from Lake Mills must be released below Carlson Canyon to prevent introduction of the lower river bull trout population into the headwater area.

Lake Mills

The largest single aggregation of bull trout in the Elwha watershed is found around Lake Mills. These fish exhibit an adfluvial life history, spending a large portion of the year in the lake before migrating upstream into Rica Canyon to spawn in the early fall (September/October). Adult and juvenile bull trout have also been observed in two other tributaries to the lake - Cat Creek and Boulder Creek. It is believed that juvenile bull trout move into the lake to rear at a relatively young age. However, no information exists to verify this assumption.

The removal of Glines Canyon Dam will eliminate Lake Mills. The reservoir will be slowly drained over a period of two to three years. During the reservoir drawdown, delta materials will be reworked and advanced downstream into the remaining reservoir. Drawdown studies conducted several years ago displayed a relatively rapid reworking of the delta materials, with the main channel of the river migrating from one valley wall to the other over a period of a day or two.

In addition to a dynamic river channel on the delta, increases in turbidity in the lake above background levels are anticipated[1]. We propose to capture and hold approximately 100 bull trout of various age classes from Lake Mills for relocation into the upper watershed prior to reservoir drawdown. As adult fish have a higher likelihood than juveniles of contributing to subsequent generations, effort will be made to capture and translocate at least 30 adults to the upper

[1] The drawdown described in this plan is associated with the final physical removal of the two dams. The Lake Mills delta was deforested, a new channel was excavated, and the reservoir was drawn down 18 feet during the fall of 2010. Protective measures were described during a separate consultation associated with that specific project and with actions taken during the removal of trees and realignment of flow into the new channel to ensure fish were not stranded by those activities. Additionally, monitoring of the delta was conducted to ensure head-cutting did not proceed upstream into Rica Canyon where bull trout spawning has occurred. No additional measures were deemed necessary as the lateral channel migration expected with this limited draw down were not expected to increase affects to bull trout above those occurring during full pool conditions.

watershed. However, it is recognized that capture of fish in Lake Mills may be difficult and limited by the amount of time fish can be safely held in captivity prior to transfer. Conversely, all bull trout captured will be transferred to the upper watershed even if the 100 fish target is slightly exceeded. If the 100 fish target is substantially exceeded (i.e. >120 fish captured) then consideration will be given to relocating excess fish below the Elwha Dam where they will have access to marine refugia.

Capture would be conducted through hook-and-line fishing, boat or backpack electrofishing, or seining. Fish will be held in live cages within Lake Mills until an adequate number are in hand to justify helicopter transport to the upper watershed. In no case will fish be held longer than 2 weeks, even if this requires that the targeted numbers for transfer (30 adults, 100 fish total) are not achieved. Fish will be released in the vicinity of the Elkhorn Ranger Station. A detailed plan for relocation (including justification for transfer number, method of capture, holding facilities, and method of relocation) of bull trout from Lake Mills is found in Appendix A of this plan.

The rapid dewatering of channels may result in the stranding of any bull trout residing in the delta area. We propose a monitoring program to identify any stranding of fish or the development of any barriers to migration. Monitoring will be conducted by park fisheries staff and will be coordinated with drawdown activities, in order to target periods when stranding is most likely to occur. Monitoring activities will be conducted a minimum of 2 days/week during active reservoir drawdown as long as the delta area can be accessed safely. It is anticipated that channel incision on the delta will make access difficult, with unsafe working conditions, within the first few months of initial reservoir drawdown.

Stranded fish will be collected by dip net, backpack electrofishing, seining, or by hand. We intend to stage equipment (e.g. electrofishing gear, nets, buckets, live cages, etc.) near the Lake Mills delta for use in fish rescue activities. The fish will then be transported to release sites in Cat Creek or Rica Canyon via bucket or river bag (depending upon numbers and size of the fish). Consideration will also be given to temporarily holding fish at the Elwha Tribal Hatchery or moving these fish below Elwha Dam where they would have access to salt water. Such actions would be acceptable if it is determined by OLYM staff that survival of relocated fish will be at least as high as survival of fish transferred to Cat Creek or Rica Canyon.

OLYM fisheries staff has considerable experience with the successful transport of both bull trout and rainbow trout over the short distances involved. The movement of the bucket or bag during transport provides adequate oxygenation of the water. It is not anticipated that fish will be held for longer than one hour.

We do not propose to relocate any stranded fish above Rica Canyon, as it would require helicopter assistance to move fish from the delta to the upper watershed. It is not feasible to have a helicopter on standby for the relatively few fish which we anticipate will be stranded. Further, by relocating up to 100 bull trout (~30 adult min.) to the upper watershed prior to reservoir drawdown, we believe we will limit the number of fish which will be affected. We considered the option of temporarily transferring stranded fish to the Elwha Tribe fish hatchery until a helicopter could be secured. The Elwha Tribe indicates that their facility will have the capacity to temporarily hold fish (Larry Ward, pers. com.). While this option can be held in

reserve, it must be noted that as lake levels recede, the ability to transport fish to the tribal hatchery will become more difficult and may become infeasible due to safety and logistics associated with access to the reservoir surface.

If barriers to migration are identified, that information will be forwarded to the Elwha Project manager. Any suspected barrier will be evaluated by the NPS hydrologist to determine if the barrier will resolve itself relatively quickly through natural erosion of delta materials or will remain stable for an extended period of time. If the barrier appears stable, consideration will be given to mechanical manipulation of the delta material or river channel if heavy equipment is available. Alternatively, options will be considered to improve passage through the use of hand tools or other measures.

Middle River

The primary effect of dam removal in the middle area of the river will be elevated levels of turbidity. No direct activities are planned for this area of the river to rescue/protect bull trout. Griff Creek, Hughes Creek, Little River, and Indian Creek (along with other smaller tributaries) will provide clean water refugium for bull trout when conditions in the main stem river are poor. Fish surveys in these tributaries will be conducted periodically to evaluate abundance of bull trout. Surveys will be conducted by NPS staff once every 14 - 21 days during periods of high turbidity in the main stem. Snorkel surveys will be the primary method employed but other options may be considered if visibility is poor (e.g. electrofishing).

Culverts in Griff Creek, Madison Creek and Indian Creek will be periodically surveyed to ensure that they remain passable to bull trout. If barriers develop, the Elwha Project manager will be notified and the culverts will be inspected by the NPS hydrologist, fisheries biologist, and civil engineer and appropriate measures will be taken to reestablish connectivity.

The Lake Aldwell delta is much smaller than the Lake Mills delta, but there is the potential for stranding and/or development of barriers to migration during the early phases of the removal of the Elwha Dam. A monitoring program similar to Lake Mills will be implemented and coordinated with dam removal activities. Stranded fish will be relocated to Little River. This transfer may require the use of a truck and transfer tank (1-ton tote with aeration system or similar) depending upon the distance fish will be moved. Consideration will also be given to temporarily holding fish at the Elwha Tribal Hatchery or moving these fish below Elwha Dam where they would have access to salt water. Such actions would be acceptable if it is determined by OLYM staff that survival of relocated fish will be at least as high as survival of fish transferred to Little River.

Non-native brook trout are present in the middle river, with the highest abundances appearing to be found in Indian Creek and a small ground water fed channel which passes through the Elwha Campground within OLYM. It will not be possible to eradicate brook trout from the Elwha watershed, but it may be possible to control isolated populations. In particular, repeated pass electrofishing in the Elwha campground tributary will be conducted to remove brook trout. This will have the direct benefit of reducing the possibility for genetic introgression with bull trout and may enhance the possibility that the channel will provide an additional clean water refugium in the middle river.

Lower River

Like the middle river, the primary effect of dam removal in the lower river will be elevated turbidity. Off channel, ground water fed habitat will provide limited freshwater refugium in the lower river. The estuary slough on the east bank of the river near the mouth is also currently utilized by bull trout and will be accessible. Some bull trout populations on the Olympic Peninsula are known to be anadromous (Brenkman and Corbett, 2006), so saltwater may also be utilized during periods of high turbidity.

No direct activities are planned for this area of the river to rescue/protect bull trout. Fish surveys will be conducted periodically in the off-channel areas to evaluate abundance of bull trout. Surveys will be conducted in off-channel areas by NPS staff once every 14 - 21 days during periods of high turbidity in the main stem. Snorkel surveys will be the method employed. At this time, surveys for potential barriers into off-channel habitat will also be evaluated. If present, barriers will be reported to the Elwha Project lead and methods to correct barriers will be considered and implemented if feasible.

In addition to snorkel surveys in the off-channel areas, it will be possible to monitor bull trout via the weir which will be installed in the lower river during the spring or summer of 2010. The weir is operated by the Washington Department of Fish and Wildlife. Any bull trout captured will be measured and then passed over the weir in the direction of travel. It is not anticipated at this time that bull trout captured at the weir would be relocated higher within the watershed, although that option could be reconsidered in the event that a number of bull trout were being captured at the weir.

Table 2. Elwha Bull Trout Action Plan.

River Section	Action	Supplies Needed	Staffing Needed
Headwaters	1. Refrain from relocating any bull trout to the headwaters. 2. Closely adhere to hatchery fish health strategy. 3. Carefully consider hatchery stocking strategy, particularly with regards to Chinook salmon	None	1. Participation of all parties involved with hatchery stocking plan.
Upper River	1. Refrain from relocating Lower River bull trout to the Upper River. 2. Closely adhere to hatchery fish health strategy 3. Carefully factor in bull trout status with respect to hatchery stocking strategy	None	1. Participation of all parties involved with hatchery stocking plan.
Lake Mills	1. Relocate ~ 100 bull trout (~30 adult min.) to the Upper River prior to final drawdown. 2. Monitor for stranding and development of barriers during final draw down and delta manipulation. 3. Relocate stranded fish to lower Rica Canyon or Cat Creek 4. Correct barriers that develop as a result of dam removal, to the extent feasible. 5. Relocate stranded fish to Elwha Hatchery and/or lower river (option) 6. Carefully factor in bull trout status with respect to hatchery stocking strategy (including fish health policy).	1. Electrofishing gear 2. Seine, dip nets 3. Buckets 4. River bags 5. Live cages 6. Knack box 7. Boat 8. Waders 9. Snorkel gear 10. Helicopter 11. Truck, 1-ton tote, aerator	1. Term project biologist 2. Supervisory biologist 3. Seasonal technicians (up to 6) 4. Boat shocker crew (2) 5. Heli-techs (up to 3) 6. Volunteers (optional) 7. NPS Hydrologist 8. Elwha Project Lead

Table 2 (cont.). Elwha Bull Trout Action Plan.

River Section	Action	Supplies Needed	Staffing Needed
Middle River	1. Monitor bull trout use of tributary habitat. 2. Monitor passage through culverts 3. Monitor for stranding and development of barriers on Lake Aldwell delta. 4. Relocate stranded fish to Little River. 7. Relocate stranded fish to Elwha Hatchery and/or lower river (option) 5. Control of brook trout in Elwha Campground tributary and consider options for other areas. 6. Correct barriers that develop as a result of dam removal, to the extent feasible. 7. Carefully consider bull trout status with respect to hatchery stocking strategy (including fish health policy).	1. Electrofishing gear 2. Seine 3. Dip nets 4. Buckets 5. River bags 6. Live cages 7. Waders 8. Snorkel gear 9. Truck, 1-ton tote, aerator	1. Term project biologist 2. Supervisory biologist 3. Seasonal techs (up to 3) 4. Volunteers (optional) 5. NPS Hydrologist 6. OLYM civil engineer 7. Elwha Project Lead
Lower River	1. Monitor bull trout use of off-channel and estuary habitat. 2. Monitor access to off-channel and estuary habitat 3. Monitoring bull trout presence at weir. 4. Correct barriers to off-channel habitat if feasible. 5. Carefully consider bull trout status with respect to hatchery stocking strategy (including fish health policy). 6. Consider options for controlling brook trout in the lower river	1. Snorkel gear 2. Waders	1. Term project biologist 2. Supervisory biologist 3. Seasonal techs (up to 3) 4. Volunteers 5. NPS Hydrologist 6. Elwha Project Lead

Appendix A
Lake Mills Translocation Plan

To minimize take of bull trout during the drawdown of Lake Mills and removal of Glines Canyon Dam, we will translocate bull trout from Lake Mills and the Lake Mills delta to the upper river prior to commencement of the final reservoir drawdown in the late-spring/early-summer of 2011 (June target). Monitoring of radio tagged bull trout that were relocated from the middle river to Lake Mills indicated that a portion of the bull trout relocated are likely to move back downstream relatively quickly. However, we believe that a significant number will remain in the vicinity of their release location for an extended period of time, thus avoiding the period of initial reservoir drawdown when conditions in the reservoir will still be conducive for fish rearing.

Precise estimates of abundance of bull trout in the Elwha watershed are not available. Riverscape snorkel surveys of the Elwha River conducted in September 2007 and September 2008 enumerated 215 and 118 bull trout respectively, from the headwaters to the river mouth. This information excluded canyon habitat and the two reservoirs so is an underestimate of the total population. Adams et al (1996) provided an estimate of 559 +/- 316 fish upstream of Lake Mills. Snorkel surveys conducted in the lower 2 km of Rica Canyon during the spawning season of 2009 identified over 200 bull trout, while hydro acoustic surveys of Lake Mills conducted in the summer of 2010 were unable to provide a conclusive estimate of bull trout abundance in the reservoir.

Given that the total abundance of bull trout is not well understood, there is no definitive basis for determining the number of fish which should be removed from Lake Mills prior to reservoir drawdown. Lacking such information, we intend to attempt to capture and translocate to the vicinity the Elkhorn Ranger Station (rkm 43) up to 100 bull trout of multiple age classes (~30 adult min.) from Lake Mills. This number is believed to be feasible based upon our experience capturing bull trout in Lake Mills using a variety of methods. Additionally, it is a reasonable number to justify use of a helicopter to transport fish to the upper watershed. Coincidently, this number also represents about 50% of the observed spawner abundance in 2009.

Adult fish have a higher likelihood than juveniles of contributing to subsequent generations. Effort will be made to capture and translocate at least 30 adults to the upper watershed, although it is recognized that capture of fish in Lake Mills may be difficult and limited by the amount of time fish can be safely held prior to transfer. All bull trout captured will be transferred to the upper watershed even if the 100 fish target is slightly exceeded. If the 100 fish target is substantially exceeded (i.e. >120 fish captured) then consideration will be given to relocating excess fish below the Elwha Dam where they will have access to marine refugia.

Capture and Holding

Fish will be captured by OLYM fisheries staff and collaborating federal agencies during full reservoir conditions utilizing hook-and-line, boat electroshocker (Lake Mills) or backpack electroshocker (Lake Mills delta). Following capture, fish will be temporarily held in live cages

for a period of up to two weeks, or until the targeted number of fish are captured, which ever occurs first.

Single point barbless hooks will be utilized for hook-and-line captures. Fish will be transported from the point of capture to live cages via a 3.8 cubic foot backpack river bag. Handling of fish will be minimized. Aeration will be provided through agitation of the bags. Generally, fish will be transported to the live cages immediately upon transfer. Time between capture and transfer to the live cages located at various locations along the shoreline should not exceed 15 minutes.

Capture utilizing a boat electrofisher will be conducted in cooperation with the USGS (Pat Connolly). Electrofishing gear will be operated according to USGS protocols. Two vessels will be employed for this operation. The first vessel will operate the electrofishing equipment while the second vessel will facilitate transfer of fish to live cages. Transfer will be accomplished as described above for hook-and-line capture except that it may be necessary to limit the number of fish held in a single river bag. No more than 50 fry (3 - 5 inches), 20 juveniles (5 - 8 inches), 5 small adults (8 - 14 inches), or one large adult (>14 inches) will be transferred in a single container. Size categories may be mixed, so long as the total fish weight transferred approximates the values provided above.

In wadeable habitat on the Lake Mills delta, bull trout will be captured via backpack electrofisher. A crew of two or three will be involved with collection, with one crew member operating the electrofishing equipment and the other crew members using dip nets to collect stunned fish. Fish will be transferred to live cages as described above for the boat-based operation. The electrofisher settings will be 60 Hz -6 ms (I-5on a Smith-Groot electrofisher), and 400- 600 v. These settings have been found by OLYM staff to safely collect bull trout in the Elwha watershed. Based upon the experience of the operator, these settings can be adjusted to fit the conditions present at the time of collection.

Captured fish will be held in a variety of live cages, with the type of cage utilized depending upon the number and size of fish being held, the location of the cage, and the duration of time the fish are expected to be held. In no case will a fish be held longer than 2 weeks.

For holding a relatively small number of fish (e.g 2-3 fish >14 inches) for short periods of time (up to 3 days), a rectangular cage (15”x20”x30”) will be utilized. The cage shall be placed in flowing water in a secure manner which prevents loss or damage of the cage. Mesh size on the cage will be small enough to ensure that the smallest fish captured will not be susceptible to gilling (1-2 mm). Cages will be closely monitored to ensure that they are secure and do not become fouled with debris.

When holding fish for a longer period of time, or for larger fish, a larger floating cage will be employed. These cages may be either circular or rectangular, but will have an approximate volume of 64 cubic feet. Mesh size may be variable, but will be sized appropriately for the fish being held. Cages will be located in Lake Mills near the mouth of the Elwha River, in a depth adequate to fully suspend the cages. Cages will be securely anchored to prevent loss. Fish may be held for up to 14 days in the floating cages. In no case will fish be held longer than 2 weeks,

even if this requires that the targeted numbers for transfer (30 adults, 100 fish total) are not achieved.

Helicopter Transport

Translocation will be facilitated through the use of a Hughes 500 or Bell Jet Ranger helicopter. Use of such helicopters for fish planting in the upper Elwha watershed has already been reviewed and approved by the USFWS.

Staging for transport will occur on the Lake Mills delta. Fish will be transferred from live cages to a 120 gallon (Bambi 1012 or similar design) fire bucket. The bucket would be filled with approximately 80 gallons of water and aerated utilizing a small oxygen tank set at a flow rate of 4 L/min. Wunderlich et al (1993) found that this configuration could safely transport up to 36 kg of Chinook salmon fingerlings to the upper Elwha watershed. We do not propose this same loading density, and will transport no more than 12 kg of fish in a single load.

Fish will be released either by the dump valve in the bottom of the fire bucket or by manual tipping of the bucket with the assistance of a ground crew, depending upon the size of the fish (largest fish may not fit through the dump valve opening). In either case, the bucket will be in contact (or nearly so) with the surface of the river at time of release.

Release locations will be associated with open canopy areas in the vicinity of the Elkhorn ranger station. The helicopter will fly along the river corridor at an elevation of more than 500 feet until approaching the area of release. All flight requirements described in the USFWS consultation for the Elwha Project will be followed.

To the extent possible, glide-type habitat will be selected for release areas. It is expected that fish will rapidly disperse from the release location. Efforts will be made to spread the release of fish over a 3 km reach of the river to avoid overpopulating any one area (Figure A-1). Riverscape surveys conducted by OLYM in 2007 and 2008 found that this area of the river had relatively few bull trout but high numbers of rainbow trout (Figure 7).

In order to minimize costs and impacts to avian populations, transfers will be made in a single day utilizing as few numbers of flights as possible. Assuming a maximum of 10 kg/flight and assuming an average fish size of 0.56 kg/fish (OLYM data from radio telemetry surveys), 100 fish could be translocated to the Elkhorn area in as few as 5 flights. A second day will be held in reserve, in the event that unforeseen circumstances arise.

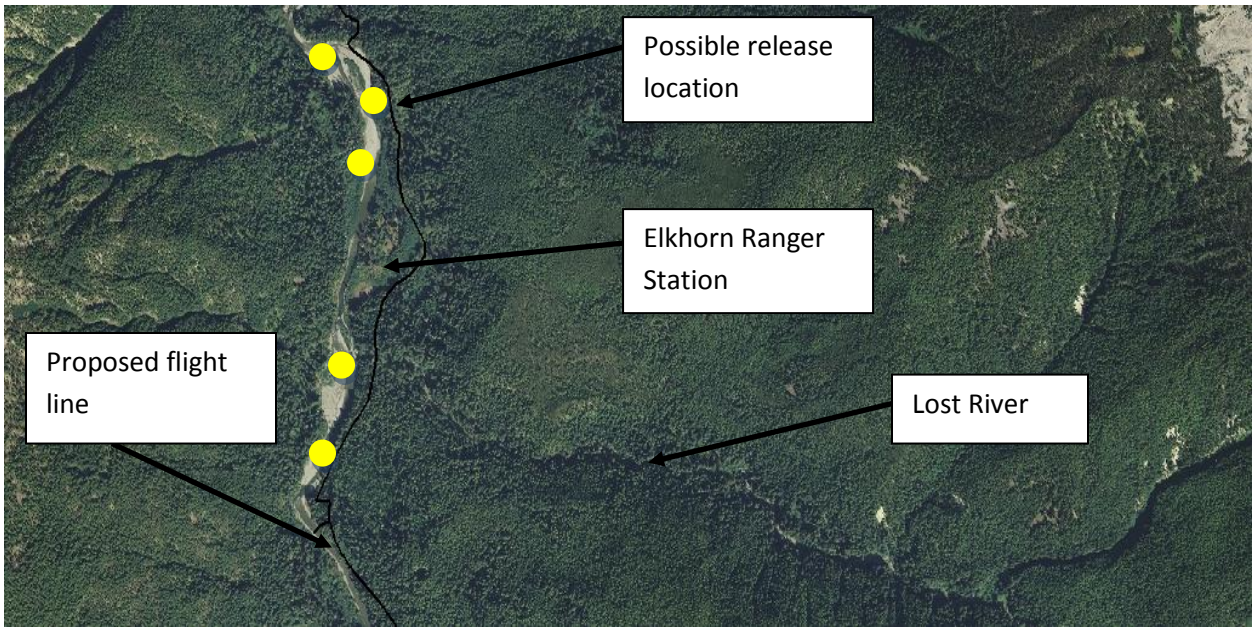

Figure A-1. Proposed flight line and 5 possible release locations in the vicinity of the Elkhorn Ranger Station.

Monitoring

Live cages will be monitored 3 times per day when holding fish, to ensure no mortality of captured fish. If mortality is observed, efforts will be made to identify and correct the condition resulting in mortality. If the condition cannot be corrected or identified, all fish remaining in the affected cage will be transferred to another holding cage or translocated to Cat Creek approximately 1 km upstream from the Elwha River confluence. Fish will not be released directly back into Lake Mills.

A fisheries biologist will be stationed in the upper river to ensure the safe release of fish during the airlift operation. If injury or mortality is observed, the helicopter operation will stand down until the condition causing mortality can be identified and corrected. If the condition cannot be corrected or identified, a determination will be made as to the relative risk of injury and mortality associated with the relocation relative to risk associated with relocating the remaining fish to Cat Creek. That is, if it is anticipated that mortality will be low for the remaining transfers, then the flight operations will continue. However, if a high percentage of fish are expected to be injured, then remaining fish will be relocated to Cat Creek.

No monitoring effort is planned to determine the number of fish that might return to their location of capture following release. However, a snorkel survey of the release reach may be conducted in the late summer following release to determine the relative abundance of bull trout in the area in comparison to the 2007 and 2008 riverscape surveys.

Based on previously conducted radio-telemetry surveys in the Elwha River, it is anticipated that some of the relocated fish will move back down stream following release, potentially returning

to the Lake Mills area. For this reason, reservoir draw down should begin shortly after the relocation effort in an attempt to deter fish from exiting Rica Canyon and returning to Lake Mills.

Radio-telemetry, floy tags, or PIT tagging could be utilized to determine the level of fall back to Lake Mills and/or redistribution of translocated fish throughout the upper watershed. It is proposed that any such work be conducted as a research project independent of this effort, as the findings would not alter the proposed approach to this project.

Staffing

The capture of bull trout in Lake Mills and their subsequent transfer to the upper river will be a short-term but labor intensive project. Capture will require a minimum of two boats (one for boat shocker and one to transfer fish to holding areas) and related crews as well as additional staff engaged in capture of fish using alternative methods. The helicopter operation will require at least 2 and possibly 3 heli-tech. staff to supervise the loading of fish from the Lake Mills delta and release of fish in the upper watershed. Fisheries technical staff will also be required for this operation. Heli-tech and fisheries staff located in the upper watershed will need to be stationed in the back country for a minimum of 3 days (2 travel days and 1 day for the translocation operation) and up to 5 days total. Additional lead time will be required for planning and training prior to the operation. In total, we anticipate that as many as 14 OLYM and USGS staff members will be involved in the planning and implementation of the operation.

Appendix B
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