National Park Service
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Olympic National Park
Washington

Elwha River

Ecosystem Restoration Implementation

Draft Supplement to the Final Environmental Impact Statement

December 2004

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Purpose and Need: The need for ecosystem restoration, dam removal, and sediment management has been explained in previous environmental impact statements, including the *Final Elwha River Ecosystem Restoration Implementation Environmental Impact Statement* (FEIS) that this document supplements. In addition to analyzing two detailed dam removal and sediment management alternatives, the FEIS proposed mitigation for impacts of dam removal related to water supply, water quality, flooding, changes in groundwater levels, and impacts to fish. Since the release of the FEIS, several changes have occurred, and additional information has been gathered. These changes and new information have resulted in the need for different mitigation than that analyzed in the FEIS. This new mitigation is analyzed in this *Draft Supplemental Environmental Impact Statement* (SEIS).

Type of Statement: This document is a draft supplement to the *Final Elwha River Ecosystem Restoration Implementation Environmental Impact Statement,* which was distributed in November 1996.

Abstract: The U.S. Department of the Interior is proposing mitigation measures to accomplish the following goals: (1) to protect municipal and industrial water users and two fish propagation facilities (hatcheries) during dam removal, (2) to provide flood protection at current levels, (3) to provide the ability to treat wastewater for those residents whose septic systems would be rendered ineffective, and (4) to protect listed fish to the maximum extent possible during and following dam removal. The means to accomplish these goals include a new surface water diversion and intake; a new water treatment plant to remove suspended solids and to supply water to hatcheries and to industrial and municipal users during and following dam removal; a municipal water treatment facility; strengthening, raising, and lengthening existing levees or homes as needed; providing flood protection or alternate supplies for affected groundwater users; providing assistance in connecting septic system users to a city wastewater treatment system; providing access to clean tributary habitat for bull trout; keeping the Washington State Department of Fish and Wildlife state chinook-rearing channel open during dam removal; modifying or moving the tribal fish hatchery; and creating rearing ponds on nearby Morse Creek to ensure the survival of Elwha chinook during dam removal. The SEIS also updates cost information, describes the selected mitigation for trumpeter swans, and proposes crushing and recycling concrete removed from the dams rather than transporting it to a land disposal site. The no-action alternative is the same as in the FEIS, as this SEIS is considered an addition to that document. The proposed actions are located in Clallam County, on the Olympic Peninsula, in Washington State.

Lead/Cooperating Agencies: The National Park Service is the lead agency. The Bureau of Reclamation and the U.S. Army Corps of Engineers, are cooperating agencies, and the Lower Elwha Klallam Tribe is a cooperating tribal government on this SEIS.

Public Comment: Comments from the public are encouraged and should be sent to the contact listed below. Comments will be accepted for 60 days from the publication in the *Federal Register* of the notice of availability of this SEIS. Please check the Elwha homepage <http://www/nps.gov/olym/elwha/home.htm> for exact dates. Send comments to Dr. Brian Winter, Elwha Project Manager, Elwha Project Office, 826 East Front Street, Suite A, Port Angeles, WA 98362; telephone 360-565-1320.

Summary

Introduction

This document supplements the second of two environmental impact statements that studied how to fully restore the Elwha River ecosystem and native anadromous fisheries in Clallam County, Washington. This restoration is directed by the Elwha River Ecosystem and Fisheries Restoration Act, Public Law 102-495 (the Elwha Act). While this Draft Supplemental EIS (SEIS) has been designed as a stand-alone document for readability, it is legally an extension of the *Elwha River Ecosystem Restoration Implementation Environmental Impact Statement* (FEIS), which was finalized in November 1996. This means, for example, that although the no-action alternative is "no dam removal" as it was in the FEIS, the decision to remove the dams has been made and formalized in a 1996 "Record of Decision." The impacts of this no-action alternative have simply been repeated in this SEIS for information purposes and to help readers understand the background of the action; it does not mean that the National Park Service or its cooperating agencies are revisiting the decision to remove the dams.

In the early 1900s the free-flowing Elwha River on the Olympic Peninsula in Washington State was blocked by two hydroelectric dams, neither of which was built with means to pass the 10 runs of native anadromous salmon and trout that had used the river for spawning and rearing for centuries. Since it was completed in 1913, the Elwha Dam has prevented migrating salmon and trout from using the upstream 70 miles of the mainstem and tributary habitat. The Glines Canyon Dam was completed farther upstream in 1927. These dams are the primary cause of the precipitous decline of salmonid populations to fewer than 3,000 naturally spawning fish today compared to an estimated 392,000 fish prior to dam construction. The loss of fish from 93% of the Elwha River has resulted in severe impacts to the entire Elwha River ecosystem due to the loss of nutrients and carcasses and the effects on aquatic and terrestrial vegetation and wildlife.

To accomplish the purposes of the Elwha Act, two environmental impact statements (EISs) were completed to analyze alternatives.

1. The *Elwha River Ecosystem Restoration: Final Environmental Impact Statement* (June 1995) evaluated options for restoring the Elwha River ecosystem and native anadromous fisheries and is referred to in this document as the Programmatic FEIS. The "Record of Decision" that followed selected the removal of both dams as the only option that would accomplish full restoration.
2. The *Elwha River Ecosystem Restoration Implementation: Final Environmental Impact Statement* (November 1996) examined two ways of removing the dams, as well as the sediment stored behind them. It is referred to throughout this document as the FEIS or Implementation EIS. The "Record of Decision" selected "river erosion" as the preferred alternative for removing sediment. (The November 1996 FEIS included only specific changes to the DEIS, not the entire text of the draft document. Subsequently, a compilation of the DEIS and FEIS was prepared that included all the text of the draft, along with changes presented in the FEIS, plus responses to comments and the U.S. Fish and Wildlife Service's "Biological Opinion."). The FEIS is available by contacting the Elwha Restoration Project Office (826 East Front Street, Suite A, Port Angeles, WA 98362), or on the Elwha homepage at <http://www/nps.gov/olym/elwha/home.htm>.

A supplemental EIS is prepared if either there is a "substantial change" to the selected action that is "relevant to environmental concerns," or "there are significant new circumstances or information relevant to environmental concerns and bearing on the selected action or its impacts." The changes to water supply, water quality, and flood control mitigation analyzed in this SEIS are considered substantial, and so a supplement has been prepared. Any other changes to the proposed action not relevant to mitigation (such as the recycling of concrete removed from the dams, for example) or additional detail relevant to the proposed action (such as fisheries protection or revegetation of the reservoirs) are also included in this document.

The choice to remove both dams and to follow the actions described for the river erosion alternative will remain the same and is not subject to further public comment. Work has not yet begun to remove the dams.

Because most of the Elwha River watershed lies within Olympic National Park, the National Park Service has served as the lead agency for the Programmatic and the Implementation EISs, as well as this SEIS. Other agencies involved in the preparation of this EIS are the Bureau of Reclamation, the U.S. Army Corps of Engineers, and the Lower Elwha Klallam Tribe.

Purpose and Need

The need for ecosystem restoration, dam removal, and sediment management resulted in the Programmatic and Implementation EISs described above. In addition to analyzing two detailed dam removal and sediment management alternatives, the Implementation FEIS proposed mitigation for impacts of dam removal related to water supply, water quality, flooding, changes in groundwater levels, and impacts to fish. Several changes have occurred since the FEIS was released, prompting the participating agencies to consider a different direction for many of the original mitigation measures. For example, changes in the requirements for treatment of the city's municipal water supply, the need to keep the state's fish-rearing channel open during dam removal, and other factors have meant revising a treatment strategy for water quality.

Other changes since the release of the Implementation FEIS that bear on the proposed action include an increase in the number of reservation residents whose septic systems will be affected by the rise in the surface water level of the river, the listing of two species of fish as threatened under the Endangered Species Act, and the changing economics of recycling concrete. In addition, more detail is now available on actions that will occur as part of the revegetation of the dewatered reservoir sites.

These changes are the reason a supplemental EIS is needed; therefore, the proposed action is primarily a package of mitigation measures designed to maintain water quality and supply, flood protection, and fish rearing and hatchery conditions.

Alternatives

No-Action Alternative

Because this document is a supplement to the Implementation FEIS, the no-action alternative is virtually the same as that in the FEIS. No action is the continuation of current management, and in the FEIS the no-action alternative is no dam removal. As noted above, the no-action alternative is presented in this SEIS primarily for background and readability, as the decision to remove the dams has been made and formalized in a 1996 "Record of Decision." Where management or the environment has changed since that "Record of Decision" was signed, the no-action alternative is slightly different than that in the FEIS.

The pieces of the no-action alternative described in this SEIS concern current management of water supply, water quality, and flood protection. These are the items that are the subject of updated mitigation measures evaluated in this SEIS.

Currently, water for industrial clients is supplied by means of a rock diversion structure and intake along the river. The city's municipal water supply is taken from an existing subsurface Ranney collector. As the water from the Ranney collector has recently been determined to be under the influence of surface water, the city will need to revise its water treatment to meet surface water treatment standards. Therefore, some change to water treatment would occur under the no-action alternative.

A federal levee on the east side of the river extends from near the mouth south for 1.5 miles, protecting reservation lands belonging to the Lower Elwha Klallam Tribe. A private, much shorter levee on the west side provides some flood protection for residents at the river's mouth. No modifications would take place at either of these levees or to homes or wells upstream to protect them from floods, including those who obtain water from the Dry Creek Water Association (DCWA) under the no-action alternative.

Tribal wastewater treatment for valley residents is currently by means of individual septic systems; this would remain the case, or the tribe could pursue community treatment independent of the river restoration project under the no-action alternative. The tribal hatchery would also remain in its current location, and operations would remain as they are now; this is also true of the chinook-rearing facility operated by the Washington Department of Fish and Wildlife (WDFW).

Because the dams would not be removed, there would be no need to revegetate reservoir areas. Also, disposal of rubble from the dams would be unnecessary.

No monitoring/mitigating actions would occur related to the trumpeter swan at Lakes Aldwell and Mills.

Proposed Action

Both dams would be removed, and sediment would be managed as described in the FEIS. Mitigation for impacts of dam removal to water quality, water supply, fish hatchery operations, and flood stage would be as described below.

Water for both industrial and municipal water would be supplied from a surface supply; a new weir and intake structure would be built slightly upstream from the existing diversion structure. The weir would be designed to pass all fish and sediment. Water collected from this intake would be treated during spikes of turbidity at an Elwha water treatment plant (EWTP) near the existing industrial intake channel at river mile (RM) 2.8. The plant would supply treated water to the tribal hatchery, to the Nippon Paper Industries treatment facility, to the fish-rearing channel, and as a back-up to a new municipal Port Angeles water treatment plant (PAWTP) during and for a period of time following dam removal. The Port Angeles plant would be built near the city's landfill.

Flood mitigation measures include raising, strengthening, and extending the federal levee to protect housing and other facilities, and raising or otherwise providing existing flood level protection for homes and wells in other locations along the river. Options for the DCWA users include an alternative well field, raising the existing well field, or connecting to the city's municipal supply. Potable water for homeowners in the Elwha Heights subdivision would be provided by a connection to DCWA.

Tribal septic systems, which could be rendered ineffective by rising groundwater associated with dam removal, would be replaced with a connection to the Port Angeles wastewater treatment facility.

Fish restoration projects would be constructed with particular emphasis on chinook salmon and bull trout (currently listed as threatened by the U.S. Fish and Wildlife Service). Modifications to or relocation of the tribal hatchery would occur to improve the functionality of that facility. Clean water would be supplied to the state chinook-rearing channel to allow it to remain open during and following dam removal.

Dam rubble would be buried, or crushed and recycled, and the dewatered reservoirs would be revegetated. Acquisition of property or development rights to offset impacts to trumpeter swans would occur.

Environmental Consequences

The environmental impacts in this SEIS evaluate the degree of change a particular resource would experience under the implementation of either the no-action alternative or the proposed action. The resources analyzed have come from park staff, laws, regulations and policies, and the interested and affected public, including other agencies, who were contacted during scoping.

The "Affected Environment" describes the resources and their current state, and the "Impacts" chapter analyzes the extent, intensity, and duration of impacts to the resources expected under each alternative. NPS *Management Policies* and various NPS Director's Orders require that the impact analysis also determine whether an alternative might impair NPS values or resources, particularly related to natural and cultural resources. Such impairment is specifically prohibited by the NPS Organic Act. The analysis in this SEIS indicates that the proposed action would not impair any park resources or values.

A summary of major conclusions presented in this SEIS is presented below.

Flooding

The Elwha River typically experiences two periods of high runoff — November through March from heavy rains, and May through June from spring snowmelt. Floods are characterized by sharp rises in discharge (usually less than 24 hours to the peak) and a gradual recession over two days or more. Statistics show that the flood stage in the Elwha and neighboring rivers is increasing over time, likely related to a combination of logging and other land-clearing activities and climate.

The reservoirs created by the Elwha and Glines Canyon Dams provide only small storage volumes, affording minimal flood protection. Since the dams were built, relatively little bedload has been introduced into the river downstream of the dams, allowing the riverbed to degrade and reducing the flood hazard from pre-dam conditions to some properties along the lower river. Nonetheless, many homes, wells, roads, facilities, and cultural resources are situated within the 100-year floodplain and are susceptible to flooding now.

Under the no-action alternative the dams would continue to be operated in natural flow mode. Structures and cultural resources within the present 100-year floodplain would continue to be flooded periodically, and riverbed degradation would offer an unnatural but existing benefit to downstream residents in some places by lowering the flood stage. The degradation of the riverbed has also resulted in less side channel or pool habitat, an adverse impact to the river's riparian ecosystem. Some existing flood control structures have also had minor to moderate localized impacts on the floodplain and the values it offers to fish, vegetation, wildlife, and recreationists.

Implementation of the mitigation measures under the proposed action would ensure that privately owned structures and facilities, as well as the federal flood protection levee, would be protected from flooding impacts associated with dam removal and increased aggradation of riverbed sediments. It is possible that two campgrounds and a ranger station inside Olympic National Park would be flooded more frequently or experience increased bank erosion. Over the long term, minor, adverse impacts to the natural floodplain could be expected from installing flood control measures, particularly along the federal levee. Temporary impacts could occur to the flow of river water and to the floodplain during the construction of mitigation facilities.

Surface Water

Annual precipitation in the Elwha River basin ranges from 220 inches in its upper reaches to 35 inches near the mouth of the river. Discharge is influenced by winter storms and spring snowmelt and by baseflow conditions during the summer and fall. Flow regimes of the river and its tributaries are nearly natural, as the dams are operated in "run-of-the-river" mode.

The Elwha River and its tributaries are classified by the Washington Department of Ecology as "salmon and trout spawning, core rearing, and migration" areas (signifying "extraordinary" water quality). Overall, the Elwha has relatively low concentrations of dissolved and suspended sediment loads, nutrients, and organics. Changes in water quality occur in the lower part of the watershed, mostly as a result of reduced sediment load and elevated water temperatures during the summer. Although the reservoirs have moderately reduced turbidity and trapped iron and manganese, they have also resulted in substantially higher water temperatures than under natural conditions, a major adverse impact to water quality and aquatic organisms. As noted above, Port Angeles municipal water is currently drawn from an underground Ranney collector that has recently been deemed to be "under the influence of surface water," and therefore additional treatment is needed.

Elwha River surface and groundwater rights are held by the City of Port Angeles, private landowners, and the Dry Creek Water Association. The Lower Elwha Klallam Tribe and the tribal fish hatchery also withdraw water from the river, and additional unquantified water rights are held in trust for the tribe to guarantee sufficient water to support treaty fisheries and the purposes of the Lower Elwha Klallam Reservation.

Water quality in Morse Creek, where up to four chinook-rearing ponds would be located to hold Elwha chinook during dam removal, is also considered a "salmon and trout spawning, core rearing, and migration" area by the Washington Department of Ecology.

Under the no-action alternative the reservoirs would continue to have moderately reduced turbidity and trapped iron and manganese particles, and increased temperatures downstream of the dams. Port Angeles would need to change the treatment of its municipal water to comply with standards related to the water being reclassified as "under the influence of surface water." Park surface water would continue to be adversely affected by higher water temperatures under the no-action alternative.

Under the proposed action surface water users would not be affected in the long term by dam removal, as mitigation measures to protect them against adverse impacts would be implemented. Water quality monitoring during and following dam removal would help identify and mitigate any additional unknown or unanticipated impacts.

The construction of water quality and water supply mitigation facilities, as well as those associated with the mitigation of flood impacts and impacts to anadromous fisheries, would result in increased erosion of soils at the construction sites and possible contamination of those soils by petroleum products during the two-year construction period. Periodic pulses of turbidity following construction, with impacts ranging from negligible to moderate, would be likely, even with the use of best management practices. Replanting and reseeding sites after construction would return erosion rates to pre-construction conditions within one year or sooner.

Providing users with surface water during dam removal would ensure a consistent supply, a benefit compared to water supply mitigation proposed in the FEIS. This alternative would return treatment residuals from the Elwha water treatment plant to the river during dam removal, but because the impact would occur during dam removal, it would be barely detectable, that is, a negligible to minor impact on water quality. Short-term releases of organic material and chemicals from the hatcheries during dam removal would have negligible impacts on water quality because of ongoing impacts from dam removal. Over the long term these releases would decrease to current levels, with a negligible to minor adverse impact on Elwha water quality. Before dam removal and following the return of turbidities to near pre-dam conditions, the impacts of the disposal of this effluent to water quality could be minor or moderate. Construction and operation of fish ponds on Morse Creek could result in exceedances of water quality standards, a major adverse impact. With mitigation, these impacts could be reduced to negligible or minor.

No impairment to park water resources in the Elwha River would occur as a result of the mitigation measures described in the proposed action.

Groundwater

An alluvial sand and gravel groundwater aquifer underlying the Elwha River valley is the current supply source for the City of Port Angeles, the Dry Creek Water Association, the Lower Elwha Klallam Tribe (including fish hatchery), and the Elwha Place Homeowners' Association. Total use by the major groundwater purveyors in the Elwha River valley is approximately 22.3 cubic feet per second (cfs).

The groundwater in the Elwha River watershed is of excellent quality; the entire headwater area is protected within Olympic National Park. The watershed land use is primarily rural, but non-point source pollution from agricultural and other land use has a minor influence on groundwater quality. Private septic systems in the lower basin present a potential for groundwater contamination because of the poor filtering capability of the soils and the high water table.

As with surface water, the reservoirs have moderated turbidity and manganese and iron concentrations, as well as having modified groundwater tables in some areas. Migration and flooding frequency have been reduced through the elimination of sediment transport to the middle and lower reaches, resulting in the armoring of the downstream channel. This has increased the yield for some wells and has allowed well users to drill wells in the floodplain. Continued use of groundwater by residents along the river and wastewater disposal (septic systems) may have had negligible to minor adverse impacts on groundwater in the study area.

The impacts of dam removal to groundwater include temporary increases in turbidity, higher levels of manganese and iron in wells, and an increase in river stage and associated groundwater levels in some areas. Without mitigation, users would experience minor to major impacts from dam removal. Mitigation under the proposed action for this SEIS for most wells remains the same as analyzed in the FEIS;

however, the Dry Creek Water Association is considering the additional alternative of an alternative well field and distribution system. Because additional homes beyond those identified in the FEIS are affected by rising groundwater levels, the Lower Elwha Klallam Tribe is proposing a wastewater collection and pumping facility to pipe wastewater to Port Angeles for treatment. These mitigation measures would keep impacts resulting from changes in groundwater following dam removal to negligible. No national park groundwater resources would be affected by this alternative; therefore, no impairment of park resources or values would occur.

Native Anadromous and Resident Fisheries

Ten stocks of anadromous salmon and trout are either now present in the Elwha River or were known to be present before the dams were built. They are winter and summer steelhead trout; coho; summer/fall and spring chinook; pink, chum and sockeye salmon; cutthroat trout; and native char (Dolly Varden and bull trout). Pacific and brook lamprey have also been documented in the Elwha River. In addition to these anadromous species, the Elwha harbors many other species of non-migrating fish (e.g., sculpins, resident cutthroat). The Elwha River is currently the largest producer of steelhead and chinook salmon on the Strait of Juan de Fuca and is second only to the Dungeness River for coho. Nearly all chinook, coho, and steelhead are hatchery-produced.

The Elwha Dam confines native anadromous fish to the lower 4.9 miles of river habitat and prevents their access to more than 70 miles of usable habitat in the middle and upper Elwha River. The two dams degrade habitat in the lower river by increasing water temperatures to levels that contribute to disease outbreaks, trapping large woody debris important for in-stream cover, reducing nutrient flow necessary for invertebrate (food) production, and trapping spawning-sized gravels essential for successful natural reproduction. The trapping of coarse sediment and nutrients also adversely affects the size and quality of the estuary near the river mouth, which serves as a nursery for juvenile salmonids. In addition, the lack of bedload in the lower river prevents the formation of side channel habitat used by chum for spawning and coho for rearing. Flood control, including the federal levee, may also have eliminated or reduced the quality of side channel and riparian habitat for fish.

The no-action alternative would continue these major adverse impacts to anadromous fisheries in the Elwha River. There would be no new wild production of native anadromous fish, and hatcheries would continue to provide the vast majority of Elwha anadromous fish. Existing stocks in the lower river unsupported by artificial propagation would likely decline to extinction.

Impacts to fish under the proposed action in this SEIS would primarily be associated with sediment released during the construction of mitigation facilities. Fish in the Elwha River or Morse Creek could experience some short-term pulses of turbidity from accidental releases at construction sites, during storm events, or from in-river work. The impacts would be short term and negligible to minor. Additional negligible to minor impacts from the short term or permanent loss of streamside vegetation as fish habitat would be possible from construction, as well as from extension of the federal levee. The replacement of the rock diversion structure would cause temporary minor adverse impacts from turbidity and loss of spawning gravel, but would ultimately result in minor to moderate benefits for anadromous fish from the installation of fish passage and state-of-the-art bypass facilities. Operation of the Elwha water treatment plant would have no more than negligible additional effects from the release of solids and coagulation chemicals over impacts from dam removal, which would occur simultaneously with these releases. No impairment of park fish resources would occur as a result of the mitigation activities described in the proposed action.

Soils

Most soils in the study area are composed of glacial drift, mixed glacial deposits, and eroded materials transported by water and deposited as alluvial terraces.

Proposed mitigation measures include activities along the lower 3.7 miles of the Elwha River and the existing landfill in western Port Angeles, where the Port Angeles water treatment plant is proposed. Soil map units along the lower reaches of the Elwha River that could be impacted include typic xerofluvents and Neilton very gravelly sandy loam. Clallam gravelly sandy loam occurs in the western portion of Port Angeles.

The dams and the reservoirs they created caused major changes and adverse impacts to soils through excavation, compaction, and inundation. These impacts would continue under the no-action alternative, as would minor to moderate impacts from several existing facilities that would be modified under the proposed action. Because the affected soils are not a resource considered unique to the park or for which the park was created, their inundation does not qualify as an impairment.

Nearly all mitigation activities in the proposed action would result in some type of ground-disturbing impact to soils. Impacts from excavation and removal of soils would be permanent, but because they would be confined to either particular locations or because the removals would occur in already disturbed areas, they would primarily be minor in intensity. Some pipeline routes proposed for the Dry Creek Water Association and possibly for transmission of wastewater from the Lower Elwha Klallam Tribe could have up to moderate effects due to the removal of soil and the length or location of the pipeline. Installing a toe to strengthen the federal levee would result in moderate localized impacts. Compaction of soils from heavy equipment at the Elwha and Port Angeles water treatment plant sites, as well as from the extension of the federal levee north and south, would also be very long term or permanent impacts, but they would be localized and minor. Erosion, which would occur at nearly all construction sites, and contamination, which is possible from fuel leaks or the transport or use of treatment chemicals at the Elwha and Port Angeles water treatment plants, would be minimized through the use of best management practices and spill response measures. Impacts to soils from erosion or contamination would be minor, site-specific, and temporary. The proposed actions would not result in impairment to any park soils.

Vegetation

The Elwha River, oriented north-south, is one of the longest drainages on the Olympic Peninsula. As a result, the river valley supports a unique mix of plant communities transitional between the vegetation of the east and west sides of the Olympic Peninsula. Most of the study area consists of upland and riparian forest communities, including conifer, mixed conifer / hardwood, and hardwood. Upland grassland and deciduous shrub communities are sparsely distributed.

A number of wetlands have been identified within the study area and include at least three types — forested, scrub/shrub, and emergent. Willow and red alder are the dominant tree species in wetlands; common understory species include salmonberry, Indian plum, and skunk cabbage. Clallam County conditional use permits require buffers around high-quality wetland areas, as well as buffers between construction areas and the river.

Long-term studies of riparian zones (the river channel and lands where vegetation is influenced by the river) have consistently found a high level of biological diversity. The Elwha riparian zone provides, or could provide, important habitat for threatened, endangered, or rare species. In the project area examined in this SEIS, the riparian zone along the Elwha River from RM 2.8 to 3.7 is expected to be impacted by the construction of proposed mitigation facilities. Upland locations that could experience impacts include the proposed Port Angeles water treatment plant adjacent to the city's existing landfill, roads and sections of pipelines, and fish-holding/rearing ponds on Morse Creek.

The reservoirs have had major adverse effects on vegetation due to the inundation of 700+ acres, much of it riparian and wetland vegetation. Vegetation in the vicinity of the proposed mitigation facilities is disturbed throughout most of the area, although small patches of riparian forest are relatively unaffected and could be restored following dam removal. Two large, high-quality wetlands and several small, less diverse wetlands are also in the study area. The no-action alternative would continue major adverse effects on park vegetation.

The proposed action could result in impacts to both upland and riparian vegetation due to removal, trampling, and shearing as mitigation facilities were built and operated. From south to north, floodproofing the existing DCWA well field could result in minor to moderate, long-term impacts to riparian vegetation, while the use of the proposed alternative well field site would have moderate, permanent impacts to riparian vegetation; minor, permanent impacts to forested wetlands along an access road; and minor impacts to floodplain wetlands. Any of the five pipeline alignments from the alternative well field would have negligible to minor impacts to vegetation; this would also be true of a possible pipeline connecting the Dry Creek Water Association to the municipal system. Loss of some riparian vegetation to remove the existing diversion and intake facility and to construct a new upstream control weir would occur, but the loss would likely be minor and temporary. The inundation of riparian vegetation at the control weir could be compensated by the recovery of downstream riparian vegetation where the existing diversion would be removed, with negligible impacts.

Impacts due to the loss of mixed forest and understory at the Elwha water treatment plant site would be permanent, and impacts at staging areas would be temporary; overall impacts would be minor to moderate. Smaller, man-made wetlands on site could be lost when drainage was altered; the loss would be considered negligible. Two larger wetlands could experience temporary, indirect, minor to moderate impacts during construction.

Impacts to riparian vegetation from raising and widening the federal levee would generally be minor because vegetation is generally disturbed or artificially maintained, although at the southern end, impacts to a relatively undisturbed forest could be minor to moderate. The forest on the east side of the levee might experience negligible to minor impacts. Impacts from constructing the hatchery or wastewater pump station on the Halberg property would be negligible to minor. Extending the levee south would result in moderate, permanent impacts to vegetation through the loss of trees and the division of a relatively pristine forested area.

Because it is already disturbed and limited in size, the impact of grading and removing forest and understory vegetation at the Port Angeles water treatment plant site would be minor, adverse, and permanent.

Negligible to minor impacts to vegetation from installing culverts for bull trout, clearing helicopter landing pads to outplant chinook, or creating chinook holding / rearing ponds (on Morse Creek) would occur.

Negligible to minor additional impacts to vegetation, beyond those described in the FEIS, could occur from helicopter landing pads and the use of heavy equipment (staging and access roads) associated with revegetating the reservoirs.

No impairment to park vegetation would occur.

Wildlife

Large and small mammals have been observed or are known to occur in the study area. Mammal species include Columbian black-tailed deer, Roosevelt elk, beaver, river otter, coyote, bear, cougar, weasels, mink, and several species of bats. Numerous bird species also use the area, including robins, red-tailed hawks, western flycatchers, ducks, great blue herons, hooded mergansers, pileated woodpeckers, gulls, cormorants, ruffed and blue grouse, mountain chickadees, great horned owls, and western screech owls. Trumpeter swans number about 80 in the Lake Aldwell and Lake Mills areas, where many temporarily overwinter. Although trumpeter swans are outside the study area for this SEIS, impacts are discussed in this document because the means to mitigate for the loss of reservoir habitat had not yet been decided in the FEIS. Common reptiles in the project area include the northwestern garter snake, common garter snake, northern alligator lizard, roughskin newts, and Pacific chorus frog.

Under the no-action alternative the dams would continue to have major adverse impacts on park wildlife, with wide-ranging effects in the Elwha River valley because of habitat inundation and blocked passage of anadromous fish upstream of RM 4.9 and the resulting loss of the calories and nutrients that they contribute to the ecosystem. Wildlife is not abundant in disturbed riverbank areas. Areas of relatively intact forest habitat exist where riparian forest species are likely. Few wildlife species were observed in developed areas where habitat is degraded. Shorebirds and gulls were observed near the shore. Habitat at the Morse Creek site is relatively undisturbed and occupied by common bird and small mammal species.

As a result of the proposed mitigation facilities, negligible to moderate, temporary impacts to wildlife from construction noise at either DCWA well field site would occur; if bats roost in the vicinity, their abandonment of roosting sites could be a moderate impact. The loss of off-channel, water-filled gravel pits due to filling at either DCWA site would be a minor to moderate, permanent impact on wildlife. Construction noise would also disrupt and displace wildlife in the vicinity of the existing and proposed diversion and intake facilities; trampling of riparian vegetation would also occur. Because there is little wildlife use of the riverbank, impacts here would be minor, although impacts to wildlife in the surrounding vegetation from noise would be moderate and temporary.

Wildlife populations in the vicinity of the Elwha water treatment plant are expected to panic, flee, and abandon the area within at least 1,500 feet during the construction period, a moderate, adverse, localized impact. Wetland habitat would also be lost, or indirectly affected by air emissions or turbidity, a negligible to moderate impact. Minor impacts from the permanent loss of habitat would also occur.

Modifying the federal levee would generally have negligible or minor impacts to wildlife from construction noise, but little wildlife habitat exists along this corridor. At the Halberg property, minor impacts from building the tribal hatchery or wastewater pumping plant are possible because wildlife use this land more. Extending the levee southward and/or placing the wastewater pipeline in dense riparian and upland mixed forest could have moderate temporary effects because of the relatively undisturbed nature of the forest.

Minor temporary impacts to wildlife from construction noise and permanent impacts from the presence of the Port Angeles water treatment plant are likely. Additional minor impacts to upland wildlife from installing culverts, and at Morse Creek to build fish-holding/rearing ponds, are likely.

Helicopter noise to outplant fish above Glines Canyon Dam could have moderate, adverse, localized impacts to wildlife. Additional minor to moderate impacts to wildlife from the use of heavy equipment, helicopters, and barriers such as fencing to revegetate the reservoir lands are possible.

No impairment of park wildlife would occur.

Species of Special Concern

The following species could occur in the project area:

> *Mammals* — The Pacific fisher has been observed in Olympic National Park, but not for many years. Four species of bats are considered federal species of concern (Townsend's big-eared bat, Keen's myotis, long-eared myotis, and long legged myotis).
>
> *Birds* — Bald eagles, federally listed as threatened, have been observed year-round in the area. No individuals or nests have been observed in areas proposed for development. The northern spotted owl, federally listed as threatened, typically inhabits unlogged, old-growth forests or mixed forests of mature and old-growth timber. No nest sites or old-growth habitat areas are available in the vicinity of planned construction sites. The marbled murrelet, federally listed as threatened, uses the Elwha River valley as a corridor between nesting sites upriver from the site where mitigation facilities would be built and the coast where it feeds.
>
> Harlequin ducks, a federal species of concern, typically breed in forests adjacent to swift-moving streams. Large numbers of ducks have been found near the river mouth in recent winter surveys, although no individuals have been sighted in any of the 2003 wildlife surveys of the project area considered in this SEIS.
>
> The northern goshawk is both a federal and state species of concern. It is a breeding resident in the project area, but it occupies mature conifer forest not generally available in the project area.
>
> The pileated woodpecker is a state species of concern that require large trees and snags for reproduction, as well as for feeding. Two pileated woodpeckers were sighted in the project area during the surveys for this SEIS.
>
> *Amphibians* — Northern red-legged frogs, tailed frogs, and western toads are all federal species of concern in the project area. Tailed frogs are also a state-monitored species.
>
> *Fish* — Ten species of anadromous fish co-exist in the Elwha River. Several of these species are offered special protection, or are currently being monitored and considered for protection. Chinook salmon and bull trout are both currently listed as federally threatened species. Most other Elwha salmon and anadromous trout have been listed as Washington State species of concern.
>
> *Plant Species* — No plant species are federally listed as threatened or endangered; 13 are considered sensitive by Washington State. This means they are vulnerable or declining, and could become endangered or threatened without active management. Although these 13 are known to occur in the park or region, none was found in the project area.

Under the no-action alternative most species of special concern would continue to be adversely affected by the presence of the dams, either because habitat is inundated or occupied by the hydroelectric projects, or salmon prey species would remain unavailable. The population of native (not hatchery raised) chinook and the lower river subpopulation of bull trout would die off.

It is unlikely that the proposed mitigation facilities would have any impact on the Pacific fisher, although moderate impacts to colony bats could occur. Minor to moderate temporary impacts on bald eagles wintering in the river construction area, or moderate, temporary impacts on nesting eagles at the river mouth from levee construction, could also occur. Helicopter use could have minor to moderate, temporary impacts on both northern spotted owls and marbled murrelets; additional minor to moderate impacts to murrelets traveling along the river corridor between nesting sites upriver and the coast would be possible because of construction activities. Wintering harlequin ducks could experience minor effects from the construction of the levee extension northward. Construction noise and the removal of trees might have a minor to moderate impact on pileated woodpeckers. Filling small wetlands or indirect impacts to larger wetlands might result in minor to moderate impacts to northern red-legged frogs and tailed frogs. Grading or excavating could have minor to moderate impacts to western toads. Turbidity during construction could result in minor impacts on chinook salmon and Pacific and brook lampreys. Turbidity could also cause moderate, temporary impacts on bull trout because this species is more sensitive to water quality. Extending the levees could have minor impacts on chinook or bull trout through the removal of riparian vegetation and other habitat. Additional mitigation measures designed to protect chinook and bull trout during dam removal, to prevent the loss of stock, and to increase the chance and pace of successful restoration would potentially have major benefits for both species. No impairment to park resources or values would occur.

Air Quality

Ambient air pollutant concentrations for the region surrounding Olympic National Park are within national, state, and local air quality standards, likely attributable to the low population density of non-urban areas and the lack of many older, large industrial sources. Major sources of air pollutants (greater than 0.907 metric tons or 100 tons per year) in Clallam County are the Nippon Paper Industries and K-Ply mills. Silvicultural burns, smoke from wood-burning stoves, dust and other particulate matter generated from vehicles using unpaved roads, vehicle exhaust, and smoke from campfires also affect air quality in the middle and lower Elwha valley area and Olympic National Park. Clallam County and the project site are designated as attainment areas (i.e., concentrations below the standards) for all criteria pollutants. Olympic National Park has been designated a Class I area under the Prevention of Significant Deterioration (PSD) program. Class I areas receive special air quality protection.

The hydroelectric projects do not adversely affect air quality. Therefore, under the no-action alternative, current high air quality within the study area would continue.

The proposed actions described in this SEIS would have temporary effects on air quality. The crushing of concrete at a privately owned facility would contribute to localized emissions, but they would be within permitted levels. Vehicular emissions from heavy construction equipment are expected to have a negligible impact compared to stationary sources or dam removal, but there might be a minor or even moderate effect on some nearby residents, staff at the rearing channel, or construction personnel. There would be no impairment of park resources or values.

Noise

The study area and the surrounding region are now relatively quiet, with few sources of noise, except car traffic along the river, and landfill and airport operations near the proposed Port Angeles water treatment plant.

Under the no-action alternative, these minor cumulative noise impacts would continue. Noise from the hydroelectric projects has negligible impacts on residents in the area now.

Under the proposed action noise from trucks and construction equipment would result in minor, primarily site-specific impacts for a few residents. Residents in the vicinity of the northern end of the federal levee, which is proposed for raising, strengthening, and extending, could experience moderate or even major impacts for short periods. Impacts of concrete crushing would be within permitted limits. Operation of the Elwha and Port Angeles water treatment plants could have short-term, severe impacts to staff, which would be mitigated to negligible or minor through the use of protective gear required by the Occupational Safety and Health Administration. No park soundscapes would be impacted as a result of the proposed action; therefore, no impairment of park values or resources would occur.

Cultural Resources

The Elwha River valley is rich in cultural resources that include buildings, structures, landscapes, traditional cultural properties, ethnographic resources, and archeological sites. The valley is the homeland of the Lower Elwha Klallam people, and the river remains at the heart of their ceremonial, cultural, and spiritual existence.

Euro-Americans began to settle and acquire lands in the lower valley in the 1860s. Exploration and development (primarily ranching/farming) of the valley was limited by climate and growing season restrictions. Development activities eventually declined on lands set aside for the Olympic Forest Reserve in 1897, Mount Olympus National Monument in 1909, and Olympic National Park in 1938.

The Elwha and Glines Canyon Dams, hydropower plants, and associated facilities are now listed on the National Register of Historic Places as historic districts. Several other resources listed on the national register reflect the role of the federal government in the Elwha River valley (the Elwha Ranger Station and campgrounds). No prehistoric cultural resources eligible for the national register are known to exist in the project area.

The no-action alternative would result in continuing and cumulative, major adverse impacts to cultural and tribal resources, including decimated fish runs and altered shellfish harvest; the loss of a free-flowing river important to tribal ceremonies, culture, and spirituality; flooded villages, camps, homesteads, plant gathering/preparation sites, and possibly burial sites. The hydroelectric projects would continue as historically important early examples of dams and power plants.

Under the proposed action mitigation actions would have the potential to adversely affect cultural resources within the study area in various ways, primarily by ground disturbance and filling activities. Adherence to the programmatic agreement, as appended to the FEIS, would ensure that major adverse impacts to cultural resources would be avoided, and only minor adverse impacts at most are expected. No park resources or values would be impaired.

Socioeconomic Environment

The highest growth in employment in Clallam County between 1985 and 1990 was in the government, retail / wholesale, and construction sectors. More recently, the county's growing retirement community has created employment gains in the service sector. The county has lagged behind the state in employment growth, while exceeding the state in the retail/wholesale and government sectors.

Commercial and recreational fishing have been a cornerstone of the Clallam County economy, with recreation and tourism also playing major roles.

Currently, the Nippon Paper Industries pays an estimated $2.1 million per year for power at their mill. This would continue or increase over time as the cost of power increases under the no-action alternative. Fishery benefits to business would continue at $840,000 per year or less. Additional losses in commercial and recreational fishing would maintain lower incomes and high unemployment levels. Recreation and tourist expenditures would increase slowly from 1993 levels of $117 million.

The need to modify water quality, water supply, and flood mitigation would increase the cost of dam removal and river restoration. The measures described in this SEIS would cost $69 million, whereas those in the FEIS were estimated to cost $27 million. Flood protection and cultural resources mitigation would increase from $4.2 million to $17 million. Other factors, such as increased operation costs and inflation have also added to the total cost, now estimated at $182.5 million, compared to the $113 million reported in the 1996 FEIS. Because costs have changed, benefits were recalculated. Total benefits of dam removal over 100 years of project life, at a 3% rate of discount, would total more than $355 million, a nearly 2:1 ratio of benefits to costs and a moderate to major, long-term, beneficial impact for several sectors of the local economy, including commercial fishing, sportfishing, and recreation and tourism spending.

Public Health and Safety

Construction and operation of mitigation facilities could present safety problems for workers. Since the FEIS was published, household debris, underground storage tanks, and contaminated soil under the former gas pump island at the former Elwha Resort have been removed, as well as all of the old residences. Contaminated soil at the former transmission line pole storage area at Elwha Dam has also been removed.

Under the no-action alternative hazardous materials (asbestos, lead-based paints, and PCBs) found at the hydroelectric projects at both dam sites would remain. The aging transformers are leaking; these and other features would need to be maintained, replaced, or removed to prevent further contamination of the dam sites. Total petroleum hydrocarbons exceeding the state allowable limit would also need to be remediated. No impairment to park resources from hazardous materials would occur.

Impacts to workers or the public from exposure to fuel or chemicals during the construction of proposed mitigation facilities would be minimal, and would be further reduced to negligible or minor through the use of best management practices. The use of hazardous chemicals during plant operation would be monitored, and standard containment and cleanup procedures would result in negligible to minor impacts. The accident risk to individuals continuing to work on the project during the deconstruction phase could increase simply because of their long-term association with the project, but OSHA regulations would minimize the risk.

Contents

Figures

Tables

Abbreviations

The following abbreviations are used in the text and bibliographic citations:

cfs	–	cubic feet per second
DCWA	–	Dry Creek Water Association
DEIS	–	draft environmental impact statement
DO	–	Director's Order (NPS)
EIS	–	environmental impact statement
EO	–	Executive Order
ESWI	–	Elwha surface water intake
EPHA	–	Elwha Place Homeowners' Association
EWTP	–	Elwha water treatment plant (industrial/fisheries/municipal pretreatment use)
FEIS	–	final environmental impact statement (in this document FEIS refers specifically to the *Elwha River Ecosystem Restoration Implementation: Final Environmental Impact Statement)*
gpd	–	gallons per day
gpm	–	gallons per minute
LEKT	–	Lower Elwha Klallam Tribe
mgd	–	million gallons per day
mg/L	–	milligrams per liter
µg/L	–	micrograms per liter
NEPA	–	National Environmental Policy Act
NPS	–	National Park Service
NPI	–	Nippon Paper Industries
OSHA	–	Occupational Safety and Health Administration
PAWTP	–	Port Angeles water treatment plant (municipal use)
PNPTC	–	Point-No-Point Treaty Council
ppb	–	parts per billion
ppm	–	parts per million
RM	–	river mile
SEIS	–	supplemental environmental impact statement
USACE	–	U.S. Army Corps of Engineers
USFWS	–	United States Fish and Wildlife Service
USGS	–	U. S. Geological Survey

Purpose and Need

Introduction

Two hydroelectric dams on the Elwha River in Washington State currently block access to the bulk of the river, adversely affecting the river ecosystem and the native anadromous fisheries because neither dam was built with fish passage facilities. The lowest of the two dams — the Elwha Dam — is only 4.9 miles from the mouth of the river and was completed in 1913; this dam has formed the Lake Aldwell reservoir. The second dam — the Glines Canyon Dam — is 8.5 miles farther upstream and was completed in 1927; it forms the Lake Mills reservoir. Even though other factors have affected Elwha River salmonid populations, these dams are the primary cause of a precipitous decline in fish runs, to fewer than 3,000 naturally spawning fish today, compared to an estimated 392,000 fish prior to dam construction. Those species that still migrate into the Elwha River to spawn are restricted to the lower 4.9 miles of river, and the problems associated with crowding into this space are exacerbated by the near-elimination of spawning gravel and higher-than-normal water temperatures caused by the dams and reservoirs. The loss of fish from 93% of the Elwha River has resulted in severe impacts to the entire river ecosystem due to the loss of nutrients and carcasses and the subsequent effects on aquatic and terrestrial vegetation and wildlife.

Congress passed the Elwha River Ecosystem and Fisheries Restoration Act on January 3, 1992 (Public Law [PL] 102-495; hereafter referred to as the Elwha Act). This act authorized the full restoration of the Elwha River ecosystem and native anadromous fisheries. Subsequently, two environmental impact statements (EISs) were completed to analyze alternatives to implement the act.

1. The *Elwha River Ecosystem Restoration: Final Environmental Impact Statement* (June 1995) evaluated options for restoring the Elwha River ecosystem and native anadromous fisheries and is referred to in this document as the Programmatic FEIS. The "Record of Decision" that followed selected the removal of both dams as the only option that would accomplish full ecosystem restoration.
2. The *Elwha River Ecosystem Restoration Implementation: Final Environmental Impact Statement* (November 1996) examined two ways of removing the dams, as well as the sediment stored behind them. It is referred to throughout this document as the FEIS or the Implementation FEIS. The "Record of Decision" selected "river erosion" as the preferred alternative for removing sediment. (The November 1996 FEIS included only specific changes to the DEIS, not the entire text of the draft document. Subsequently, a compilation of the DEIS and FEIS was prepared that includes all the text of the draft, along with changes presented in the FEIS, plus responses to comments and the U.S. Fish and Wildlife Service's "Biological Opinion.")

The impacts of the dams to the entire Elwha River ecosystem are analyzed and documented in both EISs, and extensive public involvement accompanied them. (Both the Programmatic FEIS and the Implementation FEIS can be found on the Internet at <http://www.nps.gov/olym/elwha/home.htm>.)

The choices to remove both dams, and to follow the actions described in the Implementation FEIS for the river erosion alternative, remain the same and are not subject to further public comment.

Work has not yet begun to remove the dams, and in the intervening years the U.S. Department of the Interior (USDI) has continued to study the nature of the sediment behind the dams and other factors that will help quantify downstream impacts from removing the dams. In addition, some changes unrelated to the project have occurred. The combination of these factors means some reevaluation of mitigation measures is in order, in particular those measures aimed at protecting either water quality or quantity for downstream users. It is the impacts of these new mitigation measures, as well as any updates relevant to decision-making, that are the focus of this Draft Supplemental EIS (SEIS).

The National Environmental Policy Act (NEPA) (PL 91-190, as amended) requires federal agencies to evaluate environmental impacts before making decisions on actions that may have significant effects. The regulations that guide agencies on how to implement NEPA (40 CFR 1500–1508) state that a supplement to an EIS is warranted if either there is a "substantial change" to the selected action that is "relevant to environmental concerns," or "there are significant new circumstances or information relevant to environmental concerns and bearing on the selected action or its impacts." Although changes to water quality mitigation represent only one feature of the project, they account for a higher percentage of the cost than actions directly related to dam removal. By this indicator alone, the changes would be considered "substantial." The changes and new information described above also trigger the second criterion for preparing a supplement, as there are both new circumstances and new information relevant to environmental concerns.

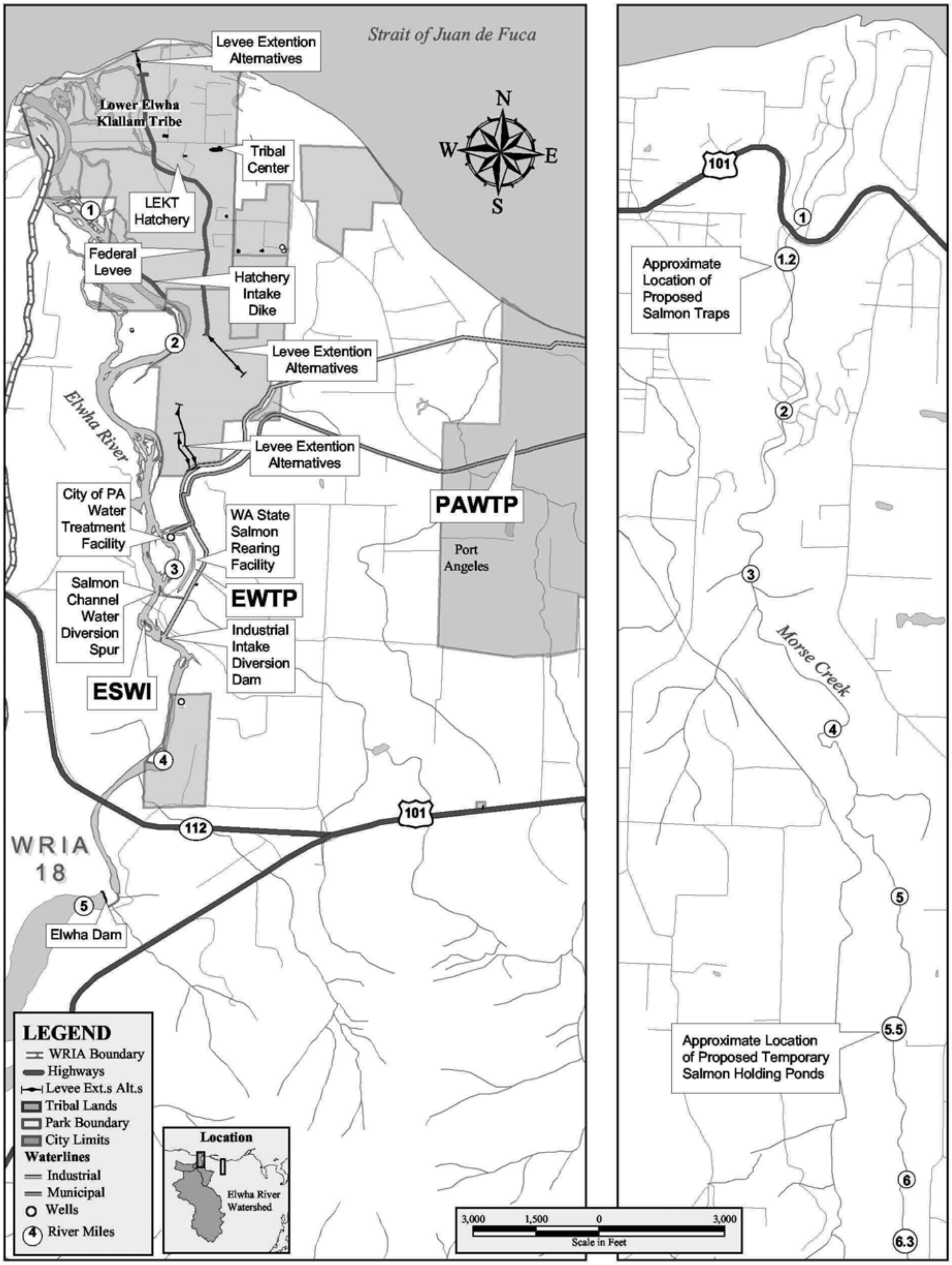
The agencies involved in preparing this SEIS include the National Park Service (NPS) as lead agency, the Bureau of Reclamation and the U.S. Army Corps of Engineers (USACE) as cooperating agencies, and the Lower Elwha Klallam Tribe as a cooperating tribal government. Technically, this document supplements the *Elwha River Ecosystem Restoration Implementation: Final Environmental Impact Statement*. It has been written to stand alone for convenience; as previously mentioned, copies of the FEIS are also available at the Elwha Restoration Project Office and on the Internet.

Purpose of and Need for Action

The need for ecosystem restoration, dam removal, and sediment management resulted in the preparation of the two environmental impact statements described above. In addition to analyzing two detailed dam removal and sediment management alternatives, the Implementation FEIS proposed mitigation for impacts of dam removal related to water supply, water quality, flooding, changes in groundwater levels, and impacts to fish. Since the release of the FEIS, several changes have prompted the participating agencies to consider taking a different direction for many of these mitigation measures. For example, using treated surface water rather than subsurface supplies makes more sense now. Changes such as requirements for treatment of the city's municipal water supply, the need to keep the Washington Department of Fish and Wildlife (WDFW) fish-rearing channel open during dam removal, and other factors have meant revising a treatment strategy for water quality since the FEIS was distributed.

Other changes since 1996 that bear on the proposed action include an increase in the number of reservation residents whose septic systems would be affected by the rise in surface water level of the river, the listing of two species of fish as threatened under the Endangered Species Act, and the changing economics of recycling concrete. In addition, more detail is now available on actions that would occur as part of the revegetation of the dewatered reservoir sites.

These changes are the reason an SEIS is needed. However, the primary reason mitigation is needed is the requirement of the Elwha Act to protect municipal and industrial water users and the Dry Creek Water Association (DCWA) from the possible adverse effects of dam removal. The National Park Service has also identified the need to investigate and provide, where appropriate, flood protection, wastewater mitigation, and hatchery water protection and facility modifications.



Lower Elwha Klallam Tribe
Map prepared by Randall E. McCoy

Study Area

Objectives in Taking Action

Objectives are specific statements of purpose. They are goals that must be met for the project or proposal to be considered a success. The following were derived by an interdisciplinary team of staff from the National Park Service and the Bureau of Reclamation.

- The Elwha Act requires that Elwha River municipal and industrial water users be protected from the possible adverse effects of dam removal. This means that the quality and quantity of their water must be protected during the sediment release period when the dams are removed.
- Water quality during and following dam removal for up to five years is expected to have pulses of very high turbidity interspersed with relatively clean periods. Water quality treatment for supplies subject to these pulses (such as surface water, or groundwater that is hydraulically connected to the river) must be able to effectively provide water of appropriate quality.
- The National Park Service has identified other measures to mitigate possible adverse effects of dam removal, including flood protection for affected properties and infrastructure that is consistent with current flood protection levels and mitigation for possible impacts to septic systems in the lower river area.
- Chinook salmon and bull trout will be protected to the maximum extent possible.
- Construction and other activities associated with changes described in this SEIS will be accomplished while minimizing impacts to resources.

Scope of the Actions Analyzed

This section describes the actions evaluated in this SEIS and the rationale behind them. Each is described in more detail in the "Alternatives" chapter.

City of Port Angeles Municipal Supply

The 1996 FEIS stated that impacts of dam removal on the city's municipal water quality would be mitigated with a temporary "package in-line filter treatment plant." Changes in supply might also occur from dam removal, as the river is expected to be more "dynamic" and migrate back and forth in its channel more frequently. The city currently supplies its municipal customers by means of a Ranney collector on the east bank of the river. A second collector on the west bank was proposed in the FEIS. Limited bench testing of the material behind the dams indicates a Ranney collector could be ineffective during periods of high turbidity because the aquifer would be susceptible to blinding (e.g., "sealing" of the surface). A surface water diversion to ensure supply during these times is considered preferable because of its predictability. The impacts of a surface diversion are evaluated in this SEIS.

The agencies are also pursuing building a permanent treatment plant for municipal customers for several reasons. Since the FEIS was released, the water from the city's current Ranney collector has been reclassified from groundwater to "groundwater under the influence of surface water," and it must now meet requirements for treatment under both the enhanced surface water treatment rule and disinfection / disinfectant by-product rule. This means the city must permanently increase its level of treatment with or without dam removal. The Washington State Department of Health also requires that water permanently meet surface water treatment rule criteria. In other words, Port Angeles could not lessen the degree of treatment even after sediment levels have stabilized following dam removal.

Industrial Users and State of Washington Chinook Salmon Rearing Facility

Surface water for both the city's industrial users and the Washington State salmon-rearing facility is currently diverted from the river at a rock diversion structure into a tunnel south of the old Washington State Highway 112 "one-lane" bridge. The mitigation for increased turbidity during and following dam removal that was analyzed in the FEIS include a buried infiltration gallery to collect water filtered through the riverbed and open-channel treatment with flocculants. The WDFW rearing channel would be closed during dam removal and for a few years afterward. Since the FEIS was released, lab and field tests on the material that would be released from the dams indicate that the infiltration gallery might not be effective because of "blinding," caused by fines filling the surface of the riverbed to such a degree as to effectively seal it. Should this occur, the yield would be significantly reduced during high turbidity events.

In addition, the chinook salmon reared in the state's facility have been listed as a federally threatened species, and the facility now needs to remain open during and for a period of time following dam removal. The rearing facility will therefore need a source of clean water.

As noted above, the proposed action analyzed in this SEIS would examine a modified surface diversion to supply a reliable source of water for industrial needs during dam removal. This source would feed into an industrial treatment facility for Nippon Paper Industries using a treatment method similar to that identified in the FEIS. Because the rearing facility must remain open, the proposed action in this SEIS includes supplying it and the tribal hatchery with some of the treated water from the industrial facility mixed with groundwater.

Tribal Fish Hatchery

The tribal fish hatchery is central to protecting and producing Elwha anadromous fish for restoration. Currently, water for the hatchery is collected through a shallow infiltration gallery at river mile (RM) 1.0 and is supplemented with well water. Additions to this facility were proposed in the FEIS to sustain yield, as were two new proposed wells, mixing and aeration chambers, and systems intended to transmit and distribute water within the hatchery that would allow dilution with clean water to maintain quality. Since the FEIS, the river has migrated away from the infiltration gallery, significantly reducing yield. In addition, lab and field tests on the material that would be released from the dams indicate the infiltration gallery could be ineffective during high turbidity events because of the blinding phenomenon described above. Also, investigations by the tribe of increases in the potential groundwater level show that groundwater elevations in the vicinity of the hatchery might be higher than previously predicted, so it might make more sense to move the hatchery to higher ground. As described in detail in the "Alternatives" chapter, this SEIS proposes to use water from the industrial pre-treatment facility and groundwater to supply the tribal hatchery, and it examines an alternative of moving the hatchery.

Dry Creek Water Association

The Dry Creek Water Association currently includes about 450 homes or businesses whose water supply needs are met with well water. The river currently floods wells in the 50-year floodplain and is expected to aggrade such that the wells in the 25-year floodplain would be inundated once the dams have been removed. Options analyzed in the FEIS included connecting to the city's municipal water system, making changes to existing wells, adding a new well farther from the river, or treating water on site with filtration and chlorination. Proposed mitigation measures for flooding included raising the road grade, one well house, and two wellheads. Expiration of the Dry Creek Water Association's 50-year lease with the owners of the existing well field is several years closer than when the FEIS was released. The Dry Creek Water Association is both considering renegotiating with the landowners and searching for a viable alternate site for their water supply wells. As described in the FEIS, the Dry Creek Water Association remains hesitant to connect with the City of Port Angeles water supply system because this could eliminate their autonomy and possibly increase costs to their shareholders. An alternative well field location and interconnecting pipelines, as well as the original options mentioned in the FEIS, are examined as part of this SEIS.

Lower Elwha Klallam Reservation

Since the FEIS was released, additional technical information, including extensive groundwater monitoring, refined topographic data, and computer mapping, have extended the potential impact area where rises in river elevation are likely to result in elevated groundwater levels, rendering most of the residential septic systems in these areas ineffective. In addition, home construction on the Lower Elwha Reservation has increased substantially. The FEIS analyzed a mounded septic system for 10 homes, but now up to 109 homes and facilities are in the potential area of effect. Therefore, a community wastewater treatment system makes more sense. The tribe has indicated its preference to collect wastewater on the reservation and convey it to the Port Angeles wastewater treatment facility, and it has reached agreement with the city to do so.

Flooding

Since the FEIS was released, side channels in the vicinity of a nearly 8,000-foot-long federal levee near the mouth of the river have proven to be more active than originally predicted. In addition, another 10 or so residents have built homes near the north end of the levee, where flooding is expected to increase following the aggradation of riverbed sediments after dam removal. A piece of the levee has already been reinforced by way of a buried toe following damage from river flow through one of the side channels in 1997. The levee is likely to require extension upstream. The agencies are also examining the potential to upgrade an existing gravel road from the southern end of the levee to Stratton Road to help provide flood protection.

In addition, a refined analysis of sediment distribution completed since the FEIS shows that some areas may experience more aggradation and increased surface elevations following dam removal than was originally predicted. A few residences and other facilities may require changes to flood protection as a result.

Fish Restoration Plan

Since the release of the FEIS, both Elwha River chinook salmon and bull trout have been listed as federal threatened species. The U.S. Fish and Wildlife Service (for bull trout) and National Oceanic and Atmospheric Administration (NOAA) Fisheries[*] (for chinook salmon) will require additions to the fish restoration plan intended to preserve and protect populations of both species. For example, the WDFW rearing channel was to have been closed during dam removal, but it is now going to remain open as a measure to more fully protect the native chinook salmon population during the dam removal process. A bull trout rescue and removal plan is required, and culverts blocking access to tributaries within Olympic National Park that could be used by bull trout as a refuge during dam removal must be replaced or

[*] Formerly the National Marine Fisheries Service.

modified. Efforts to remove eastern brook trout from these tributaries prior to culvert removal would be undertaken to prevent hybridization with bull trout. To help mitigate impacts to chinook salmon, dam removal activities would stop during two additional periods each year to facilitate seaward migration of smolts in the spring and upstream migration of adults in the summer and fall.

Revegetation

The National Park Service has refined and added detail to its plans for revegetating the dewatered reservoir areas. Although the plan described in the FEIS remains the same, the means of achieving several of the actions (such as collecting seeds and cones, controlling invasive nonnative plants, and moving woody debris) are now better known. As a result, the impacts of these specific mechanisms can be analyzed, and the SEIS will either do so, or condition future actions to prevent the occurrence of more than negligible or minor impacts from revegetation.

Dam Rubble

The FEIS analyzed the impacts associated with land disposal of concrete blocks cut from the Glines Canyon Dam. Since the release of the FEIS, the economics of recycling concrete and crushed concrete have changed. Because recycling would be environmentally preferable to disposal, this SEIS examines the option of transporting concrete blocks to a crushing facility to recycle it, rather than disposing of the blocks in open pit mines or landfills. Some combination of crushing, recycling, and disposal is also possible.

Wildlife — Trumpeter Swans

The FEIS proposed some options for mitigating the loss of trumpeter swan habitat in both reservoirs, but it did not select an alternative or analyze its effectiveness. The agencies, after consultation with swan protection groups and some initial analysis, have concluded that the best mitigation for impacts to swans is the protection of existing swan habitat from future development. Property currently used by trumpeter swans in the Sequim / Dungeness and Chimacum Valley areas has been identified, and negotiations are underway for the purchase of conservation easements on one or more of these parcels.

Relevant Laws, Policies, and Plans

Organic Act

By enacting the National Park Service Organic Act of 1916, Congress directed the U.S. Department of the Interior and the National Park Service to manage units of the national park system "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of future generations" (16 U.S.C. 1). The Redwood National Park Expansion Act of 1978 reiterates this mandate by stating that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 U.S.C. 1a-1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered [the National Park Service] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 (9th Cir. 1996)).

Yet, courts have consistently interpreted the Organic Act and its amendments to elevate resource conservation above visitor recreation. *Michigan United Conservation Clubs v. Lujan*, 949 F.2d 202, 206 (6th Cir. 1991) states, "Congress placed specific emphasis on conservation." *The National Rifle Association of America v. Potter*, 628 F. Supp. 903, 909 (D.D.C. 1986) states, "In the Organic Act Congress speaks of but a single purpose, namely, conservation." The NPS *Management Policies 2001* also recognize that resource conservation takes precedence over visitor recreation. The policy dictates "when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant" (NPS 2000).

Because conservation remains predominant, the National Park Service seeks to avoid or minimize adverse impacts on park resources and values; however, the National Park Service has discretion to allow negative impacts when necessary (*Management Policies 2001,* sec. 1.4.3]).

While some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes resource impairment (*Management Policies 2001,* sec. 1.4.3). The Organic Act prohibits actions that impair park resources unless a law directly and specifically allows for the acts (16 U.S.C. 1a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (*Management Policies 2001,* sec. 1.4.4). To determine impairment, the National Park Service must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (*Management Policies 2001,* sec. 1.4.4). This SEIS, therefore, assesses the effects of the management alternatives on park resources and values, and it determines if these effects would cause impairment. An impact to a park resource or value is more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Olympic National Park Enabling Legislation

Olympic National Park is currently undergoing an update of its *General Management Plan* and has completed its "foundation document," which reaffirms the park's understanding of Congress's intent in establishing Olympic as a unit of the national park system. As noted above, an impact to a park resource or value is more likely to constitute an impairment when those resources are named in the establishing legislation or general management plan of the park. The purpose of Olympic National Park is

> to preserve for the benefit, use, and enjoyment of the people, the finest sample of primeval forests of Sitka spruce, western hemlock, Douglas fir, and western red cedar in the entire United States; to provide suitable winter range and permanent protection for the herds of native Roosevelt elk and other wildlife indigenous to the area; to conserve and render available to the people, for recreational use, this outstanding mountainous country,

> containing numerous glaciers and perpetual snow fields, and a portion of the surrounding verdant forests together with a narrow strip along the beautiful Washington coast.

Although the foundation document also identifies the protection of the park's more than 3,000 miles of rivers and streams, as well as spawning and rearing habitat, it does not call out any one river specifically as integral to the function of Olympic as a unit of the national park system. Therefore, although the loss of 70+ miles of pristine riverine habitat, riparian vegetation, wildlife habitat, and habitat for several species of anadromous fish in the Elwha River through damming has had profound and adverse impacts on these resources, these impacts do not constitute impairment of Olympic National Park's values or resources as defined by the Organic Act. This conclusion is supported through the analysis in the "Impacts" chapter of this SEIS.

Resource Issues and Concerns

Issues and concerns are statements of problems that might occur for a particular resource from activities in the no-action alternative or the proposed action. The extent of the problem is analyzed in the "Impacts" chapter. Following is a summary of larger substantive environmental issues that have been identified by agency staff, its contractors, and the public through scoping, which was conducted for 30 days beginning September 12, 2002. Nine comment letters were received during scoping, and the issues identified by commenters during this period are addressed in the "Consultation and Coordination" chapter of this document.

Issues and Concerns Considered in This Document

Surface Water Quality in the Elwha River

Surface water would be affected as a result of site preparation and construction of water supply and water treatment facilities identified in either the no-action or proposed action alternatives. For instance, heavy equipment would be required to clear vegetation, dig and bury pipelines, and grade the site for the Elwha water treatment plant, an industrial facility. These activities would loosen soil, which could wash into the nearby river and increase turbidity. In-river construction (to replace the existing diversion and intake facilities, for example) would add to this effect.

Operation of the treatment plant would result in the disposal of residuals in the river during the sediment phase (for example, during and following dam removal for a few years), which would increase turbidity. This impact is likely to occur at the same time as very large releases of stored sediment during dam removal.

Reliance on infiltration galleries or a second Ranney collector, as identified in the no-action alternative, would result in the interruption of supply during high turbidity events. Because these sources are directly linked to surface water, the impacts on supply are discussed in the "Surface Water" section rather than the "Groundwater" section of this SEIS.

Groundwater Quality or Supply in the Study Area

Groundwater-related issues in this SEIS concern the effectiveness and options for mitigating the impact of rising groundwater in the lower Elwha River valley, and for protecting groundwater sources. Some increases in turbidity or localized fuel leaks could also impact wells.

Flooding

As noted above, the federal levee may require additional strengthening and extensions both to the north and south to provide the same degree of flood protection as offered now. A private levee opposite the federal levee may also require improvements. Other slight changes to the flood protection measures identified in the FEIS may also be required as a result of refined modeling that shows the way sediment will distribute after the dams have been removed. These mitigation measures could have noticeable effects on the floodplain itself and the values it provides to vegetation, recreation, and wildlife.

Elwha River Fisheries

The mitigation of water quality and water supply would be completed before dam removal began. Construction activities identified above for surface water would result in higher turbidity, which could cause increased mortality, and reduced reproduction because eggs could be smothered. Heavy equipment and construction workers on the river shore or conducting in-river work could trample eggs or spawning habitat, tear or crush riparian vegetation that provides cover for adults and juveniles, and reduce the concentration of invertebrate prey.

Soils and Vegetation

Preparing sites for the Elwha water treatment plant (industrial) and the Port Angeles water treatment plant (municipal), laying pipelines, building access roads, and other activities associated with mitigation measures would require removing soils and vegetation, including riparian vegetation. Construction activities (diversion channel, treatment facilities, levees, roads) could compact soils and decrease the productivity of vegetation. Soils and vegetation could also be contaminated by accidental spills of fuels and other potentially hazardous materials during the construction of mitigation facilities.

Seed and cone collection from the park or adjacent areas could involve the loss of seed sources from localized areas, cutting trees, and disturbance or loss of vegetation from human trampling.

Wildlife

Constructing water mitigation facilities could adversely affect wildlife directly through noise and the presence of humans, or indirectly through the removal of habitat. Wildlife could also be disturbed or displaced by the presence of helicopters or humans on foot as part of the fish restoration and revegetation plans.

Identifying and implementing trumpeter swan mitigation would reduce or eliminate the adverse impact that dam removal would otherwise have on the regional population.

Species of Special Concern

Measures taken to preserve the native chinook salmon population during dam removal, including maintaining an artificially propagated chinook population at the WDFW fish-rearing facility, ensuring that the WDFW facility is provided with clean water, and creating a reserve chinook population using Elwha stock in an adjacent watershed (Morse Creek), would offer beneficial outcomes by increasing the likelihood that chinook salmon would be preserved and restored in the Elwha River following dam removal.

Measures to protect bull trout fall into four categories: (1) a plan for rescuing and removing individual bull trout; (2) transporting rescued bull trout to clean water areas; (3) improving accessibility to Elwha River tributaries during and following dam removal; and (4) monitoring effects of dam removal on bull trout habitat from the mouth of the river to the upstream end of Lake Mills.

At this time, it appears that no additional impact to marbled murrelets, spotted owls, or bald eagles beyond those already allowable by the U.S. Fish and Wildlife Service under the existing "Biological Opinion" for the removal of the dams (see appendix 7 of the FEIS), would occur as a result of the changes and additions included in this SEIS.

No plants of special concern, including tall bugbane, branching montia, giant helleborine, or California hedge-parsley, have been found where water mitigation facilities, pipelines, or access roads would be built. If individuals or pockets of plants were later discovered, the National Park Service would provide input on how to alter these sites, with mitigation to prevent or minimize impacts.

Species without formal listing, but nonetheless of concern to the U.S. Fish and Wildlife Service or Washington State, could experience temporary effects from construction noise, dust, or increased turbidity.

Air Quality and Noise

The use of heavy equipment and construction activities to build the water mitigation facilities would result in emissions from internal combustion engines and dust. Standard mitigation measures would minimize these impacts. Helicopter flights and facility operation would add small amounts of these same pollutants.

Crushing concrete from material removed from either dam would be noisy and would result in increased dust and other air emissions.

Cultural Resources

Digging, trenching, grading, or other ground disturbing activities associated with any of the actions proposed in this SEIS could uncover or damage archeological or buried historical resources.

Socioeconomic Environment

Changes in proposed water quality or water supply mitigation would mean changes in the overall cost of the dam removal project. This would also mean a change in local spending and associated business activity.

On the Lower Elwha Klallam Reservation, the shift from individual, onsite septic systems to a community wastewater treatment system would result in utility bills of approximately $40 per month per residence. This cost would be paid over time by residents of the Lower Elwha Tribal Community, where the average annual income is less than $20,000 per year.

Health and Safety

Site preparation and construction activities associated with building water mitigation facilities could be dangerous for workers.

Issues Not Carried Forward

Several potential issues beyond those identified above were considered by the planning team, but were dropped from further analysis because they do not meet the requirements to be analyzed in a supplemental EIS (see page 2) or the impact to a resource would be negligible.

Fluvial Processes and Sediment Transport. Although the Bureau of Reclamation has refined and updated its sediment model, there are no environmental implications or changes to the proposed action analyzed in the FEIS. Therefore, this impact topic is not re-analyzed in this SEIS.

Native Anadromous and Resident Fisheries Numbers. In addition to the issues identified above, the agencies have updated and refined the results of their model on the expected success of restoration efforts. The numbers do not differ substantially from those presented in the FEIS, so they will not be represented or analyzed in the SEIS.

Living Marine Resources. Some small pulses of turbidity associated with the construction of mitigation facilities might be detectable at the river mouth, but impacts would likely be no more than negligible to living marine resources.

Socioeconomic Environment. In addition to the issues identified above, there are some changes in information relevant to the socioeconomic environment, such as the relative contribution of each sector to the local economy, income and employment rates, and the cost of replacement power. However, none of these has any bearing on the selection of changes proposed in this SEIS. Therefore these topics are not updated or analyzed further.

Traffic. The FEIS analyzed the traffic impacts to remove blocks of concrete and rubble from Glines Canyon Dam and dam rubble from Elwha Dam to nine possible waste disposal locations, with two different possible start dates, including 2000 and 2005. Construction of water quality facilities is now scheduled to begin in 2006, and dam removal in 2008. Although the proposed action analyzed in this SEIS assumes the transport of crushed gravel to recycling centers, no significant difference in the level of traffic along roads or at intersections of concern are expected from those identified in the FEIS. Therefore, no additional analysis has been performed.

Indian Trust Resources. No impacts beyond those described in the FEIS are expected.

Sacred Sites. No known sacred sites would be affected by any of the contemplated actions beyond those described in the FEIS.

Environmental Justice. No impacts beyond those described in the FEIS are expected.

Aesthetic Resources. No significant changes to impacts described in the FEIS are expected, although there might be negligible visual impacts from the city’s municipal treatment facility, a tribal wastewater treatment plant, or distribution pipelines or roads associated with transporting water, wastewater, or treatment residuals. These impacts would be negligible because they would occur in locations where very few people live or visit (see the FEIS for more information).

Alternatives

As noted in the "Purpose and Need" chapter, the following actions have already been analyzed in the Programmatic FEIS and the Implementation FEIS, and no further analysis is provided in this document:

- the decision to remove both Elwha and Glines Canyon dams
- specific means to remove the dams and to manage sediment
- all other actions not specifically discussed in this SEIS

These decisions were made with full public involvement and were formalized in records of decision, in accordance with the NEPA process.

For the purposes of this supplement to the FEIS, the proposed action is the set of new mitigation measures described below in the sections entitled "SEIS — Proposed Action."

The National Environmental Policy Act also requires that a no-action alternative be analyzed in an EIS for comparison purposes. Because this is a supplement of an existing environmental impact statement, the no-action alternative remains as it was described in that document; that is, the dams would remain in place and current management would continue. Therefore, since the decision to remove the dams has already been made, the description of existing conditions under the no-action alternative is for comparison purposes only and is not a viable choice.

Water Supply and Water Quality Mitigation

Industrial and Fishery Facilities

Existing Conditions — No-Action Alternative

Water for Port Angeles's industrial client, Nippon Paper Industries (NPI, formerly Daishowa America), is currently supplied by way of a rock diversion structure across the river at RM 3.3 (see Study Area map on page 3), which raises the surface elevation high enough to feed into an intake tunnel at RM 3.5. At the outlet of this tunnel, untreated water is split between an industrial diversion channel, the WDFW chinook salmon rearing channel, and two bypass channels back to the river. The diversion channel leads to a weir and screen house that controls flow into the pipeline carrying water to the NPI mill. The surface water diversion tunnel can handle the maximum City of Port Angeles surface water diversion right of about 96.8 million gallons per day (mgd) or 150 cubic feet per second (cfs). The rock diversion structure may be incapable of consistently and safely passing pink or chum salmon at certain flows and configurations.

Nippon Paper Industries treats the water at its mill to reduce turbidity by using a conventional flocculation and filtration process. Solids resulting from treatment are disposed of in the Strait of Juan de Fuca, as allowed by the company's National Pollution Discharge Elimination System (NPDES) permit.

The WDFW chinook-rearing channel is on the east bank of the river, adjacent to the industrial diversion channel at RM 2.8–3.0. It consists of an asphalt-lined channel 1,400 feet long and holding 415,000 cubic feet of water. An adult holding pond is located at the downstream end of the rearing channel. The city has a contract with the state to provide 50 cfs of water to the rearing channel, but typically no more than 44 cfs is used. Outflow from the facility returns to a side channel by an open channel, with industrial channel overflow used to help attract returning fish. The rearing facility also uses four groundwater wells to provide cooler, pathogen-free water.

The Lower Elwha Klallam tribal fish hatchery is near the mouth of the river. Current maximum demand for the hatchery is about 7.4 mgd (11.5 cfs), which is insufficient to meet current production programs (some fish are transferred to the rearing channel as needed). An infiltration gallery located about 0.5 mile upstream of the hatchery delivers 4.5–5.1 mgd to the hatchery during winter months. During the summer, contributions from this system may approach zero. Two groundwater wells supply approximately 2.9 mgd. A 1998 study found increased turbidity in the river highly correlated with increased turbidity in water from the infiltration gallery, and that 85%–92% of the river water turbidity was removed through the infiltration gallery at the flows evaluated (Gathard Engineering and Consulting Services and Larry Ward 1998).

The no-action alternative would continue these practices, as the dams would not be removed and water quality and quantity would remain the same as now.

FEIS — Previously Proposed Action

As noted above, municipal and industrial users of Elwha River water need to be protected from the release of large quantities of sediment currently stored behind the dams. At the time the FEIS was written, chinook salmon were not listed as a federal threatened species, so the WDFW rearing channel was proposed for closure, with the fish transferred to the Solduc hatchery for rearing. This action would have eliminated the need to invest in water quality protection for the rearing channel during dam removal.

To provide water for industrial users, the rock diversion structure would be removed and an infiltration gallery composed of perforated pipes would be laid beneath the riverbed in its place. The gallery would be oversized by a factor of two to provide a capacity of 300 cfs of water filtered through the riverbed to ensure the delivery of up to 150 cfs (Bureau of Reclamation 1997). A graded sand and gravel filter that would allow coarse particles to be filtered out of the inflowing water would surround the pipes. The gallery would remain in place over the long term to protect both industrial users and the WDFW rearing channel when it reopened.

A concrete pipe to collect water from the infiltration gallery would be buried along the left bank of the river to carry collected water to a pumping plant (four 30 cfs pumps and two 15 cfs pumps). Electricity for the pumping plant would be provided by a 12.5 kilovolt powerline crossing the river at the downstream end of the infiltration gallery carrier pipe; a switchyard and transformer would be located near the connection to the powerline. A backup generator would provide power during outages. A 54-inch-diameter concrete discharge pipeline passing under the Elwha River would convey water from the pumping plant to a vertical riser structure on the opposite side of the river, where it would connect to the existing industrial tunnel inlet.

A treatment system would be built near the river to produce water for the city's industrial clients. Open channel industrial treatment would be designed to work in conjunction with the infiltration gallery. It would detect incoming turbidity and appropriately dose incoming water from the infiltration gallery with standard drinking-water treatment flocculants, followed by rapid mixing with chemicals and polymers. The treated water would flow through flocculation basins and into settling basins, where chemicals would cause suspended sediments to flocculate and settle out, and the clarified water would be conveyed to the city through the industrial pipeline. Lamella plates would be installed in the settling basins to improve the efficiency of the clarification process. A collection system would collect the settled solids, which would be pumped back to the river for discharge below the city's Ranney well. A storage building for treatment chemicals would be built near existing residences at the fish-rearing channel.

Two flocculation basins, each about 45 feet by 535 feet by 5 feet high, would be required, with a total capacity of 120,000 cubic feet. Two parallel sedimentation basins, with a 20-foot-wide access road between them, would be constructed just downstream from the flocculation basins. Each would be 5 feet high and 1,330 feet long and have a trapezoidal cross section with side slopes of 3:1. Tube settlers would direct sediment to the center of each channel, and a pumping system would move accumulated sediment to the river.

An access road would be constructed from the existing road, between the one-lane bridge and a house near the river, to the pumping plant. About 1,000 feet of the new road would be elevated to provide access during floods; construction would include culverts to pass flows through existing flood channels. The remaining 1,500 feet of new road, leading to sediment traps and a backflushing system for the infiltration gallery, would be constructed at the ground surface. About 1,000 feet of the existing connector road would be improved.

The FEIS proposed the closure of the WDFW fish-rearing channel for approximately two years during dam removal, with Elwha chinook production transferred to the Solduc fish hatchery.

The tribal hatchery would continue to operate during dam removal, and it would be modified before the project started, including water supply improvements, incubation upgrades, and rearing and support capabilities. Innovative hatchery practices would be used to simulate natural rearing conditions and to potentially improve survival in the wild. The FEIS included the construction of a new infiltration gallery and two new groundwater wells, the redevelopment of existing wells, and the construction of a mixing basin and aeration system for these water sources. Surface water delivered to the hatchery would be diluted with higher quality groundwater when needed and would allow for recirculation of hatchery water during periods of high turbidity.

Changes since the Release of the FEIS

As noted in the "Purpose and Need" chapter, limited bench testing of the fine material from Lake Aldwell indicated that the riverbed material above the infiltration gallery could be susceptible to blinding (infilling of the upper layer of riverbed materials with fine sediment to such a degree that the surface may be "sealed" and unable to pass water in the quantities needed). Because of this, an alternative water source for industrial users was deemed necessary. The existing infiltration gallery and proposed infiltration gallery upgrades to supply and filter water for the tribal hatchery could also suffer these same problems, requiring an alternative source of water for continued operation.

Since the release of the FEIS, Puget Sound chinook salmon have been placed on the federal list of protected species and are now classified as threatened under the Endangered Species Act. Included in this listing are natural and hatchery-origin chinook salmon originating from the Elwha River. This means that consultation with NOAA Fisheries is required under section 7 (a)(2) of the act and must take place prior to removal of the dams. Additional mitigation measures named by NOAA Fisheries may be required.

Rayonier has closed its facility, which initially reduced the volume of water that must be treated. However, the requirement to better protect chinook meant that the WDFW fish-rearing channel would require a source of clean water, so much of the initially "unneeded" water would be used to supply the state facility and the tribal hatchery during and following dam removal.

SEIS — Proposed Action

A recently completed feasibility study examined a number of supply and treatment options to meet industrial and fisheries demand (URS 2002c). Many of these are summarized in the "Alternatives Considered but Rejected" section. The selected alternative is described below.

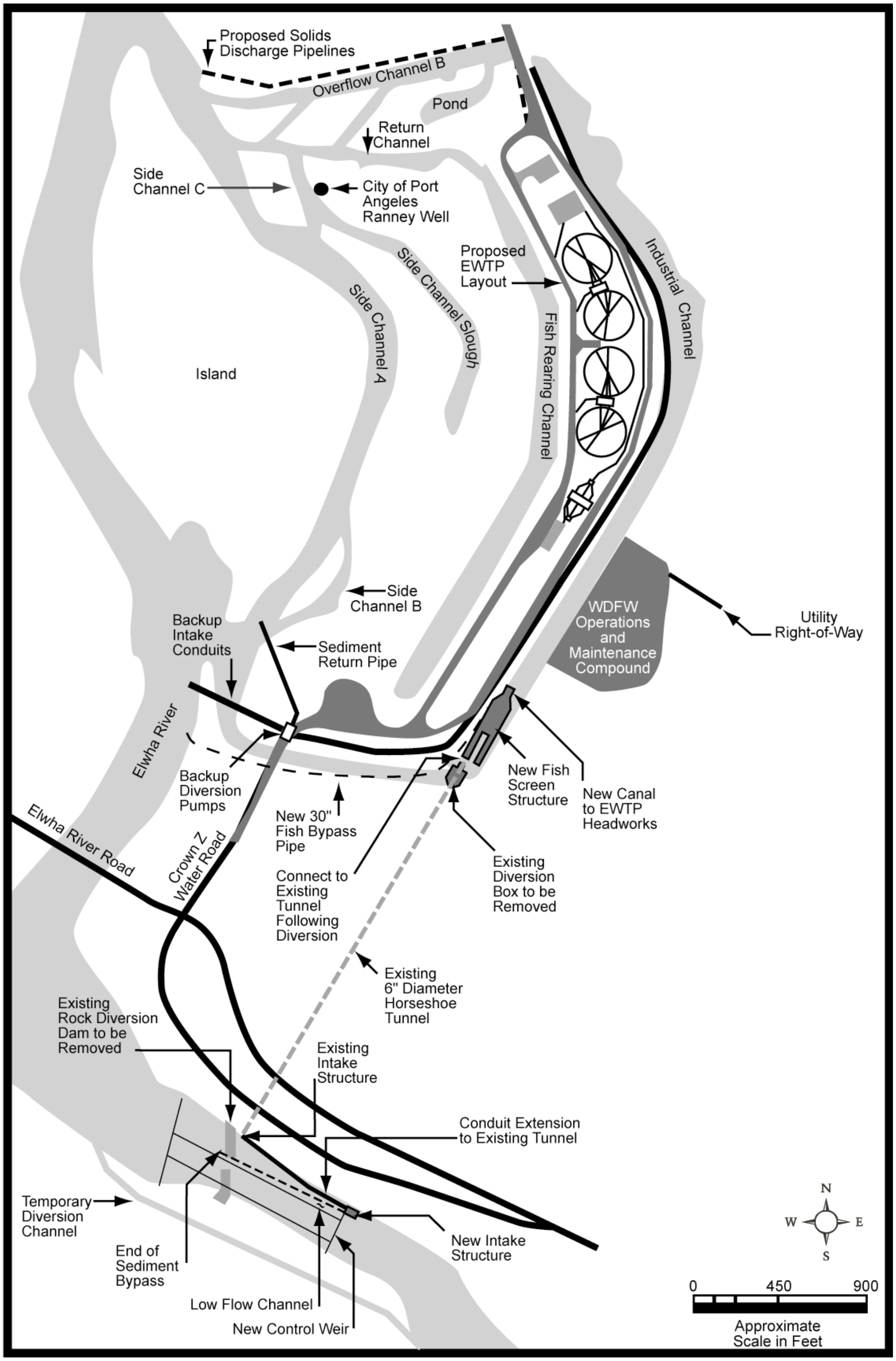
Water Supply. After examining several options, and in light of the problems with infiltration galleries described above, a combined surface source of water for both industrial and fisheries users is proposed (this would also serve as a backup supply for the Port Angeles municipal water treatment plant). This approach would also offer cost, logistical, and environmental benefits. Because the existing rock diversion structure affects fish and sediment passage, a new surface water diversion and intake facility would be required to increase reliability over the existing structure, which might be unstable during very high-flow conditions.

The new diversion and intake facilities would be sized based on their anticipated use subsequent to the sediment erosion phase. The intake facility would be designed to divert up to 116 mgd (180 cfs) based on meeting the city's current ability to withdraw water for industrial purposes and consistent with the city's surface water right and to accommodate the Lower Elwha Klallam Tribe's fish hatchery needs. During times of high turbidity associated with dam removal, water demand from this facility would be split between about 11.1 mgd for municipal drinking water, about 14.0 mgd for Nippon Paper Industries, about 14.2 mgd for the WDFW fish-rearing channel, and 12.4 mgd for the tribal fish hatchery. The water intake and treatment facilities would be sized to meet these demands. The new diversion and intake facilities are collectively referred to as the Elwha surface water intake. (See the "Elwha Surface Water Intake and Elwha Water Treatment Plant" figure.)

Five locations and designs for the surface water intake were examined (URS 2002a). A site about 225 feet upstream of the existing rock diversion structure and intake facility at RM 3.48 was selected based on further site investigations and on the results of a physical model that was constructed and operated at the Bureau of Reclamation's hydraulics laboratory in Denver, Colorado. This location would provide adequate head for flow of river water to the location of the Elwha water treatment plant, which would supply treated water to the tribal hatchery, the NPI treatment facility, the fish-rearing channel, and as needed, the Port Angeles water treatment plant (PAWTP). A channel on the control weir would allow diversion requirements to be met at low flow. This location would also be substantially better than others examined for fish passage, as the river is straight for several hundred feet downstream and a passable facility could be readily constructed. Access to the existing rock diversion structure is by walking the steep bank, on the east side of the river. A proposed means to provide permanent access to the new intake structure is to construct an approximately 500-foot road along the east bank up to the new intake structure. A stairway would also be provided from the Crown Z Water Road to the top of the new intake structure to provide access when the river level is high, preventing access along the new road. On the west side a narrow dirt road next to the abutment of the one-lane bridge (old Highway 112) would be improved for construction purposes.

The conceptual design for the new surface water intake facility consists of a control weir across the river, with a low-flow section near the right bank where a new intake structure would be located. The low profile of the control weir would allow for downstream passage of sediment and upstream migration of adult and juvenile fish.

The existing tunnel now used to convey river water to the industrial diversion channel (as well as to the WDFW fish-rearing channel) would be used to convey surface water from behind the control weir to the Elwha water treatment plant. A 225-foot conduit paralleling the river on its east bank would be built to connect the new intake to this tunnel.



Elwha Surface Water Intake and Elwha Water Treatment Plant Conceptual Designs

Upstream fish passage would be provided by constructing a 1.5% sloped riffle downstream from the control weir. The riffle would extend about 500 feet downstream from the weir. The constructed riffle would end near the upstream edge of an island, which may have been created by gravel deposited at the end of a scour hole in the riverbed caused by the existing diversion structure. The island would need to be excavated to a lower elevation to improve fish passage and flow characteristics. Vegetation would need to be removed, but the excavated material from the island could be used to help construct the riffle.

Downstream fish passage would be accommodated by constructing a new state-of-the-art fish screen facility in front of the Elwha water treatment plant. A 30-inch fish bypass pipe would be routed back to the river, following the alignment of the existing overflow channel.

A temporary diversion channel would be constructed through the floodplain on the west side of the river to divert river flows while the control weir, intake structure conduits, and riffles of the diversion facility were being constructed. Cofferdams would be built across the river at the upstream and downstream ends of the temporary diversion channel to help direct flows and keep the area dewatered during construction. Construction of this channel would require the removal of several mature cedar trees and understory shrubs. When construction in the river was completed, the upstream end of the channel would be recountoured to restore it to as near pre-diversion condition as possible. The downstream end (about 100 feet) would be maintained as a fish resting area, which would include the use of downed trees to enhance fish habitat.

A system of intake pipes and pumps would be installed on the east bank about 500 feet from the one-lane bridge to maintain direct flows during the construction of the diversion channel. The pipes would follow the riverbed to the shore and empty into a wet well. Fish screens would encase the inlet end of the pipe. Pumps would be mounted above the wet well to distribute the water to existing facilities. The diversion facility would be permanent and operated as needed.

Water Quality. Several treatment options were analyzed, including chemical treatment, membrane filters, and disk filters (URS 2002c). Alternative temporary sources of water, such as from the upper Elwha River or Morse Creek, were also examined. Due to limitations on water rights, capacity, and economic feasibility, only chemical treatment was considered feasible (see the “Actions Considered but Rejected” section, page 44).

Tribal fishery users have recommended limiting turbidity to continuous loading up to 15 milligrams per liter (mg/L) with occasional surges up to 50 mg/l (three to five days duration) and up to 80 mg/L (less than 24 hours duration). Industrial users would receive water with turbidity consistently less than 20 NTUs (a measure of turbidity that is roughly equal to 15 mg/L total suspended solids in the Elwha River). Modifications to the NPI water treatment facility would allow the mill to additionally treat the supply.

The treatment scenario is very similar to that described in the FEIS, except it would be designed to clarify more turbid water because the source would be a surface supply. At the proposed Elwha water treatment plant, water would be treated through a conventional treatment process consisting of chemical addition, mixing, and sedimentation. The chemicals would include aluminum sulfate (alum) or polyaluminum chloride (PAC), caustic soda, and small quantities of a polymer (polyacrylamide) to increase the efficiency of the coagulation process. Four clarifiers are proposed, with related chemical storage and feed, influent pumping, rapid mixing, sludge pumping, and flow control features. The treatment facility would consist of an influent pump station pumping water from a connection to the Elwha surface water intake to the mixing tanks. The mixing would consist of three parallel trains. Water would then flow to the sedimentation tanks, each with a capacity of 13 mgd. The capacity of the treatment facility would be 51.8

mgd (URS 2003g; Bureau of Reclamation 2003b). Because some of the water would be used for fisheries, the choice of chemicals is important.

From the clarifiers the treated water would flow to a clearwell structure for distribution to the Port Angeles water treatment plant, Nippon Paper Industries, the WDFW fish-rearing channel, and the tribal hatchery. As stated in the FEIS, the Elwha water treatment plant would treat water for industrial customers (and others, see above) and would be directly adjacent to the rearing channel.

An estimated 46 tons per day of residual coagulated solids would be produced on average, although on a peak turbidity day as much as 1,786 tons per day would result from treatment for municipal, industrial, and fisheries purposes. Because of this high volume, the only feasible option for disposal of these solids would be to return them to the river. River disposal would only occur during dam removal and the subsequent three- to five-year sediment erosion period, when turbidities in the river would be very high. For example, up to 350,000 tons per day of total suspended solids may enter the river in a peak day during dam removal (see FEIS).

Because the quality of water currently sent to the NPI mill historically averages about 8.7 NTU, and water quality during dam removal and subsequent erosion of sediments could be as high as 20 NTUs following treatment at the Elwha water treatment plant, changes to the NPI water treatment facilities in Port Angeles are anticipated. These changes include moving the injection of coagulant to the delivery pipeline instead of the rapid mix chambers, the addition of effluent weir troughs and solids collection and removal equipment to sedimentation basins, and replacing mono-media filters with dual-media filters to increase the efficiency of solids removal. These changes would result in water with a turbidity less than 3 NTU and an average of nearly two tons of dry solids for disposal per day (URS 2004c).

Changes to road access described under "FEIS — Previously Proposed Action" would also be required under this revised proposed action. Contractors to the Bureau of Reclamation evaluated site access road alternatives for the Elwha water treatment plant (URS 2003d). One involves upgrading the existing Crown Z Water Road that leads to the industrial channel and rearing facility. In addition to the upgrades, traffic control devices could be used at the top and bottom of this road, with vehicle-waiting areas established on the Elwha River Road. Public access during the construction period could be restricted by Clallam County, with the exception of WDFW and Port Angeles personnel. A second alternative consists of new and/or improved existing roads along sections of Kacee Way and two unnamed gravel roads to the north of the Elwha water treatment plant site. About 2,700 feet of new road and 3,800 feet of upgraded road would be required. A third road follows Rife Road to one of the unnamed roads identified above for the second alternative route. About 1,500 feet of new road to connect Rife Road and the existing gravel road would be required.

The design vehicle for the roads is assumed to be a semi tractor-trailer combination. The expected vehicle use and frequency during construction of the Elwha water treatment plant and other facilities at the site include peaks of 50 heavy vehicles entering and leaving the site per day. Traffic would consist primarily of concrete delivery trucks entering the site loaded and leaving empty, and dump trucks with trailers and semi tractor-trailer combinations entering and leaving the site both full and empty at different times. During operation of the Elwha water treatment plant, traffic would consist of private vehicles for plant operation and maintenance staff and semi tractor-trailer combinations for chemical deliveries. Peak usage would be on the order of two to four heavy vehicle trips into and out of the site on a single day. This would decline further following dam removal, once turbidities had stabilized (URS 2003d).

Port Angeles Municipal Supply

Existing Conditions — No-Action Alternative

The city's municipal water supply is taken from a Ranney collector on the east bank of the Elwha River at RM 2.8. The Ranney collector was constructed in 1977 and consists of a 13-foot diameter concrete caisson extending to 62 feet below the ground surface. From the bottom of the caisson, seven laterals extend outward, providing a total screen length of 528 feet (URS 2002c). The Ranney collector has two pumps to draw water from the laterals through the surrounding riverbed sand and gravel. The water is disinfected with chlorine on site before it is distributed to reservoirs and municipal customers. The distribution system includes five storage reservoirs holding 18 million gallons. Yield from the collector is approximately 10.7 mgd and depends on the proximity of the river. As noted below in the section on changes since the release of the FEIS, the water derived from the Ranney collector has recently been determined to be under the influence of surface water. This change is independent of the Elwha dam removal and ecosystem restoration project. Regardless of whether dam removal ever takes place, the City of Port Angeles must change its water treatment to meet surface water treatment standards. Therefore, some change to the degree and/or location of water treatment would occur under the no-action alternative.

Ranney collector water also currently feeds four homes located just east of the Elwha River, referred to as the Elwha Heights Water Association.

FEIS — Previously Proposed Action

The FEIS recognized the potential for decreased yields from the city's Ranney collector if riverbed sediment aggraded. Modeling indicated the river was likely to migrate in its channel more frequently when riverbed sediments were restored; therefore, a second collector was proposed on the opposite side of the river to maintain yields if the river migrated away from the existing collector.

Fine sediment in the water during and following dam removal might clog the alluvium supplying either Ranney collector, resulting in increased turbidity and concentrations of manganese and iron in the supply flowing into the Ranney wells. The FEIS proposed a temporary package in-line filtration plant to treat these increased concentrations during and for a period of time following dam removal. Used filters would be disposed of at a landfill site.

Changes since the Release of the FEIS

Since the release of the FEIS, the water collected by the Ranney well has been labeled "groundwater under the influence of surface water." This means the water must be treated as if it were from a surface source, with additional disinfection and/or filtration requirements aimed at removing *Giardia* cysts, cryotosporidium, and viruses. The use of a temporary treatment plant would now be questionable because the Washington Department of Health has indicated it must grant specific permission to allow a municipality to decrease the level of treatment of its drinking water once a higher standard of water quality treatment has been provided. The Department of Health is hesitant to grant such permission.

The agencies have questioned the need for a second Ranney well because the river meanders away from the existing collector now. The Washington Department of Fish and Wildlife has been mitigating the effect of this migration during extreme low-flow conditions by using temporary in-river ecology blocks (1–2 cubic yard solid concrete blocks) or other means to divert some of the flow toward its chinook salmon rearing channel.

However, as noted above, migration of the flow away from the city's collector is not the only problem in maintaining yield during dam removal. Additional testing of the material behind the dams indicates it is more likely to blind the alluvial aquifer from which the existing and proposed new Ranney collectors would draw their water than previously believed. This could make the Ranney collectors unusable during high turbidity events, which would occur both during dam removal and following it for a period of three to five years. During these events yield could be lost if the pumps remained on because of the potential for blinding.

SEIS — Proposed Action

As noted above in the discussion of water supply for industrial and fishery users, this SEIS proposes to create a new surface water diversion and intake system (see the "Elwha Surface Water Intake and Elwha Water Treatment Plant" figure, page 17). The capacity of this system would be sufficient to serve as a short-term or possibly long-term backup for the city's municipal customers if needed. It would also be a more reliable source of water than a subsurface Ranney collector or infiltration gallery during dam removal. During periods of high turbidity, a surface supply would allow the city to turn the Ranney pumps off and prevent potential plugging of the subsurface sand and gravels. When these high turbidity pulses passed, and when sediments stabilized several years after the dams were removed, the city would be able to send water collected from the Ranney well directly to a new water treatment plant.

For the reasons identified above, this SEIS also proposes building a full-scale permanent surface water treatment plant, referred to as the Port Angeles water treatment plant (see the "Port Angeles Water Treatment Plant" figure, page 23). The feasibility study examined several treatment options for such a facility, as well as possible locations (URS 2002a). Although a coagulation/filtration treatment process would use more land than the proposed package in-line water treatment plant, it would offer the greatest flexibility and reliability for treating water of unknown or highly variable quality. Three types of processes were examined (in addition to several other types of treatment reviewed in "Alternatives Considered but Rejected"), but the "Actiflo" high-rate process is preferred because of its effectiveness in treating low-temperature, low-turbidity raw water and its ability to treat significant pulses of turbidity to less than 1 NTU (surface water must be treated so that it is no more than 5 NTUs maximum). This process uses fewer chemicals, and less land is needed for a treatment facility. The study indicated that the coagulation and sedimentation process using Actiflo, followed by filtration through anthracite, sand, and gravel layers, would meet all federal and state surface water treatment standards, even if surface water was the source. The plant would treat water from the Ranney collector, and if needed from the surface diversion and intake during and following dam removal.

The Actiflo treatment process includes the following steps. Alum (a coagulant) and caustic soda would be initially added to untreated water and mixed in the first tank. The water would then enter an injection tank where microsand (60–120 microns) and polymers would be added to help accelerate the settling of the coagulated sediment (floc). In a third tank the particles would grow into a high density floc and quickly settle to the bottom of a fourth tank as sludge. The water would then be drawn off and filtered through anthracite, sand, and gravel filters. The sludge from the fourth Actiflo tank would be pumped to hydrocyclones to separate sludge from the reusable microsand. If the turbidity of the untreated water was low, chemical addition could be stopped and the water simply filtered. Before it was distributed, water would be disinfected with sodium hypochlorite.

Because the majority of water used in the process would already be filtered through the Ranney collector or pretreated at the Elwha water treatment plant, the volume of sludge or solids produced would be far less than in the industrial and fisheries treatment process, ranging from 2,786 dry pounds per day during average flow to 4,680 dry pounds per day at peak flow rates. At average flow rates this would translate to about 1,241 cubic yards of material composed of 20% solids each year taken from the proposed sludge drying bed. Although mechanical dewatering would be possible, it would be more costly.

Siting criteria for a treatment facility included topography, hydraulics, environmental constraints, adjacent land use and compatibility, access, and proximity to utilities. The plant would require about 5 acres of land and would consist of a single story and some high bay buildings. The feasibility study examined several locations owned by the city, the Port of Port Angeles, and private individuals. The top ranked site was on the same property as the city's existing landfill, which is scheduled for closure in 2007. The southern end of this site is not used for disposal and is currently a material storage area.

The primary elements of the Port Angeles water treatment plant, as shown in the "Port Angeles Water Treatment Plant" figure, would include the following buildings (moving from south to north) (see URS 2003e):

- *Actiflo / Filter / Clearwell / Administration Building* — A concrete structure with a pre-engineered metal building enclosure of about 150 feet square.
- *Backwash Holding and Recycle Storage Basin* — The backwash holding basin (25 by 84 feet) would be concrete, and the recycle storage basin (about 102 by 84 feet) a lined earthen pond.
- *Sludge Drying Bed* — A concrete basin (173 by 133 feet), with a sand layer for drying sludge.

As noted above, the Ranney collector currently feeds a small subdivision near the river known as Elwha Heights. Although water is currently chlorinated before it reaches this subdivision, this will not be the case once the Port Angeles water treatment plant has been completed. Because the Elwha Heights residents require treated water, this SEIS analyzes a pipeline connection between them and the DCWA system (see below for description of options for the Dry Creek Water Association). Such a connection would involve replacing an existing 4-inch line at Dry Creek along Rife and Walker Ranch Roads with a 6-inch line and extending an additional 6-inch line across an open field to connect Elwha Heights to the existing DCWA waterline.

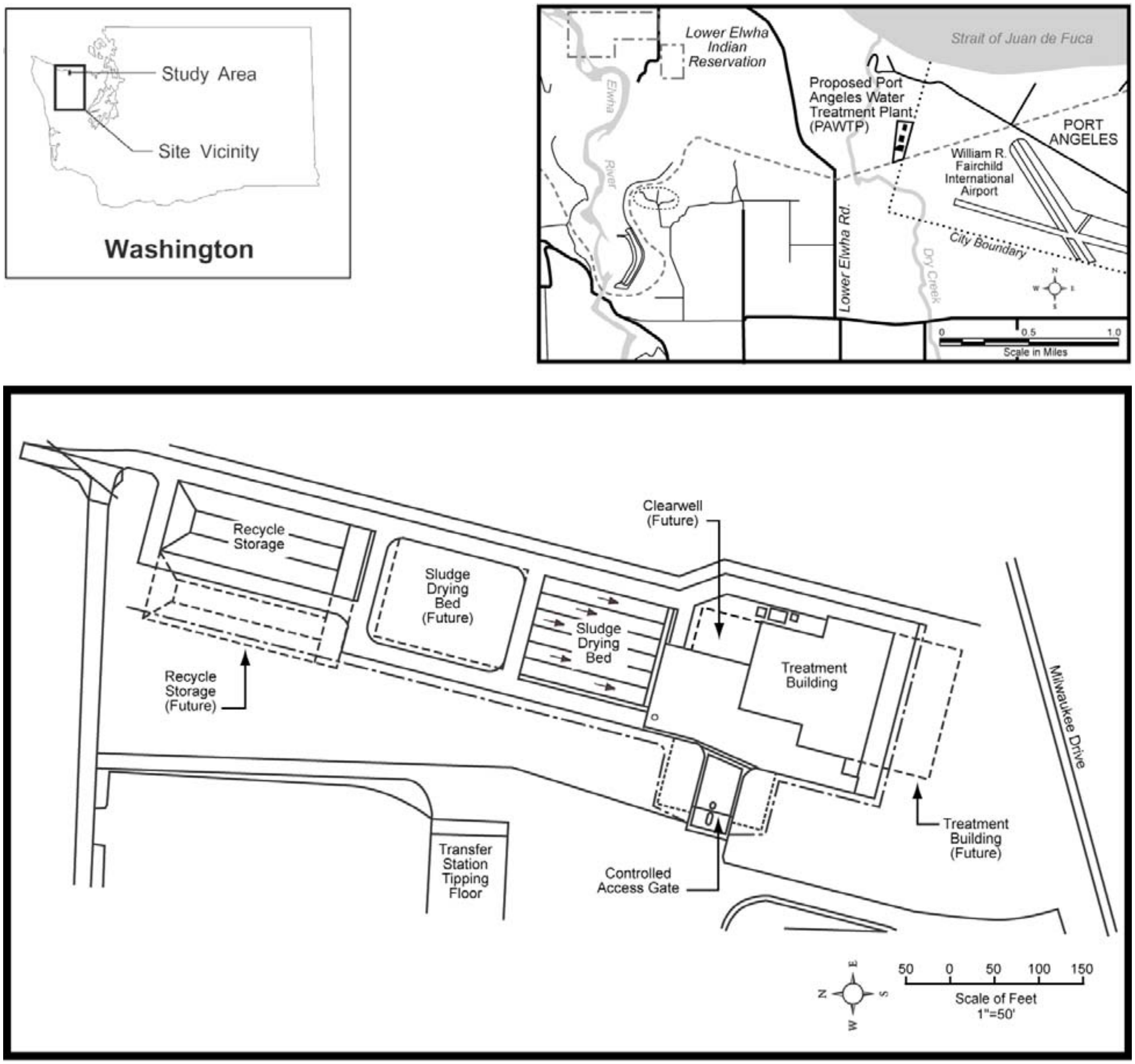
Flooding Mitigation

Re-establishing pre-dam riverbed materials would raise the surface elevation of the river in some places. Where the stream gradient is lower (i.e., the river is less steep), a greater rise in surface elevation would often be expected, with more potential for flooding. In other words, the 10-year or 100-year flood level would rise. The following discussion is separated into changes in flood mitigation measures for the 1.5-mile federal levee that protects much of the Lower Elwha Klallam Tribe's reservation and all other measures.

Lower Elwha Klallam Tribe Flood Control

Existing Conditions — No-Action Alternative

A 7,100-linear-foot setback levee was constructed in 1988 by the U.S. Army Corps of Engineers to provide flood protection (200-year frequency) to the tribal hatchery and community housing. As currently configured, the north end of the levee begins approximately 450 feet south of a protective beach berm and extends southward. The southern end of the levee terminates near the south end of the reservation. Currently, the distance from the river ranges from approximately 370 to 2,400 feet. The levee is closest to the river near its southern end, where a meander continues to move over time in a northeasterly direction.



Port Angeles Water Treatment Plant
Conceptual Design

The east bank of this meander has approached to within 370 feet of the toe of the levee, which is about 230 feet closer to the levee than its new construction configuration.

At the time the Implementation DEIS was written (April 1996), 10 structures on reservation land near the mouth of the Elwha were susceptible to backwater flooding in a 200-year flood. Tribal housing development has occurred in this vicinity since completion of the EIS. The no-action alternative would include the increased development of low-lying areas of the reservation.

FEIS — Previously Proposed Action

The FEIS proposed raising the entire length of the levee an average of 2.5 feet to continue the current level of protection. Because sediment deposition might induce lateral channel instabilities that could cause additional meandering and high velocity flow along the levee embankment, about 1,000 feet of the levee closest to the historic meander belt (near the upstream end) would be thickened with 2 feet of graded riprap. In addition, the channel lateral migration would be monitored over the life of the levee project. If the channel migrated to within 100 feet of the levee at any location, armoring of the embankment would be required in that area.

Near the downstream (north) end of the levee, water from either the river or tides can flow around and into the downstream portion of the protected area. Consequently, 10 structures in the area at that time were subject to flooding during a 200-year flood. Increased water elevation in the river as a result of restoring river sediments would subject five additional structures to backwater flooding. The FEIS proposed either raising these 15 structures approximately 1 foot or extending the levee approximately 400 feet downstream. Extending the levee would also require the construction and operation of a pumping facility to pump stormwater and hatchery ditch water from the protected area. Pumping facilities would likely include multiple pump redundancy, backup generators, and fuel storage provisions.

Changes since the Release of the FEIS

Recent topographic and channel bathymetry data have improved the accuracy and precision of flood modeling efforts. A historic side channel (visible in 1939 aerial photographs) was reactivated during a flood March 18–19, 1997, and a 1,500-foot segment of the levee was damaged. During this flood the Elwha River reached a peak flood stage of 21.9 feet at the U.S. Geological Survey (USGS) gaging station (23,000 cfs). This segment was repaired and significantly improved with rock armoring and a buried toe. This channel will likely continue to be a threat to the integrity of the levee, and it has influenced future design considerations.

Topographic data from Light Detection and Ranging (LiDAR) surveys and channel bathymetry data were used to create a continuous digital terrain model that provides a more detailed view of historic channel topography and to facilitate use of a greater density of river cross sections in hydraulic modeling efforts to update the flood analysis for the lower Elwha River. The model was recalibrated based on a January 2002 storm that was about twice the size of the event used to calibrate the model used in the FEIS.

The LiDAR data showed previously unknown relict channels south of the upstream end of the federal levee near RM 2 (USACE 2003). The modeling indicated that, with the dams removed, these channels would be more likely to be reactivated during a 200-year flood and overtop the levee. Dam removal is predicted to increase the frequency of these overflows to once in 50 years on average, and to increase the magnitude of overflow significantly during the 200-year flood event. If activated, these channels could outflank the upstream end of the existing federal levee and inundate housing on the reservation.

In addition to the above changes, tribal housing development has occurred throughout the reservation, particularly in the vicinity of the north end of the levee, which currently does not protect residents from backwater flooding during a 200-year flood. The number of homes in this area has increased to 24.

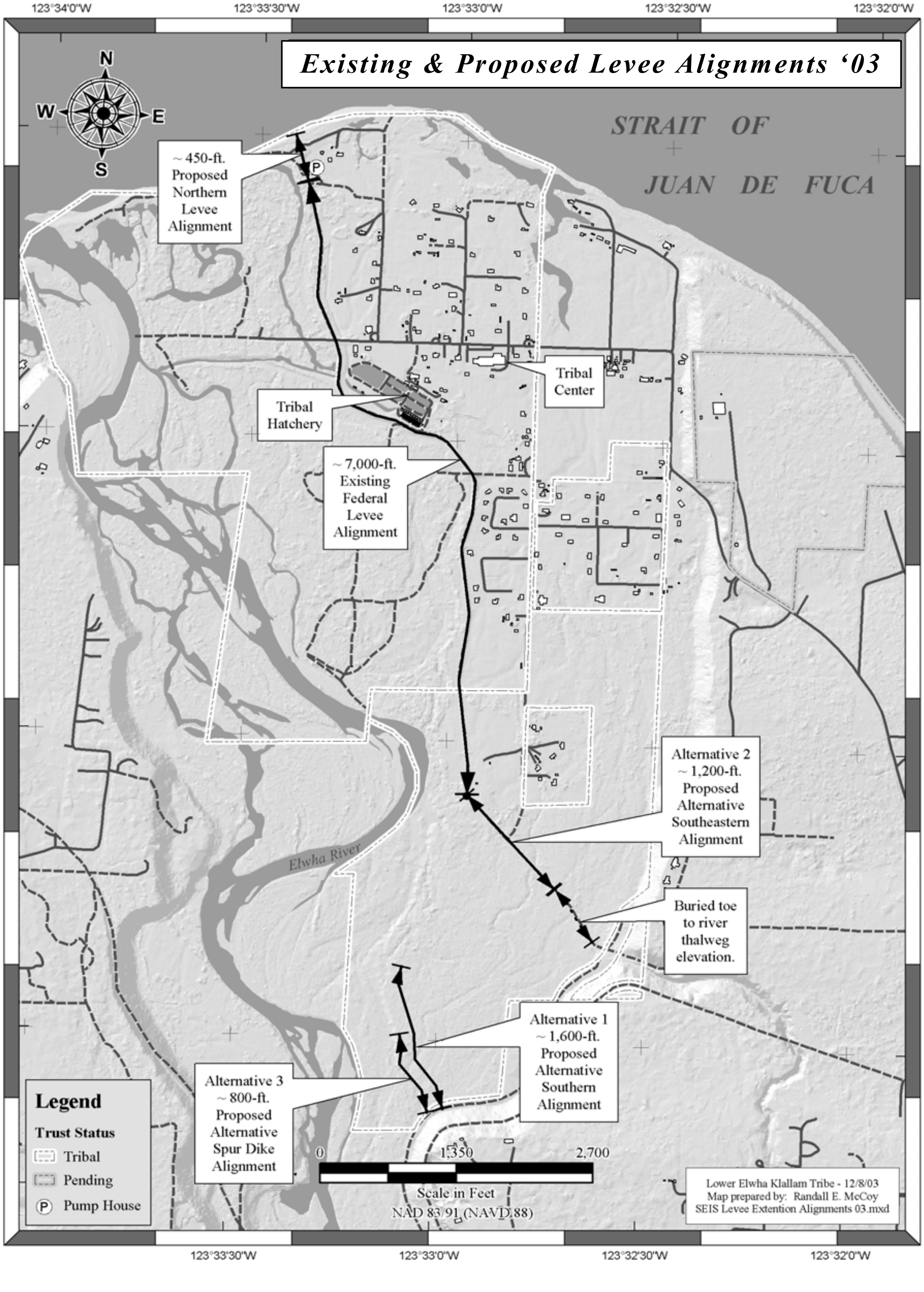
SEIS — Proposed Action

The alternative analyzed in this SEIS for strengthening the levee includes armoring from an elevation that matches the existing river thalweg to the proposed top of the levee with 2 feet of rock riprap able to resist hydraulic forces should the river migrate against the levee. The levee would be raised an average of 3.3 feet, as compared to 2.5 feet in the FEIS, to add freeboard sufficient to stop a 200-year flood.

To protect tribal housing at the north end of the reservation, the levee would be extended approximately 450 feet to the north and tie into the beach berm (see the "Existing and Proposed Levee Alignments" figure, page 26). A pumping facility could be needed to remove storm water from the east side of the levee. Pumping facilities could include multiple pump redundancy, backup generators, and fuel storage provision.

The levee would be extended to the south (upstream) to provide protection against the potential reactivation of two relic channels located at about RM 2.3 (see the "Existing and Proposed Levee Alignments" map). There are three alternatives for this levee extension: (1) a 1,600-foot levee positioned along the floodplain terrace, (2) a raised and strengthened 1,200-foot section of the existing levee haul road, and (3) a series of spur dikes and deflection structures. The terrace levee would be expected to provide a similar level of protection as the spur dike complex, and either would keep the southern reservation (including the recently acquired Halberg property) safe from a 200-year flood. The second alternative would require cutting diagonally across the Halberg property, exposing 80 acres of the southwest corner to increased flooding once the dams were removed and aggradation took place. All three are analyzed in this SEIS, and no one alternative is preferred.

During the original construction of the federal levee in 1988, a gravel haul road was constructed from the southern terminus of the levee to the bluff face to the southeast. An analysis of the levee alignment would include an examination of the feasibility of modifying this road as a flood control facility sufficient to maintain the current level of flood protection and to resist outflanking of the river.


Existing & Proposed Levee Alignments '03
STRAIT OF
JUAN DE FUCA
N
S
E
W
~ 450-ft. Proposed Northern Levee Alignment
P
Tribal Center
Tribal Hatchery
~ 7,000-ft. Existing Federal Levee Alignment
Alternative 2 ~ 1,200-ft. Proposed Alternative Southeastern Alignment
Elwha River
Buried toe to river thalweg elevation.
Alternative 1 ~ 1,600-ft. Proposed Alternative Southern Alignment
Alternative 3 ~ 800-ft. Proposed Alternative Spur Dike Alignment
Legend
Trust Status
Tribal
Pending
Pump House
0
1,350
2,700
Scale in Feet
NAD 83/91 (NAVD 88)
Lower Elwha Klallam Tribe - 12/8/03
Map prepared by: Randall E. McCoy
SEIS Levee Extention Alignments 03.mxd
123°34'0"W
123°33'30"W
123°33'0"W
123°32'30"W
123°32'0"W
48°9'0"N
48°8'30"N
48°8'0"N
48°7'30"N

Other Flood Control Mitigation

Existing Conditions — No-Action Alternative

Table 1 shows structures in or near the river that may experience additional flooding as a result of re-establishing the pre-dam riverbed. These are in addition to the federal flood control levee on the Lower Elwha Klallam Reservation.

Table 1. Other Structures Subject to Flooding — No-Action Alternative

Structure	RM	Existing Flooding Conditions
Locally constructed, privately owned levee (west bank)	0.0–0.1	Protects 30 acres of land for 25- to 50-year frequency flood.
Elwha Place Homeowners' Association (EPHA) wells and residence	1.4	2 EPHA wells and private residence and private well are 2′ below the 100-year frequency flood elevation.
Port Angeles industrial water supply channel	2.5–3.1	Protected from the 100-year flood by an access road.
City of Port Angeles Ranney well collector	2.8	Well caisson and chlorination building are at the 100-year flood elevation.
WDFW fish-rearing facility	2.8–3.0	Shallow nuisance type flooding occurs with a 100-year flood.
Water wells at the WDFW fish-rearing facility	2.8	Lies below the 100-year flood level.
West bank residences	3.5	Two structures and associated private wells are 2′ to 3.5′ below the 100-year flood elevation and are flooded by a 10- to 30-year flood.
East bank residences	3.5	Residence and well are 2′ below the 100-year flood level and are flooded by a 10- to 20-year flood.
Private well	7.9	Situated near the confluence of the Little and Elwha Rivers, the well lies 2′ to 3′ below the 100-year flood level.
East bank private residences	8.4	Three structures are flooded by 5- to 10-year floods.
River training dike	8.5	No flood protection offered, but high-velocity flows are redirected. Flooded by a 25-year flood.
East bank private residence and well	9.5	Residence and well are 1.5′ below the 100-year flood elevation.
Elwha campground	11.0	Campground and well are below the 100-year flood level and currently floods at less than a 5-year frequency.
Elwha Ranger Station	12.0	The site is 2′ above the 100-year flood elevation, although the well is probably below the 100-year flood level
Altaire campground	12.5	Partially flooded by annual floods; flooded by as much as 8′ during a 100-year flood.
Olympic Hot Springs (Elwha Valley) Road		The road extends for 1 mile inside the park and 0.33 mile outside the park, below the 100-year frequency flood elevation.
Bridges	7.7	None affected by high-water levels or floating woody debris during flood events.

SOURCE: USACE 1995a.

FEIS — Previously Proposed Action

Table 2 shows the mitigations proposed in the FEIS for structures in or near the river that would be subject to flooding.

Table 2. Mitigations for Structures Subject to Flooding — FEIS Previously Proposed Action

Location and Structure	RM	Mitigation
Locally constructed, privately owned levee	0.0-0.1	Raise levee 1′ and armor with 2′ of graded riprap.
EPHA wells and private residence	1.4	Raise wellheads and residence up to 3′.
City of Port Angeles Ranney well collector	2.8	Protect with levee (required).
Port Angeles industrial water supply channel	2.5–3.1	Raise 3,000′ of Crown Z Road by 5′ (immediately west of facility) and add flap gate to entrance channel culvert.
WDFW fish-rearing facility	2.8–3.0	Raise Crown Z Road as above (required).
Water wells at fish-rearing facility	2.8	Raise wellheads 3′ to 4′.
West bank residences	3.5	Raise structures or floodproof.
East bank residence	3.5	Raise structure or floodproof.
East bank residences	8.4	Raise 2,000′ of the Elwha Valley Road (Olympic Hot Springs Road) by 3.5′ and raise or floodproof three houses.
River training dike	8.5	Raise dike 3′ and armor with riprap.
East bank residence	9.5	Raise structure or floodproof; armor channel bank with riprap 15′ high and 3′ thick.
Elwha campground	11.0	Close campground during high flows or relocate if suitable areas outside floodplain are available.
Elwha Ranger Station	12.0	Monitor / evaluate bank erosion threat and take corrective action (e.g., bank stabilization, engineered logjam) as needed.
Altaire campground-	12.5	Close campground during high flows or relocate if suitable areas outside floodplain are available.
Elwha Valley (Olympic Hot Springs) Road – 4 miles long		Raise about 1 mile of low-elevation sections of the road inside the park 1.5′; raise 0.33 mile of road outside the park by 1.5′ to 2.5′. Riprap select sections of the road.
Bridges: U.S. Highway 101	7.7	Add debris deflectors to the in-water piers.

Source: USACE 1995a.

Changes since the Release of the FEIS

Recent re-analysis of the flood stage that would occur after removal of the dams has incorporated information from a January 2002 moderate-sized flood, as well as additional topographical information (such as pools and riffle controls, and split flows), to refine the predictions of both the impact of continuing with no-action and of removing the dams (USACE 2003). In addition, flood control mitigation has been completed for the Elwha Place Homeowners' Association.

SEIS — Proposed Action

Actions proposed in this SEIS, in addition to those for the federal flood control levee, are presented in Table 3.

Table 3. Mitigations for Structures Subject to Flooding — SEIS

LOCATION AND STRUCTURE	RM	MITIGATION
Locally constructed, privately owned levee (west bank)	0.0-0.1	Raise and armor the levee (preferred alternative); realign it along higher ground; or remove it and raise affected homes.
EPHA wells and private residence	1.4	Mitigation completed.
City of Port Angeles Ranney well collector	2.8	Protect with levee.
Port Angeles industrial water supply channel	2.5–3.1	Raise 4,850′ of the Crown Z Road by 4.5′ (immediately west of facility) and add flap gate to entrance channel culvert; raise wellheads at least 2.5′ to 2.8′; or possibly construct a single levee to protect gate and wellheads.
WDFW fish-rearing facility	2.8–3.0	Raise the Crown Z Road as above.
Elwha water treatment plant	2.8	Raise the Crown Z Road as above.
West bank residences	3.5	Ring dike; move on site, and elevate until first floor is 4.5′ higher.
East bank residence	3.5	Move on site and elevate until first floor is 4.5′ higher.
DCWA well field and access road	3.7	If existing site maintained on the east side, raise ground level, road grade, one well house, and two wellheads. If alternative site developed on the west side, raise well field area.
East bank private well	7.9	Raise wellhead.
East bank residences	8.4	Move offsite (temporary structure); elevate in place and use a ring dike; or move to higher ground on site.
River training dike	8.5	Raise dike 1.5′ and armor with riprap (not in USACE 2003 report).
East bank residence	9.5	Raise or floodproof residence; armor channel bank with riprap 15′ high and 3′ thick.
Elwha campground	11.0	Take no active flood protection measures because use is seasonal and outside flood periods; flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.
Elwha Ranger Station (including structures, septic system, roads, and utilities)	12.0	Monitor/evaluate bank erosion threat and take corrective action (e.g., bank stabilization, engineered logjams) as needed.
Altaire campground	12.5	Take no active flood protection measures because use is seasonal and outside flood periods (campground closed from late summer / early fall to late spring / early summer); flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.
Elwha Valley (Olympic Hot Springs) Road – 4 miles long		Raise about 1 mile of low-elevation sections of the road in the park and 0.33 mile of road outside of park by 1′. Riprap select sections of road. (USACE 2003 report recommends monitoring to assess when or if a road segment needs to be raised.)
Bridges:		
U.S. Highway 101	7.7	Add debris deflectors to the in-water piers.
Elwha Valley Road	12.1	

SOURCE: USACE 1995a and 2003.

Groundwater Mitigation

Dry Creek Water Association

Existing Conditions — No-Action Alternative

The Dry Creek Water Association was incorporated in 1964 to serve the water needs of residents and businesses to the south and west of Port Angeles. In 1994 the association included 392 connections: 349 residential and 43 commercial; by 2002 there were 450 connections. Water is provided through two groundwater wells on the east bank of the river near RM 3.7. A third well is maintained for backup use. Current pumpage from the two wells averages about 250 gallons per minute (gpm) or 403 acre-feet per year. The no-action alternative over the planning horizon of dam removal in the FEIS would include growth rates projected over the next several years. Based on the Dry Creek Water Association's most recent comprehensive water plan, usage by DCWA customers may increase to 664 acre-feet per year in 10 years, and to 818 acre-feet per year in 20 years. The Dry Creek Water Association currently has a 50-year lease for the existing well field; the lease is due to expire in 2014 and is administered as an Indian family trust property by the Bureau of Indian Affairs.

FEIS — Previously Proposed Action

Hydraulic modeling indicated the river terrace on which the existing well field is located would be inundated by a 50-year flood. Aggradation of the riverbed in the area following dam removal would likely result in inundation by a 25-year flood. In other words, the well field is likely to flood more frequently after the dams have been removed.

At least two of the wells in use by the Dry Creek Water Association are hydraulically connected to the river, but they are not considered to be under the influence of surface water. Projected levels of suspended sediment during and following dam removal, which could exceed 50,000 parts per million (ppm) for short periods, could cause water in the DCWA wells to exceed water quality standards for turbidity. The mobilization of manganese and iron in fine sediments in the reservoirs could also affect DCWA water quality during and following dam removal.

The FEIS proposed two alternative solutions: either connect to the city's proposed Ranney collector and package treatment plant, or drill a new well farther from the river's edge and modify one existing well to provide less turbid water. A new chlorine station and filtration treatment system would be installed to treat well water. The FEIS noted significant constraints in terms of land easements and physical space with this latter alternative. Because the wells and the access road would both be flooded more frequently following dam removal, the road grade, two well houses, and one exterior wellhead would have to be raised to provide the same level of flood protection as is currently provided.

Changes since the Release of the FEIS

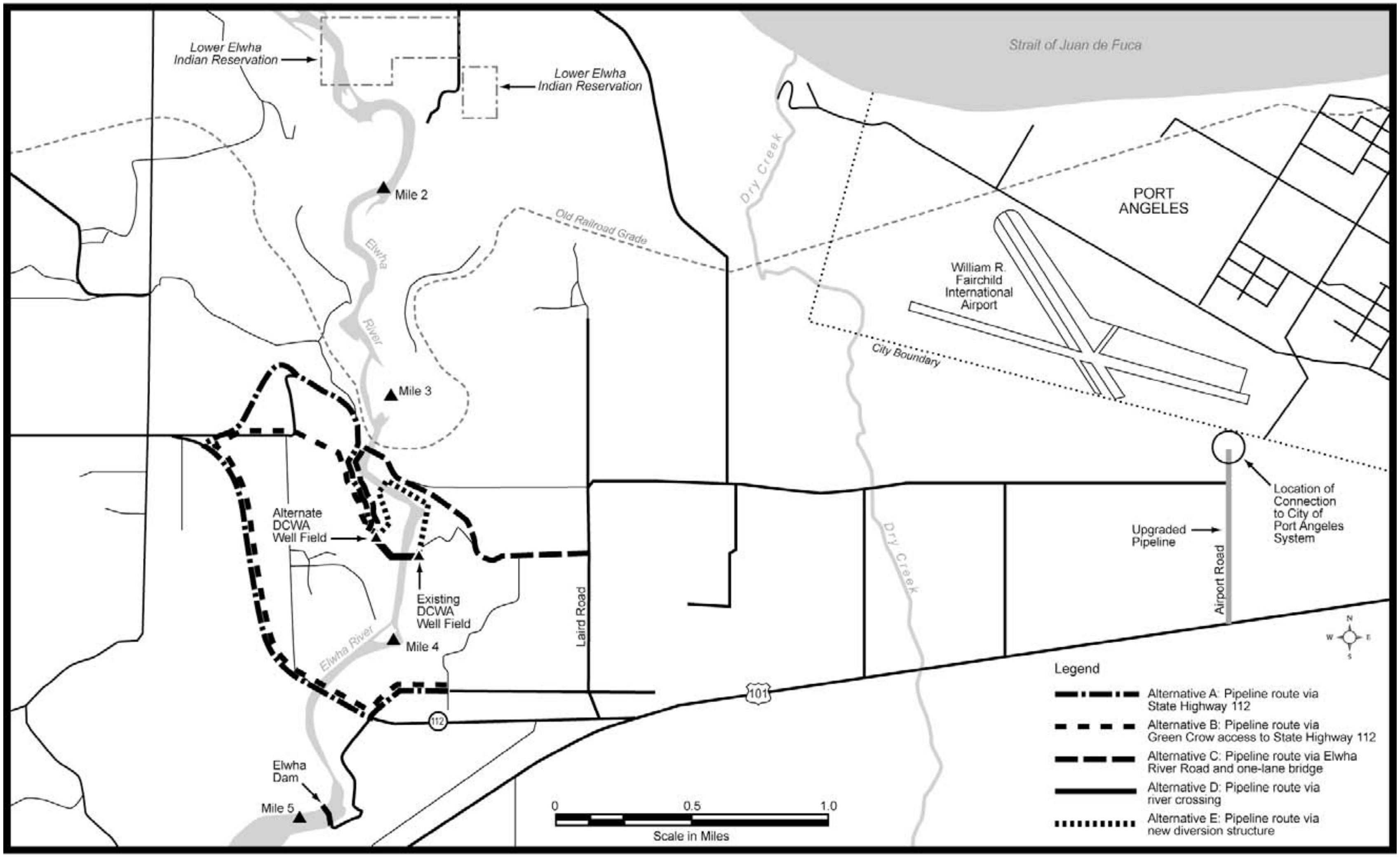
Although no changes other than growth expected under current trends have taken place since the release of the FEIS, the Dry Creek Water Association's 50-year lease for the existing well field has only 10 more years (the association owns the wells and structures). The association is considering both renegotiating the current lease and searching for a viable alternative site for their water supply wells. As described in the FEIS, the association remains hesitant to connect with the city's system, as this could eliminate their autonomy. In addition, two older DCWA wells were determined to be under the influence of river water; one has been plugged, and the other is used only for emergencies. Groundwater from the two newer wells may not be subject to changes in Elwha River water quality.

SEIS — Proposed Action

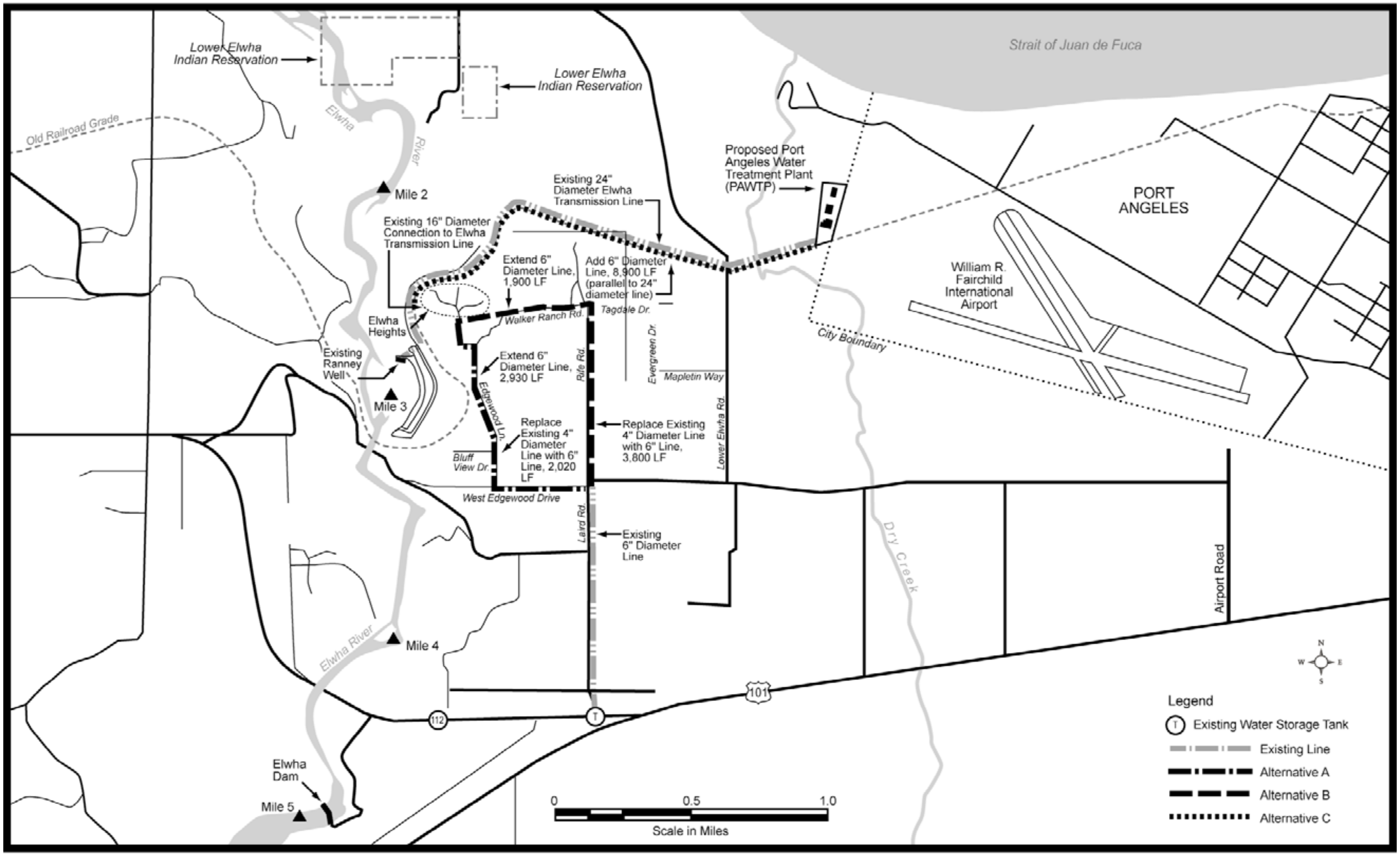
A feasibility analysis of three options was conducted to maintain existing quantity and quality for DCWA water users following dam removal (URS 2003a).

1. **Floodproof the Existing Well Field —** This action would have a relatively low capital cost and would be less likely to impact sensitive resources.
2. **Find an Alternative Well Field —** With only 10 more years for the existing lease, the association has intensified its search for another well field. To date, the well field location most closely examined is on the west bank of the Elwha River on property owned by the Green Crow Partnership. The transmissivity of the aquifer is very high, and well yields should be more than adequate to meet the demands of DCWA users (Bureau of Reclamation, pers. comm. Mar. 2002). Additional testing of an existing unused well in the field indicated that, even though a hydraulic connection to the river exists, there is sufficient natural filtration that it is considered separate for water treatment purposes. The site lies within the 100-year floodplain of the Elwha River and would be more frequently flooded as a result of river aggradation. Five alternative distribution pipeline corridors are being considered from this site to DCWA users. All alternative routes would involve at least moderately complex design challenges and would include bridge or river crossings (URS 2003a). The "Dry Creek Water Association Alternatives" figure (page 32) shows the various alignments.
    - *Alternative Route A* — About 2 miles of new pipeline and a river crossing on the Highway 112 bridge would be required.
    - *Alternative Route B* — The route A alignment would be modified. Instead of following existing roads, the route would include a cross-country section and would follow an overgrown access road to the Highway 112 bridge, where it would cross the river.
    - *Alternative Route C* — Under this option 6,000 feet of new pipeline would be laid along Elwha River Road, then east across the one-lane bridge, and again follow the Elwha River Road to the DCWA connection point at Laird Road.
    - *Alternative Route D* — Only about 1,800 feet of pipe would be laid, but the route would require crossing under the river or in the riverbed.
    - *Alternative Route E* — This option would require 5,300 feet of new pipeline, crossing the river by way of the new intake facilities.
3. **Connect to the City of Port Angeles Municipal Water System —** This option would have relatively low capital costs ranging from one half to one third of the alternative well field option and with very low potential for impact to wetlands or endangered species. A connection to the city system would require about 3,000 feet of waterline that would run along Airport Road.

As noted above, some small changes to the DCWA system would be required to supply water to the four homeowners in Elwha Heights subdivision (see the "Elwha Heights Water System Alternatives" figure, page 33). At this time, negotiations are still underway with the Dry Creek Water Association, and no preferred alternative has been selected.



DCWA Alternative Water Distribution Corridors



Elwha Heights Water System Alternatives

Lower Elwha Klallam Tribe Wastewater Treatment

Existing Conditions — No-Action Alternative

The Lower Elwha Klallam Reservation, tribal trust lands, and individual trust lands include about 1,262 acres near the mouth of the Elwha River. The reservation comprises two distinct areas: the Valley community along the river, and the Heights community above a steep escarpment that physically bounds the valley. A total of 208 homes and other facilities generate wastewater, which is treated by individual septic systems. A majority of the existing systems are either conventional septic systems or a modified version of conventional septic systems. The depths for the drainfields range from 6 inches to 10 feet, depending on the type of system used. About 60% of the tribe's limited land base is dedicated to floodplain and open space west of the lower Elwha flood control levee, along the coast of the Strait of Juan de Fuca for eagle habitat, and on the Tower Addition along the bluffs for erosion control. There are over 100 families on the Lower Elwha Housing Authority waiting list.

Growth has increased on the reservation, and the tribe is expecting this growth to continue at about 5% per year (Ridolfi Inc. 2002). Given the limited land base, the shallow, unconfined aquifer, and growth demands, the tribe has considered a community approach to wastewater treatment in the future, as it may make economic and technical sense to treat water throughout the Valley community in a centralized fashion rather than continuing to use individual septic systems. Because a community wastewater treatment system may be built within 20 to 25 years regardless of whether the dams were removed, it is considered a likely part of the no-action alternative. However, it is not analyzed in this SEIS as part of the no-action alternative because there would be no federal connection to the building (the National Environmental Policy Act only applies to federal actions). One reason the tribe is considering centralized wastewater treatment is because rising groundwater levels after dam removal could make some low-lying septic systems unusable or ineffective, resulting in contamination of groundwater and coastal shellfish habitat.

FEIS — Previously Proposed Action

Hydraulic and sediment transport studies indicate that the groundwater is hydraulically connected to the river and therefore is expected to rise in elevation as the river rises as a result of aggradation of the riverbed. Piezometric monitoring of wells in the valley area from July through November 2001 indicated that the average ratio of river level change to groundwater level change would range from 1:0.4 to 1:1 (Bureau of Reclamation 1995; USACE 1995b). This means that groundwater could eventually rise 2 to 5 feet on average in some areas in response to the rise in river level.

The FEIS proposed modifying about 10 conventional septic systems to mound systems with lift stations. This would elevate the drainfields for a few of the affected systems to a level above the groundwater.

Changes since the Release of the FEIS

Since the FEIS was released, the agencies, the tribe, and contractors secured additional topographic and groundwater information (Ridolfi Inc. 2002) and integrated it with existing Geographic Information System (GIS) data. The new information from the tribe showed that the area of potential impact from increases in groundwater elevation following dam removal would extend over a larger portion of the reservation than estimated in the FEIS, but that the average potential increase would likely be only 2.5 feet. In addition, the reservation has experienced significant growth since the FEIS was published in 1996, and similar growth is expected over the next 10 to 20 years. Up to 109 tribal septic systems, and an additional 13 septic systems under Clallam County jurisdiction, or up to 100% of the existing valley systems, are now identified as being potentially ineffective because of rising groundwater following dam removal.

SEIS — Proposed Action

As noted above, many septic systems on the reservation could be rendered ineffective by rising groundwater associated with dam removal; therefore, federal funds from this project and other sources would be expended to construct a community wastewater treatment system in the Valley community of the reservation. Three alternative treatment and disposal alternatives were examined in detail: (1) a community drainfield, (2) community treatment by an on-reservation package plant (such as a membrane bioreactor, with land disposal of treated effluent), and (3) a connection to the Port Angeles wastewater treatment facility (Berryman & Henigar 2003). After analysis of the pros and cons of each alternative, the tribe found the community drainfield to be inadequate for full build-out of the reservation, and the community treatment option would have greater land base requirements and monthly cost to individual homeowners than the Port Angeles connection. The tribal community held three meetings to share information, discuss the alternatives, and to vote on their preferred alternative. A majority (57%) voted in favor of a connection with Port Angeles.

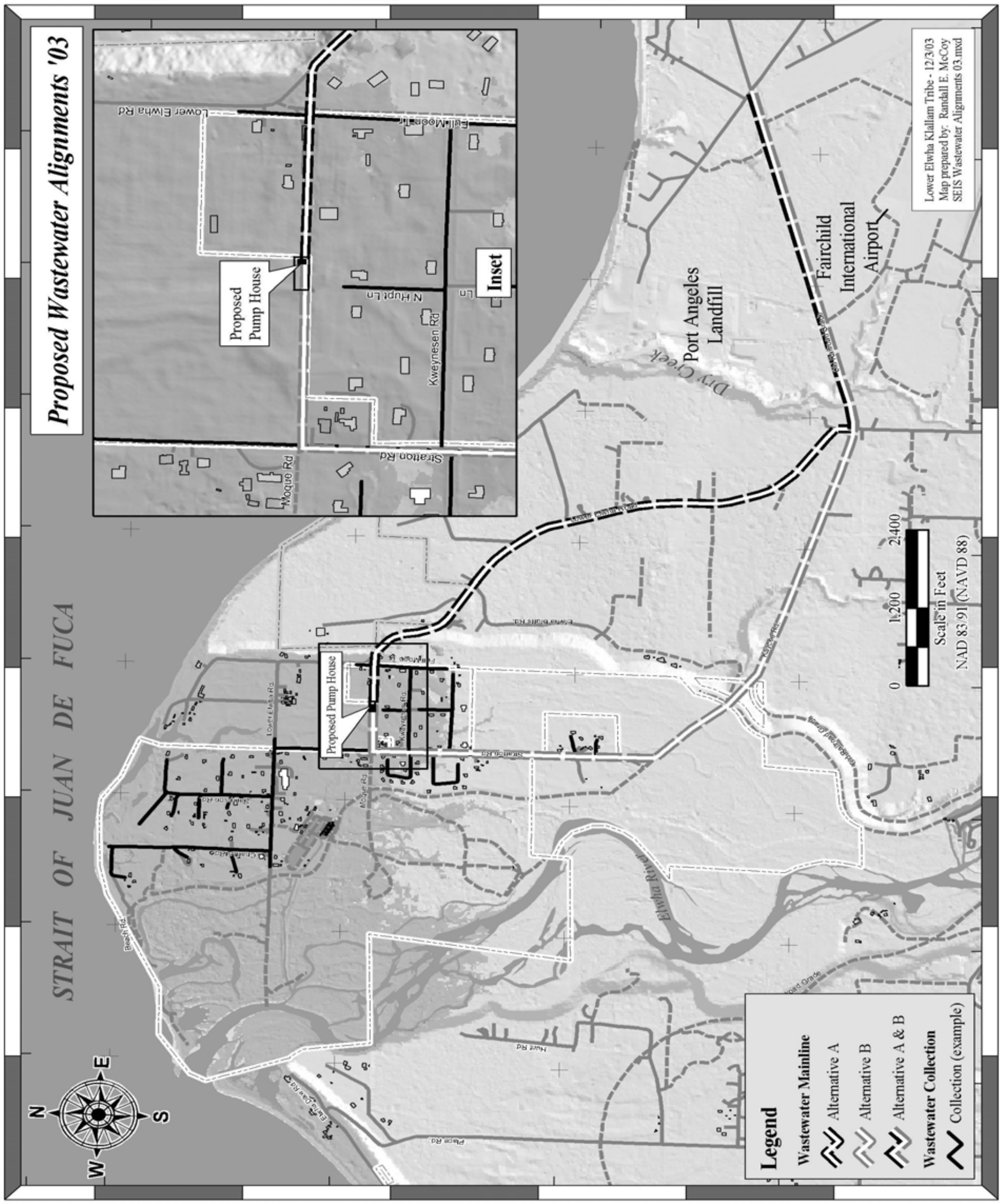
The onsite components for the Port Angeles connection would include a vacuum collection system and a central lift station to pump the wastewater through 2.5 miles of conveyance pipeline to the nearest Port Angeles sewerline for treatment. Two alternative pipeline routes are being evaluated (see the "Proposed Wastewater Alignments" figure, page 36). The tribe has not yet selected a preferred alternative from these two routes, and both are analyzed in this SEIS.

- *Alternative A* — The route would follow the Lower Elwha Road along the existing roadbed to the intersection with the Milwaukee Railroad right-of-way, and then east along the railroad grade, across Dry Creek, and to the 18th Street connection to the city's sewer system.
- *Alternative B* — The alternative B route would follow south along a new primary access route from the reservation, then southeast near the southern terminus of Elwha Bluffs Road, then along the railroad grade and across Dry Creek. It would continue in a more easterly direction along the old railroad grade into Port Angeles at the point the grade crosses 18th Street, where it would connect with the city's sewer system.

A manhole at the connection point to the city's sewer and air scrubber units at both the pump station and the discharge manhole would be installed. (Scrubbers are typically 85-gallon drums set on a concrete pad, filled with filtering media and topped by a suction fan that pulls gases from belowground structures through the filter media.) To avoid problems from combining sewer and stormwater overflow in Port Angeles, wastewater during storm events would be stored at the tribe's lift station or in the pipeline between Dry Creek and the 18th Street connection.

Meetings held from September 2002 through December 2003 with the City of Port Angeles, the Washington Office of Community Trade and Economic Development, and the Washington Department of Ecology indicated a connection would benefit the tribal community, provide feasible mitigation for impacts of dam removal, and would also be welcome because the city's wastewater plant is currently underutilized.

Mitigation for potential groundwater impacts to 13 non-tribal homes in the Valley community under Clallam County jurisdiction could be provided either through onsite mound systems or by connecting to the municipal sewer system by means of the tribe's proposed wastewater lift station. Because of lower residential density, mitigation for these homes would be evaluated on cost factors related to their distance from the tribe's collection system.


Proposed Wastewater Alignments '03
STRAIT OF JUAN DE FUCA
Proposed Pump House
Inset
Lower Elwha Rd
Station Rd
Moque Rd
N Hupt Ln
Kweynesen Rd
Port Angeles Landfill
Dry Creek
Fairchild International Airport
Elwha River
Lower Elwha Klallam Tribe - 12/3/03
Map prepared by: Randall E. McCoy
SEIS Wastewater Alignments 03.mxd
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1,200
2,400
Scale in Feet
NAD 83/91 (NAVD 88)
Legend
Wastewater Mainline
Alternative A
Alternative B
Alternative A & B
Wastewater Collection
Collection (example)
N
E
S
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Fisheries Mitigation

Fish Restoration Plan

Existing Conditions — No-Action Alternative

Chinook Salmon. Chinook salmon are described by the season in which they enter their natal streams to spawn. Spring chinook enter freshwater several months earlier than summer/fall chinook. Biologists believe that spring chinook entering the Elwha River before the dams were built spawned farther upstream (upstream of RM 34 at Carlson Canyon Falls) than those entering in the summer or fall. The extant chinook salmon population enters the lower 4.9 miles of the now-dammed river primarily from June through September. Peak spawning occurs from September through mid October. Juveniles predominantly emigrate seaward their first spring as subyearling fish. A small proportion of the population continues to rear in the river and emigrates the following spring as yearlings. All are likely to spend some time in the estuary and nearshore shallows as they grow and adapt to saltwater.

Elwha chinook salmon stock has been artificially propagated in the watershed since the early 1930s as a means to mitigate the loss of juvenile and adult fish production due to dam construction. The stock is currently reared and released from the state's Elwha facility, which was constructed in 1974. The major stock used in the hatchery program has been the Elwha River summer/fall chinook. NOAA Fisheries included the Elwha hatchery stock as part of the threatened Puget Sound chinook salmon evolutionarily significant unit (ESU) in its 1999 listing. The hatchery stock was included in the listing because it was considered essential for recovery of the ESU. An annual average of approximately 1.82 million chinook salmon fingerlings and 528,000 yearlings were released from 1988 through 1996. The current hatchery program produces only subyearling chinook fingerlings, with an annual goal release of 3.85 million fish. The program will be adjusted to produce 2.5 million subyearlings and 200,000 yearlings each year during the dam removal phase as a measure to improve the likelihood of maintaining viable adult return numbers. Chinook fingerlings were also released from the tribal fish hatchery, but that program was discontinued in the early 1990s. Without dam removal, hatchery rearing of chinook would continue as part of the no-action alternative.

In recent years (1990–2000), an annual average of 47% (range 18% to 70%) of the sub-adult and adult chinook salmon population originating from the Elwha River are estimated to have been intercepted in ocean fisheries. Another substantial portion die in marine waters before returning to the river because of predation or other natural causes. Fishing pressure has been decreased on Elwha River chinook salmon in U.S.-managed marine and freshwater areas in response to the listing of the population under the Endangered Species Act. Harvest protection measures implemented by the state and the tribes are now designed to limit the proportion of the total Elwha River chinook return for a particular year to less than 6% in southern U.S. fisheries.

Total annual spawning escapement (including hatchery volunteer escapement) averaged about 2,000 adult fish between 1990 and 2002, ranging from 1,150 to 3,361 fish during this period. A substantial proportion of the total number of adult chinook escaping into the river die prior to spawning during years when river flows are low and water temperatures become high. Pre-spawning mortality has ranged up to 68% of the population, due largely to parasitic infestations promoted by periodically high water temperatures. The Elwha River chinook spawning escapement goal of 2,900 fish has not been achieved in the past 10 years. The average number of spawners over the last five years has been 2,079, which is somewhat higher than the average of 1,611 for the preceding five years (1993–1997). From 1986 through 2002, the total number of adult chinook salmon surviving to spawn naturally in the Elwha River has ranged from 163 fish (1994) to 5,228 fish (1988). During the same period, the number of adult fish collected as volunteers to the hatchery or removed from natural spawning areas for use as hatchery broodstock has ranged from 663 fish (1995) to 2,595 fish (1988).

Bull Trout. Bull trout occur in limited numbers in Washington State waters. Bull trout can be anadromous or live in freshwater their entire lives. Anadromous populations migrate from the sea upriver from May to December, primarily in August and September. Spawning occurs in the fall, and fry emerge in April to mid-May. Spawning requires cold, low-gradient tributary streams with loose gravel and cobble having groundwater inflow. Anadromous bull trout migrate to sea at age three or four and spend only late spring to early fall in the nearshore marine environment.

Information on the status and abundance of bull trout in the Elwha River basin is limited, but the presence of upper and lower river subpopulations is considered possible because of the separation caused by the dams. The lower Elwha subpopulation is likely primarily anadromous. The upper river population may be resident in the river, or may migrate within the Elwha River basin to spawn. Three bull trout fry were observed in 2003 below the Elwha Dam during snorkel surveys conducted by NOAA Fisheries and the tribe (Pess, pers. comm. 2003).

Conditions in the lower Elwha River are unlikely to be suitable for spawning as the riverbed is composed of large substrate. Although its status is unknown, the lower Elwha subpopulation is likely "depressed," according to the U.S. Fish and Wildlife Service (e.g., a major life history form has been eliminated, or abundance is half the historic population size, or less than 500 adults are present). It is unknown whether the native char in the lower Elwha are bull trout, Dolly Varden (a closely related species), or both.

Through genetic testing, the subpopulation upstream of the Elwha Dam has been identified as bull trout. Good habitat for bull trout exists upstream of Lake Mills and in both the Elwha mainstem and in a number of tributaries. Based on field observations, the size of the subpopulation above the Elwha Dam has been estimated at about 560 in the mainstem and 480 in the tributaries (Reisenbichler 1999). The status of the subpopulation is unknown, but likely to be much healthier than that in the lower Elwha River. These conditions would likely continue indefinitely under the no-action alternative.

FEIS — Previously Proposed Action

Chinook Salmon. The FEIS indicated that very few, if any, of the chinook salmon that may be considered part of a spring-run race remain in the Elwha River. Therefore, using the chinook salmon that now return to the river to restore a spring chinook population is not likely. The restoration strategy for spring chinook would be to collect eggs from the earliest adult spawners entering the river and to outplant the juvenile (pre-smolts) progeny of these adults into the uppermost reaches of the basin. Because outplanting would occur in the relatively inaccessible upper Elwha basin, helicopters would be used. After several generations, this strategy might lead to the reestablishment of a spring component of the chinook salmon population.

The extant summer/fall chinook salmon population in the Elwha is a composite of naturally spawning fish and fish produced in the hatchery. This composite population is considered the appropriate broodstock source for restoring a viable, self-sustaining chinook salmon return to the river following dam removal through the use of artificial propagation. The restoration strategy would involve collecting eggs across the range of spawning chinook and outplanting juvenile chinook salmon at various sites within the river basin, including upstream of the dam sites. In addition to releasing chinook salmon from the Elwha rearing channel, some fish would be held and fed in mid-river acclimation sites for up to two months and then allowed to emigrate. To safeguard the stock during dam removal, the FEIS proposed moving production from the WDFW fish-rearing channel to the Solduc hatchery on the northern Washington coast for up to three years.

Bull Trout. The FEIS indicated that natural recolonization of the Elwha River population would be expected over time as access to the upper river was reestablished and salmon stocks restored. Remnant landlocked populations in the river above the dams are expected to contribute to the recolonization of the entire river.

Changes since the Release of the FEIS

Since the release of the FEIS, both the bull trout and Puget Sound chinook salmon were federally listed as threatened. This means formal consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries and a biological opinion on how best to protect each species during and following dam removal are required.

SEIS — Proposed Action

Chinook Salmon. In consultation with NOAA Fisheries, the state of Washington and the Lower Elwha Klallam Tribe (fishery co-managers) have created a list of measures aimed at protecting hatchery production of chinook during dam removal and at increasing the pace of restoration for Elwha chinook afterwards. These measures include additional clean water "windows" during the dam removal process, keeping the state's fish-rearing channel in the Elwha open during dam removal, using Morse Creek and other facilities within the Dungeness/Solduc hatchery complex for additional hatchery production, additional outplanting following dam removal, and monitoring and best management practices to minimize the effects of flood control and water quality mitigation measures on chinook (and all fisheries). Each of these is described in more detail below.

The FEIS indicated that dam removal activities resulting in sedimentation downstream would be stopped during high spring runoff in May and June to help chinook (and steelhead) entering the river. This suspension of activities would be extended under the SEIS to June 30 to allow chinook smolt to migrate out of the river. A second period of closure from August 1 to September 14 for fall/winter chinook to return to the river, and in particular to the WDFW fish-rearing channel, would also be added.

As noted above, the FEIS proposed moving the WDFW rearing channel activities to another drainage during dam removal to protect the chinook stock. This would mean the chinook reared during these three years would return to the Solduc River, where they could mix with existing chinook stock in that river. To keep the Elwha stock pure, and to keep production of the Elwha chinook high, the co-managers decided that the rearing channel in the Elwha would remain open throughout dam removal. A clean water source (as described above under "Industrial and Fishery Facilities," beginning on page 13) would be required to keep the rearing channel open.

To further protect the stock, some hatchery production during dam removal might be shifted to Morse Creek, a nearby creek that is not a tributary to the Elwha, but that empties into the Strait of Juan de Fuca near Port Angeles. Adults returning to Morse Creek would be captured and used to produce additional eggs and young fish for the restoration process. The Washington State Department of Fish and Wildlife is designing the rearing and acclimation facility at RM 5.5, near the Morse Creek hydroelectric project. This temporary facility would raise 200,000 yearling chinook in four ponds from November through May. In November water use at the ponds would be approximately 6 cfs, increasing to about 8.5 cfs in May as the fish increased in size and were released on site. If required, a pollution abatement pond to ensure National

Pollutant Discharge Elimination System criteria were met could be added. Minimum flows would be maintained in the bypass reach to protect fish life and water quality. Adults returning from the fish releases could either be collected with a temporary fish trap in the stream or by netting.

Construction of the ponds and support facilities (storage shed, access) would take up to six weeks and would involve as many as 10 truck trips per day. Up to three fish hauling trucks could be used to transfer fish to the ponds or to haul returning adults to the ponds each season. The fish trap could be constructed within a week each season of need, and it could be removed within days near the end of the adult return season.

In addition to outplanting eggs or subyearlings, adult fish might be transported by helicopter above what is now Lake Mills to increase the restoration of chinook in the Elwha River. The number of flights would be restricted during the period when spotted owls or marbled murrelets are nesting.

The mitigation measures added to the SEIS to minimize the impacts of installing flood control structures or protecting water quality include the use of best management practices to minimize erosion; release of sediments; or the removal of trees, shrubs, coarse woody debris, and large woody debris. Road widening would be kept to the minimum needed to provide access by heavy equipment. Instead of further widening to maintain public access during the construction period, shuttle service through the road closure zone could be provided.

Bull Trout. The U.S. Fish and Wildlife Service has granted the agencies permission for “incidental take” of bull trout as a result of dam removal. However, it has included a series of measures in its “Biological Opinion” aimed at reducing the impact of that take (USFWS 2000; see appendix B). These measures fall into four categories: (1) preparing a rescue and removal plan for individual bull trout; (2) transporting rescued bull trout to clean water areas; (3) improving accessibility to Elwha River tributaries during and following dam removal; and (4) monitoring effects on bull trout habitat from dam removal (from the mouth of the river to the upstream end of Lake Mills).

Bull trout collected from the river below the Glines Canyon Dam and above the Elwha Dam prior to dam removal would be transported to the Elwha River above Lake Mills. Bull trout collected from the river below the Elwha Dam would be genetically tested to determine their river of origin (i.e., the Elwha River, the Dungeness River, or another stream). Elwha origin fish would be transported above Lake Mills, while bull trout from other streams would be either transported to Dungeness Bay or Freshwater Bay.

The National Park Service is required to replace or modify Hot Springs Road culverts that limit or block access to tributaries that could be used by bull trout as a refuge during periods of high turbidity. Efforts to remove eastern brook trout from these tributaries prior to culvert removal would be needed to prevent hybridization with bull trout. The U.S. Fish and Wildlife Service has also required the monitoring of sediment levels before and after dam removal for 10 years or until pre-dam levels of sediment were restored, and periodic monitoring of suspended sediment and bedload levels after turbidity has stabilized. If it is not stable after 10 years, the “Biological Opinion” calls for the use of sediment stabilization techniques such as replanting to reduce upstream erosion.

Tribal Hatchery

Existing Conditions — No-Action Alternative

The Lower Elwha Klallam Tribe’s fish hatchery is on the reservation near the mouth of the river. Coho and steelhead are raised at the facility. In addition, the tribe has been conducting a chum salmon supplementation program, including the collection of eggs from adults for transport to the hatchery, where they are fertilized and initially incubated. Eyed eggs are outplanted into side channels in the lower Elwha River using remote site incubators, where the fish hatch, migrate into the surrounding gravels, and then remain until yolk absorption is complete. Water for the facility is supplied by an infiltration gallery and wells on the reservation.

FEIS — Proposed Action

The tribal hatchery would continue to operate during dam removal and would be expanded before dam removal was started. As previously noted, modifications include improvements to water supplies. However, in addition, upgrades to incubation, as well as rearing and support capabilities, would also be required. Innovative hatchery practices would be used to simulate natural rearing conditions and to potentially improve survival in the wild.

Aggradation and an increased surface water elevation near the tribal hatchery outflow could impact hatchery operations. Under normal operations outflow from the hatchery is by way of Bosco Creek, which is expected to aggrade during and following dam removal. Periodic dredging would be required to keep this outlet open. During high flows, an outlet pipe flowing under the flood protection levee adjacent to the hatchery bypasses Bosco Creek. Increased surface elevations could cause backflow from this bypass into the hatchery.

Changes since the Release of the FEIS

Since the release of the FEIS, modeling of sediment deposition following dam removal has been refined using actual flood data and incorporating smaller scale topographical and river flow characteristics. These data show that increases in groundwater and surface elevations of the river may be greater in some areas than previously believed. The location of the hatchery is one of those sites.

The hatchery, if left in its current location, would be more difficult to operate because of the annual impacts of flooding and sediment deposition. During periods of elevated groundwater, impacts to hatchery operations would include the inability to recover adults to the hatchery and the volitional release of juveniles from the hatchery. Ponds in this alternative would not be able to be fully drained and cleaned during periods of moderate to high water in the Elwha River. Other impacts from elevated groundwater levels include the potential to lift (float) pond bottoms, difficulties in repairing and maintaining buried utilities, and reduced life of electrical cables, fuel tanks, and other items that are buried in saturated soils.

The current hatchery location would require a pump station to lift hatchery effluent over the levee when flows in the river are high. This is estimated to occur four to five days per year on average. Additionally, the pump station would need to be operated 50% of the time during the fish release period in April and May to substantially drain the two lower rearing ponds. It is expected that no pumping would be required some years and that several weeks of pumping could be required in other years. The pump station would need to be virtually 100% reliable since failure could result in the flooding of the hatchery and surrounding area and the loss of fish from the ponds.

SEIS — Proposed Action

Two options for the tribal hatchery are under consideration: (1) expanding the hatchery at the existing site, or (2) moving it to a location at the Halberg property (RM 2.0–2.3). A hatchery at the Halberg location could result in a facility that would have greater functionality and that would be simpler to use and less frequently affected by high water events in the Elwha River. The facility would use gravity water flow for the supply of all surface water, a shorter pipeline to deliver water from the Elwha water treatment plant (in the short term) and the Elwha surface water intake (in the long term); no pumping of effluent would be required. River levels and conditions would not adversely impact the ability of adult fish to enter the facility or the volitional release of juveniles. Facility infrastructure would be new, would require less long-term maintenance, and would not be adversely impacted by constant exposure to soils saturated with groundwater. The agencies and the tribe have identified the Halberg location at a preferred location for the hatchery.

Revegetation Plan

Existing Conditions — No-Action Alternative

The revegetation plan in the FEIS is primarily concerned with the areas now inundated by the reservoirs. The FEIS indicated that the reservoirs flooded more than 5 linear miles of riverine habitat or an estimated 534 acres of riparian vegetation, including 48 acres of wetlands and 122 acres of unvegetated wet river channel and gravel bars. Both dams and reservoirs are federally owned. Without dam removal, the long-term ownership of these dams and reservoirs is unknown. However, neither dam has fish passage facilities.

FEIS — Previously Proposed Action

Two to three years prior to dam removal, park staff would begin empirical growing trials to identify candidate revegetation species and to determine how well they would grow in lake silts. Park staff would also begin seed and cone collection and the control and removal of nonnative invasive plants upstream of the reservoirs. When the park received adequate restoration funding, it would begin large-scale plant production, in part through non-NPS propagation sources. Sites identified for plant propagation include Sweet's Field. During dam removal and immediately afterwards, initial seeding and planting of remaining sediments would begin as the reservoir was dewatered. Helicopters would be used to overseed inaccessible areas. Coarse woody debris might be relocated to promote recolonization of native species. Biotechnical slope stabilization techniques might be used for sensitive or unstable areas. Intensive planting within habitat types would continue for four years following dam removal, as would the control of invasive nonnative plants and monitoring.

Changes since the Release of the FEIS

Park staff have conducted additional studies and calculations of the amount of material and effort needed to adequately revegetate the site, and they have refined and updated some of the proposals. For instance, the number of seeds and cuttings required may be higher than originally predicted, manual labor may be inadequate given the scale of the plan, and animal grazing of planted material may be a larger problem than the staff believed initially.

SEIS — Proposed Action

In addition to the actions identified above, the park anticipates a greater need for the use of mechanized equipment on the ground and helicopters to complete the revegetation of the dewatered reservoir areas. Either means could be used to collect cones and seeds; to carry large woody debris, duff, or litter from borrow sites; to fertilize or apply soil amendments; or to transport plants or crews. Park staff would take advantage of clearing associated with either new greenhouse construction or dam demolition to collect cones. No trees would be cut in order only to collect cones. Seeds, cuttings, and cones would also only be collected from inside park boundaries. The construction of a greenhouse would be analyzed in a separate NEPA document, which would be completed with public input. Animal control, including fencing newly planted material, might also be required.

Removal of Dam Rubble

Existing Conditions — No-Action Alternative

Both dams would remain in place, so no rubble would be generated.

FEIS — Previously Proposed Actions

Removal of both dams would generate more than 200,000 cubic yards of concrete, rock, and earth fill, including 20,000 cubic yards of concrete from the Elwha Dam site and 15,000 cubic yards from the Glines Canyon Dam site. Some of the material would be buried on site to backfill the spillway outlet channel and penstock area at the Elwha Dam and to restore natural contours. Mechanical and electrical items, timber, glass, fencing, and hazardous materials would be removed from the site for recycling, salvage, disposal, or retention as historic artifacts. The remaining material, much of it concrete from the Glines Canyon Dam, would be trucked to one or more of several surface mines or other open pit sites evaluated in the FEIS. (An extensive traffic analysis of impacts to any of nine sites was included in the FEIS.)

Changes since the Release of the FEIS

Concrete is now more expensive, and the option of finding a party interested in purchasing crushed material for recycling is viable.

SEIS — Proposed Action

The FEIS examined the option of crushing concrete removed from the Glines Canyon Dam on site and transporting the material to be recycled. At the time, the cost was greater than transporting large blocks of concrete and the option was rejected (see "Alternatives Considered but Rejected"). However, as noted above, the economics have changed and recycling crushed concrete may make economic sense. It is also environmentally preferable to recycle the material rather than dispose of it. Logistically, there is no room to locate a crusher at the dam site, so concrete blocks would be transported to a privately owned crushing facility in the region. The park and cooperating agencies have identified the crushing and/or recycling of dam rubble as their preferred alternative.

Wildlife — Trumpeter Swans

Existing Conditions — No-Action Alternative

Lake Aldwell is used during the winter by trumpeter swans, a species of local concern. The swans, which also use some habitat in Lake Mills, have numbered up to 80. About 20 of them spend the entire winter in the Elwha / Port Angeles / Sequim area. The FEIS estimated about 20 acres of foraging habitat at Lake Aldwell and another 3 acres at Lake Mills. Population numbers in the region have remained relatively stable or have recently increased. A slight increase in the use of reservoir habitat is possible over the 20-year horizon of this EIS under the no-action alternative.

FEIS — Previously Proposed Action

Although the FEIS proposed options such as the acquisition of protective easements at other known wintering sites and/or the monitoring of the local population of trumpeter swans, it did not select a particular approach for mitigating impacts to them.

Changes since the Release of the FEIS

No changes relating to trumpeter swans have occurred since the FEIS was released.

SEIS — Proposed Action

The National Park Service has examined options for mitigating the impact to trumpeter swans and has decided that the acquisition of property or conservation easements to protect swan habitat from future development or use would be the best way to offset impacts. The Park Service is pursing the acquisition of conservation easements at this time on appropriate property; however, to protect sensitive negotiations, the exact location of the property is not revealed in this draft.

Actions Considered but Rejected

Several options for water supply and water quality mitigation were analyzed before selecting the actions analyzed in this SEIS. Some of those options are presented below. (For more information, visit the Elwha River restoration website at <www.nps.gov/olym/elwha/home.htm>.) Some alternatives were eliminated because they were not feasible economically or environmentally. Others were rejected because they had the same or more environmental impacts, higher costs, or because they had no technical or other advantage compared to the proposed action.

Water Intake Options

The "Elwha River Water Quality Mitigation Project Planning Report" examined water intake options for industrial supply, fisheries supply, and a backup for municipal supply (URS 2002c). The report concluded that all subsurface supplies, such as from infiltration galleries, Ranney collectors, or vertical groundwater wells, could be subject to blinding during periods of high turbidity. Alternate sources of water, such as from the upper Elwha River, tributaries to the Elwha, or neighboring Morse Creek, were also examined.

The report reanalyzed infiltration galleries, but based on limited bench scale testing results, they would be very susceptible to blinding from river sediment. Also, frequent backwashing of the galleries would be required to maintain them over time. Operation and maintenance costs would be higher because of these issues, and careful monitoring of gallery performance and maintenance of the pump station would be required.

The water quality mitigation report also examined an on-land infiltration gallery, but found it would have the same potential for reduction in yield from blinding of the aquifer.

Drilling a series of vertical groundwater wells or Ranney collectors to provide water was also examined as a supply option for fisheries and industrial supplies. The feasibility study found that 40 to 50 groundwater wells located no closer than 300–400 feet apart along the shore of the river would be required. The depth of the wells would be about 95 feet, and they would produce between 0.4 mgd and 1.5 mgd. This matched production rates in the report *Lower Elwha River Groundwater Resource Evaluation* (Bureau of Reclamation 2001). Spacing the wells would require between 2.5 and 4 miles of available shoreline above the aquifer. Eight Ranney collectors would be required to supply existing needs, no closer than 1,500 feet apart. Future industrial needs for which the city has a water right would require additional Ranney collectors. The feasibility study concludes that there would not be enough river length in the middle and lower basins for the number of wells required (URS 2002c). In addition, utilities, distribution, and access needed to maintain the wells or Ranney collectors would require the acquisition of easements from many different property owners. These difficulties, added to the problem of blinding, made the use of groundwater wells or Ranney collectors infeasible.

Clean water sources during and following dam removal that were evaluated included the upper Elwha River, Morse Creek, and a combination of Little River and Indian Creek. Water quality, supply, and water rights were all investigated. The upper Elwha River was not a feasible choice because of water rights and regulatory restrictions, as well as environmental impacts from using the water and installing a distribution system. The upper Elwha is in a designated wilderness area, and laws and policies regulating use in the wilderness prevent facility construction or the use of mechanized equipment. In addition, federal laws (PL 91-383 and PL 94-458) dictate that water in the park can only be used for public accommodations or services "when there are no reasonable alternative water sources."

Water in Morse Creek is constrained because minimum flows are required by the Washington Department of Ecology to ensure fish protection in the creek, so they are not available for withdrawal. Also, Morse Creek does not have enough flow to provide for the water users that currently withdraw from the Elwha River. The drainage area for Little River and Indian Creek would be inadequate to provide enough water for industrial and fishery needs.

Location of Intakes

Five locations for an intake facility were examined under contract to the Bureau of Reclamation (URS 2002a). Because of the potential for channel migration, two sites were eliminated. In addition, one of these two sites would have required removing a substantial amount of material prior to construction, and construction would have resulted in major adverse impacts on water quality, as well as interference with the industrial water supply during construction. Conceptual layouts, costs, and technical and environmental factors for the three remaining sites were then evaluated and compared.

The cost of an intake facility at site 1 would include 2,700 feet of 72-inch transmission piping and a river crossing, as well as the purchase of land or easements. For these reasons, it would be substantially more expensive than either of the other sites.

One site was designed as a floating intake, which would provide environmental and water quality benefits because no stream modification would be required, but it would be very difficult to maintain. Sediment that was unable to pass through fish screens would have to be manually removed. In addition, the size of the intake would have a major impact on flow conditions in the river at higher stages, and the intake and protecting devices would be at risk of damage from boulders and floating debris.

The remaining site (site 4) was found to be the lowest estimated cost option, primarily because it would be very near the existing industrial intake and rock diversion structure, and because access already exists.

The primary problem with this site was the small amount of head between the intake and the proposed Elwha water treatment plant. Although the team chose this site as its preferred option, additional modeling of sediment flow and fish passage indicated that the river's morphology at this location is not ideal. In fact, because of a downstream bend, sediment following dam removal would be more likely directed toward the intake facility. In addition, the existing rock diversion structure and intake facility have caused a downstream scour hole that would make creating fish passage for fish traveling upstream more difficult. A site further upstream, about 225 feet from the existing diversion and intake facility, was chosen instead.

The proposed layout for the control weir and intake structure has the following advantages over the previously selected site:

- a shorter weir length and height
- a rock foundation for the intake structure on the right bank
- a stable section of river for about 1,000 feet upstream from the existing rock diversion structure, thus reducing the potential for channel migration (There is evidence that the primary channel in the river through this section has been along the right side for over 60 years.)
- a uniform section of river for constructing the roughened channel downstream from the control weir for fish passage

Water Treatment Options

Industrial and Fishery Uses

The "Elwha River Water Quality Mitigation Project Planning Report" examined several alternatives besides chemical coagulation and sedimentation to treat water for industrial and hatchery use (URS 2002c). These included treatment with membrane filters or disk filters, and storing clean water for use during high turbidity periods. The two filtering options were rejected because of very high costs and the potential for clogging and fouling during high turbidity events.

The storage option would have used the settling basins associated with industrial treatment to collect water for storage in one or more reservoirs. A minimum of five days worth of water would have to be stored in the reservoir(s), which means 45 acres of land would be required. The report examined a single reservoir option, as well as individual storage facilities for the tribe, the state hatchery, Nippon Paper Industries, and the City of Port Angeles. The option was rejected because of the required land area, and because of concerns about the likelihood of algal blooms in the reservoirs and the colloidal nature of fine sediments in the surface water. This means that treatment would still have been required. Since the scale of treatment would remain the same as in the proposed action, no environmental or economic cost savings would be realized with this alternative. Because it would offer no advantage, would have substantially more environmental impacts, and would be costlier than the proposed set of mitigation measures, it was dropped from further analysis.

Municipal Supply

The "Elwha River Water Quality Mitigation Project Planning Report" examined several options for treating the city's municipal supply (URS 2002c). Normally the supply would come from the city's Ranney well and would be pumped to a separate treatment facility. However, during periods of high turbidity, when surface supplies are used, water would be pretreated in the industrial/fisheries treatment process before it was sent to the city for further treatment and disinfection. The options for treating the city's municipal supply included conventional treatment, direct filtration, micro filtration membranes, high-rate treatment, diatomaceous earth filtration, and slow sand filters. As noted above, high-rate treatment (the Actiflo process) was selected based on pilot testing.

Conventional treatment was rejected because it would require a larger area and would be more expensive than the high-rate treatment process. While feasible, it would offer no advantage compared to high-rate treatment and would have greater environmental and monetary impacts.

Neither direct filtration nor diatomaceous earth filtration would be appropriate alone, as untreated water quality must be consistently high. Treatment by using membranes or diatomaceous earth were eliminated because they are ineffective in removing dissolved constituents, such as iron and manganese, without the addition of a costly pretreatment process. Slow sand filters would filter water more slowly than high-rate or ordinary rapid sand filters, and so would require a large land area. They would offer no advantage to high-rate treatment and would have more adverse environmental impacts.

A variety of disinfection and treatment residual options were also examined. Because of cost, safety risk, and by-product formation, sodium hypochlorite was selected over the use of chlorine gas, ozone, chloramines, or ultraviolet radiation to disinfect treated water.

Disposal options for treatment plant sludge included river or ocean discharge and disposal in the city's sanitary sewer system. Discharge to either the ocean or to surface water would require extensive permitting and possibly result in adverse environmental impacts. The addition of treatment residuals to the city's sanitary sewer system would be viable, but would require additional hydraulic capacity in the sewer and treatment plant to accommodate the additional flow.

The water quality mitigation report also examined several locations for the proposed city water treatment plant, including two sites owned by the City of Port Angeles, four sites owned by the Port of Port Angeles, one owned by Rayonier, and five owned by private individuals. Using criteria such as access, environmental impacts, compatibility with adjacent land use, availability of utilities, ease of disposal of residuals, and other site characteristics, the agencies (including the city) prioritized the top six. The staging area at the city's landfill site was the preferred site, followed by a private site adjacent to the landfill, then the four parcels belonging to the port.

Groundwater Changes

Lower Elwha Klallam Tribe Wastewater

The Lower Elwha Klallam Tribe examined many wastewater treatment options, including a constructed wetland, lagoon treatment, and multiple mound systems before deciding that community level treatment would be best. The tribe determined that 400 homes or their equivalent would require wastewater treatment at full build-out on reservation lands. Data collected from 1998 to 2001 indicated flows of 190 gpd per structure or a requirement to treat 77,000 gpd on average.

The community drainfield approach would retain septic tanks at individual homes, but it would replace individual drainfields with one large community drainfield in an area where groundwater would not hamper its effectiveness. Although this would be technically possible, even flows of 30,000 gpd would pose an unacceptable risk of potential failure (Berryman & Henigar 2003). The drainfield, which would require nearly 10 acres, would also have the potential for adverse impacts to fish or shellfish, particularly if it failed or partially failed.

The alternative for community treatment would use a membrane bioreactor and sequencing batch reactor to treat wastewater. Treated effluent would be spread over onsite soils. This scenario would require significantly less land (1.7 acres or less), and effluent could be reused. It would be more expensive than a Port Angeles connection and would require more maintenance, but it would offer the tribe independence in terms of rate hikes or system changes. Relative to the selected alternative of a Port Angeles connection, the community treatment alternative scored lower for environmental protection, public health protection, dependability as a proven technology, ability to support future development, and capital costs. The protection of the environment and public health were weighted heavier than other factors. In the final community review the monthly cost was estimated at $70 per month per home; this was the primary deciding factor in choosing the pipeline to the city over the more independent community treatment alternative.

Tribal Fish Hatchery

The tribe conducted a site investigation to assess potential alternate locations for the tribal hatchery. Among the alternatives considered was a facility at the present WDFW fish-rearing channel, which would be owned by the tribe and jointly managed by the tribe and the Department of Fish and Wildlife. This option was rejected by the state after extended consideration because a shared facility would not be in the state's interest, and such a facility could potentially prevent the state from carrying out its legal mandates and responsibilities.

Other Mitigation Measures

Options for providing flood protection for the Lower Elwha Klallam Tribe and for private residences near the mouth of the Elwha River and now protected by a levee are examined in the SEIS. No options have been rejected at this time. This is also true for the DCWA groundwater wells.

Environmentally Preferred Alternative

The environmentally preferred alternative is the one that has the least impact on the human (i.e., physical and natural) environment. In this case, the proposed action is the environmentally preferred alternative because leaving the dams in place, as described for the no-action alternative, would have major, adverse, long-term impacts on fisheries, vegetation, cultural resources, wildlife, and water quality. The dams have resulted in water temperatures in the lower 4.9 miles of river that are 4°C–8°C warmer and less oxygenated than water above the dams. The dams have prevented fish access to all but the lower 4.9 miles of river, with a resulting decrease in numbers that is so significant that it will lead to the extinction of all natural stocks of Elwha salmon and sea-run trout, and may have already led to extinction in some cases. The reservoirs have also inundated 5 miles and over 500 acres of low elevation riparian and wetland communities that would serve a variety of functions, including cycling of water, nutrients, sediment, organic matter, and aquatic and terrestrial organisms in the riverine ecosystem. Wetlands and riparian vegetation also reduce the severity of flood events, act as a buffer to pollution, and provide important fish and other aquatic organism habitat. The proposed action is also preferred to other water quality, water supply and flooding mitigation options for the reasons outlined above in "Actions Considered but Rejected."

Compliance with National Environmental Policy Act, Sections 101 and 102

In any NPS environmental impact statement, the action alternatives are compared to the provisions in sections 101 and 102 of the National Environmental Policy Act to provide additional clarity in choosing among alternatives, particularly the environmentally preferred. Section 101(b) instructs federal agencies to:

- fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- assure for all visitors safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
- achieve a balance of population and resource use which would permit high standards of living and a wide sharing of life's amenities; and
- enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The proposed action would perform significantly better on each of these requirements, although the no-action alternative would continue to provide a renewable source of energy. However, the mitigation measures described in the proposed action in this SEIS, which would be required to implement the previously approved decision to remove the dams (see other sections of this SEIS describing what has been approved), would also "enhance the quality of renewable resources" by restoring stocks of anadromous fish native to the Elwha ecosystem, returning water quality to its natural state, restoring 5 miles and over 400 acres of riparian and wetland vegetation, restoring access to 70 miles of riverine habitat, and restoring spawning and rearing habitat between and below the dams.

The set of mitigation measures analyzed in this SEIS are the only ones considered reasonable, as described above. Implementing them would provide water quality, water supply, and flood protection at current levels, and would therefore be a sustainable practice as described above. Although visitors would not be affected by mitigation measures described in this SEIS, the residents who live near the Elwha River would be significantly benefited by their implementation, which would provide a "safe, healthful, productive and aesthetically pleasing" environment by maintaining drinking water quality and quantity. Best management practices described in appendix A would help in preserving important cultural and natural resources. Conversely, implementing the no-action alternative would continue severe unsustainable environmental and ecological damage to park resources as described above.

NPS policy also directs that all environmental analysis documents address compliance with NEPA section 102(1). This section states that the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forward in the act. This document was written in support of the NPS Organic Act, the Elwha Act, NPS *Management Policies,* and other policies and legislation governing management of the national park system in accordance with the National Environmental Policy Act.

Table 4. Summary Comparison of the Alternatives

FEATURE	EXISTING CONDITIONS — NO-ACTION ALTERNATIVE	SEIS — PROPOSED ACTION FOR MITIGATION
	Water Supply	
Industrial supply	Diversion and intake facility.	Construct new diversion and intake facility.
Tribal hatchery supply	Infiltration gallery.	Use industrial diversion and intake facility; add new wells.
Chinook-rearing facility supply	Industrial diversion and intake facility.	Use industrial diversion and intake facility; add new wells.
Backup municipal supply	Not required / use existing Ranney well.	Use industrial diversion / intake as backup.
	Water Quality	
Industrial supply	Treatment at mill.	Treat water from the Elwha water treatment plant with coagulation, flocculation, and sedimentation.
Tribal hatchery supply	None required.	Use water from the Elwha water treatment plant.
Chinook-rearing facility supply	None required.	Use water from the Elwha water treatment plant.
Municipal treatment	Chlorination of Ranney supply.	Treat water from the Elwha water treatment plant with permanent high-rate Actiflo treatment, dual media filtration, and disinfection when river turbidity was high (during dam removal impact period); treat water from the Ranney collector when river turbidity was low.
	Flooding	
Federal levee	Some repair from damage when a side channel was reactivated. Seasonal backflooding around north end of levee.	Raise levee average of 3.3′ and armor; extend up to 450′ north to the beach berm and 600′–1,600′ to the south.
Private residences, wells	Differing degrees of flood protection now.	Modify to maintain flood protection.
Private levee	Protection from 25-year level floods.	Extend and raise levee or raise homes.
Elwha Ranger Station	Outside the current 100-year floodplain.	Monitor / evaluate bank erosion threat and take corrective action (e.g., bank stabilization, engineered logjams) as needed.
Altaire and Elwha campgrounds	Occasional flooding largely following peak seasonal visitor use.	Take no active flood protection measures because use is seasonal and outside flood periods; flood warnings are provided and the Elwha subdistrict is closed during floods; and the campgrounds have minimal development.
	Groundwater	
DCWA supply	Well field	Either floodproof existing well field, drill new well field, or connect to city's supply.
Tribal septic system	Individual septic systems.	Connect to the Port Angeles wastewater treatment facility.
	Fish Restoration	
Chinook salmon	WDFW rearing channel used and natural spawning.	Keep rearing channel open; suspend dam removal activity May–June 30 and Aug. 1–Sept. 14 to enhance spawning; use Morse Creek to supplement production; mitigate to reduce erosion and vegetation removal.

FEATURE	EXISTING CONDITIONS — NO-ACTION ALTERNATIVE	SEIS — PROPOSED ACTION FOR MITIGATION
Bull trout	No management actions	Prepare a rescue and removal plan; identify a temporary holding area for rescued trout; improve accessibility to clean water tributaries; monitor effects of dam removal on Lake Mills population.
Tribal hatchery location	No mitigation required	Provide flood protection, new outlet, or move to upstream location.
Dam Rubble		
Removal of dam rubble	No action needed	Remove blocks to concrete crushing facility in region to offset costs; recycle materials.
Wildlife — Trumpeter Swan		
Trumpeter swan mitigation	About 80 swans use some habitat at reservoirs during some part of the year	Negotiate conservation easement(s) to protect property currently used in winter by trumpeter swans.

Table 5. Summary of Impacts

IMPACT TOPIC	NO-ACTION ALTERNATIVE	PROPOSED ACTION FOR MITIGATION
Flooding		
Flood protection	Degradation of riverbed offers unnatural minor benefit to some downstream residents.	Flood impacts remain the same for all privately owned structures and facilities, and for federal flood protection levee. Some additional impacts possible to two Olympic park campgrounds and ranger station.
Floodplains	Less side channel habitat and restrictions in floodplain; minor to moderate impact on floodplain values.	Minor, long-term, adverse impacts to the floodplain from additional flood protection measures, particularly the federal levee.
Surface Water		
Water quality and water supply for users	Excellent quality; moderately reduced turbidity and dissolved metals from reservoirs.	Water quality would remain excellent; guaranteed supply during and after dam removal.
Turbidity and dissolved metals in river (aquatic organisms)	Moderately reduced turbidity and dissolved metals from reservoirs; Morse Creek water quality excellent.	Negligible to moderate, temporary impacts to water quality (turbidity pulses) during construction using best management practices, returning within a year to pre-construction conditions (long-term, negligible impact). Negligible to minor impacts on water quality from returning treatment residual from the Elwha water treatment plant and hatcheries to the river. Negligible to minor impacts on water quality from fish pond construction at Morse Creek if best management practices used.
Water temperature	Elwha River below dams 4°C–8°C warmer than under natural conditions; major adverse impact of park water quality.	Major benefit from returning temperatures in the Elwha River to the natural range, as described in the FEIS.
Groundwater		
Groundwater quality and yield for users	Somewhat lower turbidity and dissolved metal concentrations than under natural conditions; also some changes in yield and groundwater tables from degradation.	Users protected from increased turbidity during and following dam removal; and from aggradation and increased groundwater levels and its impact on septic systems.

IMPACT TOPIC	NO-ACTION ALTERNATIVE	PROPOSED ACTION FOR MITIGATION
Native Anadromous and Resident Fisheries		
Anadromous and resident fish habitat	Continuing major adverse impacts to anadromous fisheries from degraded habitat, blocked access.	Negligible to minor, adverse, short-term increases in turbidity from construction of mitigation facilities. Minor to moderate, long-term benefit from removing rock diversion structure and replacing it with a passable weir.
Elwha water treatment plant operation (effluent discharge)	No impact (no discharge).	Negligible impact from releases, as they would occur primarily during and following dam removal.
Soils		
Construction of mitigation facilities	No impacts from mitigation facilities, although reservoirs and dams have resulted in major adverse impacts to soils from removal during dam construction.	Long-term, minor, site-specific impacts from erosion and loss of soil, assuming use of best management practices.
Vegetation		
DCWA water supply / connection to Elwha Heights	Vegetation disturbed at current well field by mowing.	Minor to moderate, local, long-term impacts from floodproofing existing well field; minor to moderate permanent impacts to forested wetlands, riparian areas, and floodplain wetlands from use of alternative well field site. Negligible to minor impacts from pipeline construction and connection to Elwha Heights.
Removal/replacement of diversion/intake structures	Riparian vegetation currently inundated by pooled water at diversion structure.	Negligible to minor temporary impacts from trampling; inundation would remain as it is currently.
Elwha water treatment plant construction	Industrial intake channel, roads, and facilities have resulted in the removal of some riparian vegetation.	Permanent, minor to moderate impacts from loss of riparian forest; minor, temporary impacts from staging. Negligible to moderate impacts to wetlands directly or indirectly affected by construction.
Federal levee modifications	Levee has removed or buried riparian vegetation along its length. Maintenance keeps forest from growing on the levee banks.	Generally negligible to minor impacts to riparian forest from strengthening, raising, and extending the levee, although possible moderate, permanent impacts from a southern extension.
Tribal hatchery expansion	Vegetation was removed to build the hatchery.	Negligible to minor impacts to pasture and orchard vegetation.
Port Angeles water treatment plant construction	Disturbed forest with many crisscrossing roads at proposed plant site.	Minor, adverse, permanent impacts to already disturbed area.
Morse Creek ponds, fish restoration in the Elwha	Upland vegetation relatively undisturbed at Morse Creek; restoration for bull trout, including culverts, could remove some vegetation.	Negligible to minor impacts possible from staging, construction of ponds, or outplanting of fish (helicopter landing pads).
Revegetation of reservoir areas	Continued major, adverse impacts to riparian, wetland, and upland vegetation from dams and reservoir inundation.	Negligible to minor impacts from use of heavy equipment, helicopter landing pads, staging and access roads to revegetate reservoir.
Wildlife		
Actions related to the DCWA well fields, pipelines, connection to Elwha Heights	Riparian habitat somewhat degraded or changed; bird species in the area typical of developed or urbanized areas; side channel habitat for frogs and ducks.	Negligible to moderate, temporary impacts from construction noise to mobile wildlife. Moderate impacts possible to roosting bats. Minor to moderate, permanent impacts possible from the loss of side channel ponds. Negligible impact from loss of wetland along Elwha Heights pipeline.

IMPACT TOPIC	NO-ACTION ALTERNATIVE	PROPOSED ACTION FOR MITIGATION
Removal/replacement of diversion and intake facilities.	Riparian forest well used by recreationists; few animals in the vicinity.	Minor noise impacts to the few species using the site; moderate and temporary noise impacts to wildlife in surrounding vegetation.
Elwha water treatment plant construction	Beaver, river otter observed; great blue heron, pileated woodpecker, mergansers in wetland areas west and east of the plant site; Pacific chorus frogs observed; garter snakes, northwestern salamanders likely.	Moderate, localized impacts within 1,500′ of the construction site. Negligible to moderate impacts as a result of wetland habitat loss, air emissions, and/or turbidity related to construction. Minor, permanent impacts from general habitat loss.
Construction in the vicinity of the federal levee and Halberg property	Some deer browse and many birds feed at the Halberg ranch orchards; gull and shorebirds at northern end of levee; nesting hawk, quail along levee, otherwise common passerines and highly disturbed habitat.	Negligible to minor impacts from modification of most of the levee. Moderate, temporary impacts as a result of levee extension southward. Minor impacts related to hatchery construction possible.
Port Angeles water treatment plant construction	Black-tailed deer observed; nesting red-tailed hawk nearby; otherwise common passerine species at disturbed and noisy site.	Minor temporary impacts from construction noise; permanent impacts from the new facility.
Fish restoration activities	No fish restoration likely except possible culvert replacement for bull trout; minor noise impacts to wildlife.	Minor noise impacts to upland wildlife from culvert installations on Elwha River and construction of fish-holding/rearing ponds at Morse Creek. Potential localized moderate impacts from helicopter noise (outplanting of fish). Additional minor to moderate impacts from use of heavy equipment, helicopters, and barriers for fish restoration.
Species of Special Concern		
Townsend's big-eared bats	Riparian habitat already noisy and used by recreationists; bats may already be disturbed.	Possible moderate impacts from construction, blasting to nearby colonies if present (no colonies have been located).
Bald eagles	Nests along the coast; no known nesting along the river study area.	Possible minor to moderate, temporary impacts to wintering eagles in construction areas; also possible moderate impacts to nesting eagles at river mouth and along coast near river mouth from levee extension.
Northern spotted owls	Nesting in old-growth forest near the river, but no known nest sites or habitat in the impact study area.	Possible minor to moderate temporary impacts from the use of helicopters to outplant fish in the upper drainage or to revegetate the reservoirs.
Marbled murrelets	The river valley used as a flyway to access food at the coast and nests in the upper drainage.	Possible minor to moderate impacts if construction noise caused murrelets to avoid the river valley flyway in certain spots.
Harlequin ducks	No known nesting in the project area, but ducks winter near the mouth of the river.	Possible minor impacts to wintering ducks from the construction of the northward extension of the federal levee.
Pileated woodpecker	Two individuals observed in the project vicinity, one at the Elwha water treatment plant site, and one in the forest south of the Halberg property.	Minor to moderate impacts from construction noise at least in the areas where this species was observed, and likely in other locations where habitat is available.
Northern red-legged frogs and tailed frogs	Individuals observed in wetlands near the DCWA well field; additional habitat exists at the Elwha water treatment plant site.	Possible minor to moderate impacts from filling / modification of wetlands.
Western toad	Observed in the forested portion of the Elwha water treatment plant; likely to occur in riparian forest throughout the study area.	Minor to moderate impacts from trampling, use of heavy equipment in riparian areas.
Chinook salmon, Pacific and brook lampreys	Major, adverse impacts from dams, degradation of habitat.	Possible minor impacts from turbidity during construction.

IMPACT TOPIC	NO-ACTION ALTERNATIVE	PROPOSED ACTION FOR MITIGATION
Bull trout	Major, adverse impacts from dams, habitat degradation.	Possible moderate, temporary impacts from turbidity during construction.
	Air Quality	
Dam rubble disposal (concrete crushing)	No impacts (no rubble disposal). Continued high air quality for study area.	Temporary, negligible to minor impacts within permitted levels.
Vehicular emissions from construction equipment	No impacts (no construction). Continued high air quality for study area.	Negligible impact compared to stationary sources or dam removal; possible minor to moderate impact on nearby residents, staff at rearing channel, construction workers.
	Noise	
Construction	No impacts (no construction activities proposed).	Minor, primarily site-specific, short-term impacts for a few residents near construction sites. Possible moderate to major, short-term impacts for residents near the northern end of the levee.
Concrete crushing	No impacts (no crushing proposed).	Noise levels within permitted Clallam County limits; no adverse impacts.
Operation of the Elwha and Port Angeles water treatment plants	No impacts (plants not constructed).	Negligible to minor effects on workers.
	Cultural Resources	
Construction	Continued major adverse impacts to tribal cultural resources from dams and reservoirs.	With adherence to the programmatic agreement, no more than minor, site-specific impacts.
	Socioeconomic Environment	
Project costs and benefits	No project would take place.	Benefit:cost ratio would be slightly less than 2:1 (total benefits = $355 million, total cost = $182.5 million).
County economic base	Regional economic difficulties exacerbated by decreases in commercial fishing, timber sector.	Moderate to major, long-term benefits for local economy from $67 million to $73 million in business activity; $36 million to $38 million in personal income; 1,150–1,240 jobs generated by dam removal and river restoration projects.
Ediz Hook maintenance	Increased maintenance cost of Ediz Hook (about $100,000 per year) from dams.	Dam removal would decrease maintenance costs by about $31,000 annually.
Infrastructure, service and utilities	County does not collect taxes on the dams now.	Same as the no-action alternative.
Fisheries and fish processing	Continued $840,000 in business benefits from fishing sectors.	Economic benefit over 100 years = $36.7 million; corresponding economic benefit to sportfishing = $10.3 million.
Recreation and tourism in Clallam County	Travel/tourism expenditures (1993) = $116.9 million; related payroll income = $21.3 million (approximately 2,000 jobs).	Addition of an estimated 507,084 recreation trips, generating about $57.1 million annually in additional expenditures by visitors.
	Public Health and Safety	
Safety of workers during construction	No impacts (no construction proposed).	Negligible to minor impacts with OSHA regulations.
Use of hazardous materials (plant operations/construction)	No impacts (no water treatment plants proposed).	Negligible to minor impacts to workers / public with standardized containment and clean-up procedures.

Affected Environment

Fluvial Processes and Sediment Transport

Even though no changes to fluvial processes or sediment transport are expected as a result of implementing the mitigation facilities in the proposed action, the dynamics of these processes are important to understanding impacts to water quality and fisheries. For more information on any of the topics analyzed in this SEIS, the reader should refer to the 1996 FEIS.

Sediments in the Elwha River drainage basin are dominated by glacial deposits and recent alluvium. Sediments range in size from clay to boulders. River alluvium typically consists of sand, gravel, cobbles, and boulders. Considerable amounts of recent alluvium are stored along the river channel, particularly in the wide terraces outside the floodplain and at the river mouth.

The Elwha River has a steep slope. It is steepest at the headwaters (16% average gradient) and generally decreases in slope farther downstream. The river flows through several steep, narrow, bedrock canyons. Between these canyons, the channel is less steep and has wider reaches within its broad floodplains. At the outlet of the canyons, deltas are created where the channel widens, the streamflow slows, and sand, gravel, cobbles, and large woody debris are left behind by the slower-flowing river. In the floodplain the river typically meanders, in some cases undercutting alluvial terrace and valley wall deposits.

The Elwha and Glines Canyon Dams have blocked sediment flow downstream.

- The Glines Canyon Dam has trapped an estimated 13.8 million cubic yards of sediment; it has also created the Lake Mills delta, which inundated a 2.5-mile stretch of the river. The upstream portion of the delta in Rica Canyon and in the Cat and Boulder Creek fans consists of approximately 1.55 million cubic yards of mostly coarse (i.e., sand-sized and larger) material. The main delta contains 6.97 million cubic yards, which is 70 feet thick in some places. Downstream of the delta, Lake Mills contains 6.6 million cubic yards of fine lake sediments composed primarily of silt and clay, with minor amounts of sand. This material is spread fairly evenly across the lakebed. It is an estimated 12-feet thick along the center of the reservoir and thins toward the edges. Most of the sediment is composed of silt-sized particles. The clay-size particles have little cohesion and lack many common properties of clay.
- The Elwha Dam has trapped approximately 3.88 million cubic yards of sediment in Lake Aldwell and its delta, which has inundated 2.8 miles of the Elwha River. The reservoir area consists of two wide alluvial reaches divided by a canyon. The delta contains an estimated 1.78 million cubic yards, as much as 40 feet thick, composed of sand and gravel with smaller amounts of clay, silt, cobbles, and boulders. Downstream of this delta, the reservoir contains 2.1 million cubic yards of fine-grained sediments, with minor amounts of sand. This material is 5–6 feet thick in the southern basin, thinning to less than 1 foot in the narrow canyon section.

From the Elwha Dam downstream to RM 4, the river is constrained by steep bedrock walls of Elwha Canyon. Below Elwha Canyon the stream gradient is less steep and the channel floodway widens to approximately 1,500 feet. Farther downstream are DCWA wells at RM 3.7, the City of Port Angeles diversion and industrial surface water intake (RM 3.5), the Ranney collector adjacent to the channel for municipal water (RM 2.8), and the WDFW fish-rearing channel (RM 2.8–3.0). At RM 2.8 the river channel narrows where it is constrained by bedrock on the right bank.

Between RM 2.8 and the river mouth, the floodplain widens and is bound on the west side by steep cliffs of glacial deposits more than 150 feet high. The pre-dam river migrated throughout the entire floodplain; nearer the mouth, it moved laterally over an area 1.2 miles wide. The erosive action of the meandering river prevented the establishment of a mature evergreen forest. But dam construction has caused the channel to shift less frequently and dense, woody vegetation has grown near the mouth, increasingly constraining the river in the lower reach. The 1.5-mile-long lower Elwha federal flood control levee on the east side of the floodplain constrains the eastward migration of the river. A 900-foot-long privately owned levee downstream from the high river bluffs on the west side of the river also restricts the floodplain near the river mouth.

At the mouth of the river an extensive delta roughly 5 miles wide, 6 miles long, and an estimated 200 feet thick has formed. It is composed of sand, gravel, and cobbles, and samples indicate a sand and gravel surface to approximately 2,000 feet offshore (USACE 1971). Because the dams have blocked much of the natural sediment transport, the only current source of delta sediment is from the erosion of loose material (alluvium) from the bluffs along the west side of the river in the 4.9 miles upstream from the mouth. As a result, sediment yields to the delta have dropped from a pre-dam total sediment supply of 280,000 cubic yards per year to 5,900 cubic yards per year, approximately 2% of the pre-dam volume (FERC 1993).

Sediment from the Elwha delta moves with the currents in the strait, predominantly in an eastward direction along the coast. The sediment nourishes beaches and nearshore areas with sand and gravel, and supplies some of the sediment to Ediz Hook, which forms the bayward side of Port Angeles Harbor (FERC 1993). The drastic reduction in bedload sediment supply from the river has caused 75–150 feet of beach erosion along the western edge of Ediz Hook (FERC 1993).

Flooding

The floodplain between the dams (from Glines Canyon Dam to the U.S. Highway 101 bridge at the head of Lake Aldwell) can be characterized as a largely undeveloped, relatively narrow floodplain confined by steep, forested valley side slopes. The river gradient in these sections averages 40 feet per mile, and the river flows swiftly. There is no development within the 100-year floodplain on the west side of the river between the dams, but five residential properties (four near RM 8.4, one near RM 9.7) lie within the floodplain on the east side of the river. Four of these residences are vulnerable to 5- to 25-year floods, and the fifth residence was recently constructed on a raised metal platform. Portions of the Olympic Hot Springs Road (Elwha Valley Road), paralleling the east side of the river channel, and the Elwha and Altaire campgrounds in Olympic National Park also lie within the 100-year floodplain. The Elwha Ranger Station facilities near RM 12.1 are just 1 foot above the 100-year floodplain. In addition to their location in the floodplain, both Hot Springs Road and the Elwha Ranger Station are vulnerable to loss through bank erosion following dam removal. Monitoring to determine whether bank erosion is occurring would take place during dam removal, and bank protection in the form of large angular rock, engineered log jams, or a combination of the two would be applied as needed to stabilize the bank.

The area from the Elwha Dam to RM 4 is forested and relatively undeveloped. In the broad floodplain between the old Highway 112 bridge (at RM 3.3) and RM 4, two residential properties on the west side of the river and one on the east side are flooded every 10 to 30 years on average; these residences lie approximately 3 feet below the current 100-year flood elevation. The DCWA wells and wellhead access road on the east side of the river are also within the 100-year floodplain.

Compared to the middle reach of the river, the floodplain along the lowest 3 miles broadens significantly and has a much lower gradient (approximately 15 feet per mile). Development in this portion of the 100-

year floodplain includes the state fish-rearing facility, the Port Angeles domestic water supply system, the federal flood control levee on the east side of the river, and residences on the west side near the river mouth.

Levees

The 7,100-foot-long federal Elwha flood control levee was constructed in 1988 by the U.S. Army Corps of Engineers in the lower 1.5-mile floodplain on the east side of the river. Approximately 300 acres of Lower Elwha Klallam Reservation lands between the levee and the river are dedicated to flood abatement. The levee, designed and constructed to withstand a 200-year flood, was built to protect structures in the 700-acre floodplain, including 305 acres east of the levee on Lower Elwha Klallam Reservation and private property. Annual operation and maintenance of the levee is the responsibility of the tribe, the local sponsor of the project. However, under the current agreement with the Army Corps of Engineers, any levee damage or imminent threats of outflanking may be addressed as a mitigation measure by the Corps or a subcontractor. Structures within the floodplain now protected by this levee include approximately 60 houses, a community tribal center, two churches, a Head Start facility, a dental clinic, a tribal fish hatchery, and agricultural lands.

Approximately 30 acres of residential development on the west side of the river are protected against lower frequency (25- to 50-year) floods by a privately owned and maintained levee. This 900-foot-long levee extends downstream to near the mouth of the river from the high natural bluff line, preventing the river from migrating to the west beyond the shore zone. Flooding at the mouth of the river is also influenced by tidal conditions.

Flooding Frequency

The Elwha River typically experiences two periods of high runoff — November through March runoff from rainfall, and May through June from spring snowmelt. Annual peak discharges have ranged from 4,680 cfs in 1936 to 41,600 cfs in 1897. The largest recent discharges were 25,900 cfs on October 17, 2003, and 25,000 cfs on October 21, 2003 (provisional data from USGS). Typically, flood discharges rise sharply (usually less than 24 hours to the peak) and gradually recede over two days or more. It is not uncommon for two or more periods of high flows to follow one another in swift succession, such as occurred on October 16 and 20, 2003 (25,370 cfs and 24,650 cfs, respectively).

Statistics compiled since 1924 show that the flood stage in the Elwha and the neighboring Dungeness and Hoh Rivers is increasing over time. For example the predicted peak flow for 2002 is nearly double that predicted for 1924 (Crain, pers. comm. 2003). Some of this trend may be related to logging and other land clearing activities (primarily in the neighboring drainages), but it appears climate is having a major effect as well.

Both the Elwha and Glines Canyon Dams are operated in a “run-of-the-river” mode, in which the reservoir level is held constant and very little of the water entering the drainage is stored or released differently from the way it was before the dams were built. This is done to maximize power production, and not much storage for flood control is available in the reservoirs without stopping power production altogether. Consequently, the dams provide minimal flood protection and only during short-duration storms or snowmelt.

Since the dams were built, relatively little bedload entered the river downstream of the dams, allowing the riverbed to degrade (become lower at some locations), which has reduced the flood hazard from pre-dam conditions to some properties along the lower river. Many homes, wells, and cultural resources within the 100-year floodplain will be more susceptible to flooding after the removal of the dams.

Surface Water

Elwha River

Discharge

Annual precipitation in the Elwha River basin ranges from 220 inches in its upper reaches to 35 inches near its mouth. Average annual discharge is approximately 1,500 cfs at the McDonald Bridge stream gage and 1,650 cfs (about 10% higher) at the river mouth. Discharge is influenced by winter storms and spring snowmelt and by baseflow conditions during the summer and fall. The lowest flow period is during late summer and fall, when discharges average from 618 cfs to 952 cfs. Flow regimes of the river and its tributaries are nearly natural because the dams are operated in run-of-the-river mode.

Water Rights

Of the 206 cfs of state-issued water rights on the Elwha River, the City of Port Angeles holds 200 cfs — a 50 cfs groundwater right for municipal purposes at the Ranney collector at RM 3.0, and a 150 cfs surface water right for the industrial intake channel at RM 3.5. The surface diversion currently provides water to two users — the NPI paper and pulp mill and the WDFW fish-rearing channel. Private landowners, the Dry Creek Water Association (5.58 cfs), and the Elwha Place Homeowners' Association (0.4 cfs) also hold groundwater rights. The Lower Elwha Klallam Tribe and the tribal fish hatchery withdraw approximately 10 cfs. The United States holds additional unquantified water rights in trust for the tribe; these rights are not issued by or registered with the state. They guarantee sufficient water to support treaty fisheries and the purposes of the Lower Elwha Klallam Reservation.

Water Quality

The Elwha River and its tributaries are classified by the Washington Department of Ecology as a "salmon and trout spawning, core rearing, and migration" area, signifying "extraordinary" quality. Overall, the Elwha has relatively low concentrations of dissolved and suspended sediment loads, nutrients, and organics (see Table 6). Changes in water quality occur in the lower part of the watershed, mostly as a result of reduced sediment load and elevated water temperatures during the summer. Suspended sediment concentrations and turbidity of the lower river are related to the reservoir's trapping efficiency, flood flows, logging, agricultural practices, and bank erosion. Values for pH and alkalinity indicate neutral to slightly alkaline conditions typical of oligotrophic (low biological productivity) waters (Wetzel 1975). Dissolved oxygen values are very close to saturation at all times of the year; these are excellent conditions for cold-water fish (EPA 1976). Most water quality parameters vary little with time except for turbidity and suspended sediments, which increase during high discharge periods.

The City of Port Angeles Ranney collector, a large diameter caisson near the river's edge with laterally radiating perforated collection pipes beneath the riverbed, has the capacity to pump approximately 17 cfs. Generally, Ranney collector water is lower in turbidity than river water because alluvial sands and gravels filter out a large portion of the particulate matter. The 1994 measured mean turbidity of 0.08 NTU (nephelometric turbidity units — a measure of how much light is scattered by particles in the water) is below the drinking water standard of 1.0 NTU. However, the maximum turbidity detected in the city's well from 1983 to 1993 was 4.8 NTUs, well above the drinking water standard. Mean iron concentrations

Table 6. Elwha River Water Quality Impact Indicators

IMPACT INDICATOR	CURRENT CONDITIONS
Dissolved Oxygen (% saturation)	95–110
Total Suspended Solids (fines) (mg/L)	1–1,500
Turbidity (NTU)	1–2,800+
Total Iron (μg/L)	20–2,300
Total Manganese (μg/L)	4–210
pH	6.7–10
Total Organic Carbon (mg/L)	0–10

SOURCE: USGS water quality data and NPI.

are lower than state drinking water standards, although maximum concentrations are not. Only two constituents, iron and turbidity, were detected above maximum contaminant levels in the Port Angeles Ranney well samples taken from 1983 to 1993.

In April 2000 the Washington Department of Health informed the city that water obtained from the Ranney collector had been designated as "GWI" or "groundwater under the influence of surface water." This change is unrelated to proposed dam removal activities; it means the city must now treat its water to surface water treatment standards, including the removal or inactivation of viruses and *Giardia* cysts. This can be accomplished by appropriate filtration and disinfection, or by reconstructing the Ranney collector to eliminate surface water influence, if possible (URS 2002c). As noted in the "Alternatives" chapter, the city has agreed to build a water treatment facility near its existing landfill site, and to have surface water pre-treated at the Elwha water treatment plant sent to the Port Angeles plant as a back-up supply during dam removal. Because water collected in the Ranney well is no longer considered groundwater, the impacts of providing a source of treated water to the city's municipal customers is discussed under "Surface Water" in this SEIS.

Morse Creek

The Morse Creek watershed includes four subwatershed areas, including an extensive highland area that lies within old-growth forest inside Olympic National Park (DeMond, pers. comm. Sept. 2002). The headwaters of Morse Creek lie in a subalpine environment above 6,000 feet in the southern mountains of the park. The southernmost divide of the watershed is defined by Hurricane Ridge.

In the lowland subwatershed, the mainstem of the creek lies within a heavily wooded, ravine-like valley outside the park. Vegetation here has been altered through extensive logging, clear-cutting, and land clearing for development and agricultural purposes. The drainage network in this area is poorly integrated, so impacts from these activities have remained localized rather than affecting the entire mainstem of Morse Creek. Rain at this elevation and snow at higher elevations contribute to runoff in the watershed. Chinook-rearing ponds are planned for development in this part of the watershed, approximately 5.5 miles upstream from the mouth of the creek.

Streamflow in the Morse Creek watershed is highest during winter and spring, and lowest during late summer and into fall. The Washington State Department of Ecology rates Morse Creek water quality as a "salmon and trout spawning, core rearing, and migration" area, or extraordinary water quality.

Groundwater

An alluvial sand and gravel groundwater aquifer, which supplies municipal water for local residents and businesses, underlies the Elwha River valley (Bureau of Reclamation 1995). Five major purveyors withdraw groundwater from the alluvial aquifer: the City of Port Angeles (although as noted above, this source is now considered to be hydraulically connected to surface water to such an extent that it has been redesignated as under the influence of surface water and must be treated as if it were a surface water source), the Dry Creek Water Association, the Lower Elwha Klallam Tribe, the tribal fish hatchery, and the Elwha Place Homeowners' Association (EPHA).

Alluvial Aquifer Characteristics (Lower Elwha River)

Above Elwha Dam the alluvial aquifer is restricted to the river channel and the narrow floodplain within the valley; it is bounded primarily by bedrock. The alluvium thickens and laterally extends into the lower Indian Creek valley.

Below Elwha Dam the river valley is divided into three distinct alluvium-filled groundwater subbasins separated by bedrock outcrops or constrictions in the surrounding glacial deposits.

- The upper subbasin (RM 4.0–3.1) is where the river emerges from the narrow, bedrock-walled Elwha Canyon. The alluvium in the 60-acre upper subbasin is estimated to be as much as 75 feet thick. The DCWA wells are located in the upper subbasin.
- The middle groundwater subbasin (between RM 3.1 and 2.8) is approximately 70 acres and includes the Port Angeles Ranney collector and the WDFW rearing channel wells. Drilling in the middle subbasin showed alluvium thicknesses of 55 feet.
- The lower subbasin (RM 2.8 to the river mouth) is approximately 1,100 acres and includes the EPHA wells and the Lower Elwha Klallam Reservation. Drilling in the lower subbasin showed the alluvium was 125 feet thick.

The transmissivity of the aquifer increases from upstream to downstream. In the upper subbasin, the transmissivity is estimated to be 75,000 gallons per day per foot of aquifer; in the middle, 100,000; and, in the lower, up to 400,000.

The alluvial aquifer and the river are hydraulically connected, and both surface and groundwater flow north toward the Strait of Juan de Fuca. Groundwater flows through the aquifer from the upper to the lower subbasin. The discharge from the middle to the lower subbasin is approximately 1–2 cfs. In the lower subbasin, the river loses water to the aquifer; the U.S. Geological Survey estimates the discharge at between 3 and 12 cfs from the alluvial aquifer to the strait (URS 2001).

Groundwater Levels

Lake Aldwell supports an artificially high groundwater level at the east end of the Indian Creek valley, near the confluence of Indian Creek and the Elwha River, which allows at least one well in this area to access groundwater at a shallower depth. Also, residents of the Lower Elwha Klallam Reservation Valley community have been able to install septic systems because groundwater levels are lower now than before the dam was built. This is due to the riverbed degrading without a continued supply of sand and gravel, consequently dropping the river's surface elevation.

Groundwater Use

Total use by the five major groundwater purveyors in the Elwha River valley is approximately 22.3 cfs. In the upper subbasin the Dry Creek Water Association holds a groundwater right for 5.58 cfs, and average use is approximately 0.56 cfs (250 gallons per minute [gpm]). The association wells are at approximately RM 3.7. Because of their proximity to the river channel, turbidity in the river increases turbidity in the two oldest (hand dug) wells. One of these wells has been removed, and the other is reserved for emergency use.

In the middle subbasin the City of Port Angeles holds a groundwater right for 50 cfs. As noted above, because water collected in the Ranney well is no longer considered groundwater, the impacts of providing a source of treated water to the city's municipal customers is discussed under "Surface Water" in this SEIS.

In the lower subbasin the Lower Elwha Klallam Tribe community water system and the tribal fish hatchery together withdraw a total of approximately 10 cfs from both wells and a shallow infiltration gallery. The Elwha Place Homeowners' Association holds a groundwater right for 0.4 cfs and uses approximately 0.1 cfs. The EPHA wells are at approximately RM 1.4; their water supply does not become turbid when the river does. Other groundwater withdrawals from domestic wells total less than 0.2 cfs.

Groundwater Quality

The groundwater in the Elwha River watershed is of excellent quality, and the entire headwater area within Olympic National Park is protected. Watershed land use is primarily rural, but non-point source pollution from agricultural and other uses has a minor influence on groundwater quality. Low chloride levels (less than 1 mg/L to 8 mg/L) detected in wells near the mouth indicate that saltwater intrusion has not occurred. Private septic systems in the lower basin present a potential for groundwater contamination because of the poor filtering capability of the coarse-grained alluvial soils and the high water table.

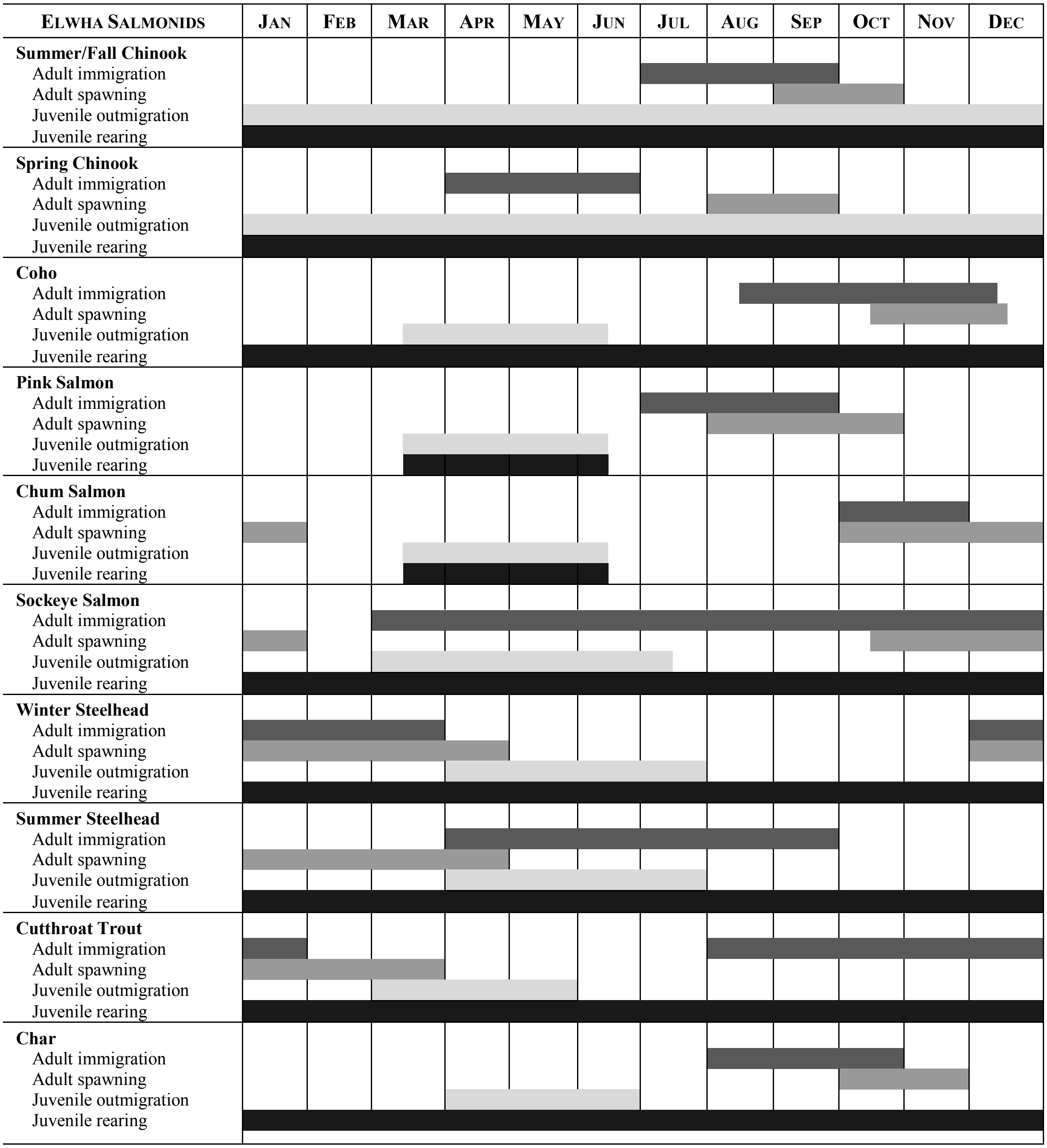
Groundwater withdrawals by the Dry Creek Water Association and the Elwha Place Homeowners' Association are periodically tested for several contaminants, as required by the Washington State Department of Health. Well water that was tested for turbidity, coliform bacteria, inorganic chemicals, trihalomethane, volatile organic chemicals, and pesticides was found to be of very high quality. Volatile organic chemicals were not detected in any samples. Inorganic maximum contaminant levels were not exceeded in any sample taken from the DCWA wells (2003-04) or the EPHA wells (1985–93). Trihalomethane concentrations were below the maximum contaminant levels in all DCWA samples (1989–94).

The U.S. Geological Survey tested water resources of the Lower Elwha Klallam Reservation in 1977 and found them to be of excellent chemical quality. The Lower Elwha Klallam Tribe has sampled two of their community wells for complete inorganic and organic analysis. All parameters tested were lower than state maximum contaminant levels.

Native Anadromous and Resident Fisheries

Ten stocks of anadromous salmon and trout are either now present in the Elwha River or, based on data from neighboring rivers or other information, were present before the dams were built (see Table 7). They are winter and summer steelhead trout, coho, summer/fall and spring chinook, pink, chum and sockeye salmon, cutthroat trout, and native char (Dolly Varden and bull trout). Pacific lamprey and brook lamprey have also been documented in the Elwha River. In addition to these anadromous species, the Elwha harbors many non-migrating fish, including sculpins, resident cutthroat, and rainbow trout, and marine species such as flounder are found in the estuary. White sturgeon and smelt also have been observed in this river in the past. Native char, chinook, and coho have special species status and are discussed in that section of this SEIS.

Table 7. In-River Life Cycle Stages of Elwha Salmonids



The Elwha River was legendary for its production of huge chinook; individual fish in excess of 100 pounds were recorded as late as 1930, 18 years after the closure of the river by Elwha Dam (Brannon 1930). The river was also known as a producer of large quantities of pink and chum salmon. Pink salmon were numerous through the 1960s. They appeared to have died out by the late 1980s, but the population is slowly rebuilding at this time.

About 70 miles of the mainstem of the river and its tributaries are estimated to have been available to anadromous species before the dams were built. Steelhead and possibly other species could have traveled as far as 43 miles up the 45-mile mainstem before encountering impassable stretches (James River II 1988). Carlson Canyon Falls at RM 34 may have blocked some species, depending on timing and the condition of the fish. It is unknown but widely speculated that the relatively poor jumping ability of pink and chum salmon may have restricted them to the river below Rica Canyon (RM 16) (James River II 1988).

The Elwha River is currently the largest producer of steelhead and chinook salmon on the Strait of Juan de Fuca and is second only to the Dungeness River for coho. While the salmon and steelhead run sizes appear minor in relation to Washington State's total production, they are significant contributors to the Strait of Juan de Fuca and Vancouver Island fisheries, with the exception of chum salmon production, which is small compared to other streams emptying into the strait. Nearly all chinook, coho, and steelhead are produced at hatcheries. A chum hatchery program was operated for 10 years but was abandoned in 1986. The tribe relatively recently began taking chum salmon eggs once again and is burying them in egg trays set in the substrate in lower river side channels as an alternative, less invasive enhancement strategy.

Resident trout in the river system are dominated by rainbow trout and, to a lesser degree, native char (Dolly Varden and bull trout). A very small number of cutthroat trout and brook trout are also present (Morrill and McHenry 1995; Mausolf and Sundvick 1976; Collins 1983). The Elwha drainage is a major wild trout producer on the Olympic Peninsula. Its ranking to other regional streams is not known, but a creel survey conducted on Lake Aldwell, Lake Mills, and the middle reach indicated a high fishing effort in the early 1980s (Collins 1983).

Current condition information is presented below for fish species that are not on the federal endangered species list. Chinook, coho, bull trout, and Pacific and brook lampreys are discussed in the "Species of Special Concern" section.

Pink Salmon

Pink salmon are a major commercial salmon species in Puget Sound, returning primarily every odd year. Elwha River pink salmon production has dramatically declined since 1979, with virtually no fish observed to spawn in 1989 or 1991. However, spawning abundance in the last three cycles (1991, 2001, and 2003) has been increasing, with several hundred fish observed spawning in 2001. The Elwha Tribe has collected genetic samples from Elwha pink salmon, and the WDFW genetics lab is evaluating the samples to determine if fish observed in the Elwha River are related to the Dungeness River pink salmon. Pink salmon are a Washington State species of concern.

Chum Salmon

Chum salmon are a major commercial species in Puget Sound, infrequently captured by sport anglers. The historic Elwha River chum run, like the Elwha pink run, was considered abundant. During the last two decades, though, the Elwha River has been a small contributor to total chum production in the strait and a very small portion to Puget Sound, with runs to the Elwha River typically less than 1,000 fish and peaking at 1,500 in 1980. Chum are a Washington State species of concern.

Sockeye Salmon

Sockeye salmon are one of the most prized commercial salmon species in Washington, although state-originated runs are small. Sockeye are a species of concern in Washington. All major stocks of sockeye require a river system with a connected lake for spawning and rearing purposes. The only lake in the Elwha River drainage is Lake Sutherland, now inaccessible to adults attempting to swim upstream because of the Elwha Dam. Records from 1982–91 show an in-river harvest of only eight sockeye total over the 10-year period (Hoines 1994); these fish were probably strays and could have come from coastal (Ozette or Quinault), Puget Sound (Baker or Lake Washington), or Fraser River runs. It is also possible that these fish were the returning adults of a kokanee population in Lake Sutherland that is known to be producing smolts who pass through the spillway of the dam. There are no hatchery operations for sockeye on the Elwha River.

Steelhead Trout

Steelhead trout, an anadromous race of rainbow trout, are one of the most sought-after sport fish in the state and also support substantial tribal commercial harvest. Because of the tribal hatchery program, the Elwha River is the largest producer of steelhead in the Strait of Juan de Fuca. Although the Elwha ranked 10th among state streams for winter steelhead sport catch in 1987–88, this ranking has declined in recent years (Washington Department of Fisheries [WDF] 1988; WDFW 1993).

Approximately 3,100 winter adults enter the river from an average of 82,000 hatchery smolts released each year (Pacific States Marine Fisheries Council 1995). The Lower Elwha Klallam Tribe operates a commercial in-river fishery for hatchery run winter steelhead; these harvests average 1,450 fish per year for the tribe (PNPTC and WDFW 1994). Sport anglers additionally harvest an estimated 1,150 winter and 355 summer steelhead each year (PNPTC and WDFW 1994).

Sea-run and Resident Cutthroat Trout

Both resident and anadromous races of cutthroat trout were probably present in the pre-dam Elwha River. Sea-run cutthroat trout are a major sport species in the state, although they are less abundant than steelhead in most areas (Johnston and Mercer 1976; DeShazo 1980). A regionwide decline in sea-run cutthroat populations has occurred in the past 15 to 20 years (Trotter 1989).

Sea-run cutthroat are not abundant in the lower river, although they are caught incidentally (fewer than five annually) during other in-river fisheries. Similarly, resident cutthroat trout are not numerous in the upper reaches of the Elwha (Morrill and McHenry 1995), although small numbers were found in the middle reach, particularly in Indian Creek. This population may be related to the large lacustrine native cutthroat that occurs in Lake Sutherland. The Lake Sutherland cutthroat shares characteristics (large body size, spawn timing) with the Lake Crescent cutthroat. It is possible that more isolated populations may be present farther up tributary streams in this system, since cutthroat are often present (Trotter 1989). An introduced population of westslope cutthroat is thought to exist in Long Creek.

Resident Rainbow Trout and Other Species

Rainbow trout and small populations of brook trout (nonnative) occupy the upper Elwha, as well as the reservoirs and middle reach of the river. These are non-anadromous populations of trout, although the impulse for rainbow to migrate to sea may remain.

Other fish that may occur in the Elwha River include threespine stickleback, sculpins, smelt, and sturgeon. Sturgeon are a major commercial and recreational species in Washington, with the most important stocks utilizing the Columbia and Chehalis Rivers. While resident populations occur in the largest Northwest rivers (i.e., the Columbia), most stocks are anadromous. They are occasionally taken in tribal net fisheries in the Elwha River (James River II 1988). See the "Socioeconomic Environment" section for more information about tribal, commercial, and recreational fisheries.

Soils

The mitigation measures analyzed in this SEIS are all located in Clallam County, Washington. No systematic soil survey has been conducted for the specific project area; however, several individual studies that address soils in specific areas have been prepared for aspects of this project and are referenced where appropriate.

A 1987 Soil Conservation Service soil survey for the Clallam County area forms the basis for county data on soils (Crain, pers. comm. 2003) and is used to discuss general soil types and locations within the project area.

Soil is characterized by physical, biological, and chemical processes that result from the interaction of time, parent material, climate, living organisms, and topography (Birkeland 1974). For example, as soil formed in the survey area, unweathered, moderately coarse textured parent material was exposed as the continental ice sheet melted. It is believed that the climate was conducive to soil development during most of the intervening period. Soil development actually begins when organic matter accumulates from the first colonizing plants that occupy a soil surface. Marine sediments and most alluvium, loess, and volcanic ash in the survey area have been involved in soil formation for 7,000 to 12,000 years. On a geologic time scale, the soils in the study area are young.

Bedrock in the study area began as sediment or igneous rock deposited beneath the Pacific Ocean as much as 50 million years ago. The sediment ranges in size from very fine clay and silt to pebbles and cobbles. Uplifting as a result of slow movements and collisions between huge plates of the earth's crust are responsible for the structural formation of the Olympic Mountains.

The oldest established age for coastal Pleistocene glacial deposits is about 71,000 years. The most recent glaciation during which continental and alpine glaciers occupied western Washington (about 18,000 years ago) is the Fraser glaciation, during which most of the foothills and mountains in the area were covered with ice. Glacial drift deposited during this period covered or mixed previous glacial deposits and became the landforms and parent material for many of the soils in the study area. The glacier scoured and removed from the mountains the existing surface material, which was commonly replaced with glacial drift. Glacial scour and erosion from steep slopes exposed fresh parent material. The mountainous landforms and the parent rock are relatively old; however, the soils have formed in unweathered material exposed since the last glaciation.

As sea level dropped around 15,000–20,000 years ago, a broad, vegetation-free coastal plain was exposed along the Pacific Ocean. This area served as a source for loess, which covered much of the coastal area, some areas to depths of 15 feet. About 6,600 years ago, Mount Mazama in southern Oregon erupted, depositing a thick layer of volcanic ash across the area, contributing to the development of identifiable ash-related soil properties in the area.

Since the glacial period, mass wasting, surface erosion, and deposition have further modified landforms. In the Elwha and other major rivers, eroded materials such as sandy gravel, cobbles, and boulders transported by water were deposited as alluvial terraces. Sediment continues to erode from the valley walls and is transported by the Elwha River and its tributaries. While the dams stop the natural flow of sediment to the river mouth, alluvium from below Elwha Dam is stored along the river channel.

Proposed actions addressed in this document include activities along the lower 3.7 miles of the Elwha River and a landfill site in western Port Angeles within the city limits, where the municipal water treatment plant is proposed. Soil map units along the lower reaches of the Elwha River that may be impacted include typic xerofluvents and Neilton very gravelly sandy loam. Clallam gravelly sandy loam occurs at the landfill site.

Typic Xerofluvents — These are very deep, somewhat excessively drained soils that occur on floodplains and in recent alluvium along 0%–5% slopes. Native vegetation is mainly mixed conifers, deciduous trees, and shrubs. Elevation is near sea level to 300 feet. No single profile is typical of this soil unit, but one commonly observed in the survey area is a surface covered with a mat of organic material about 2 inches thick. These soils vary widely in texture within short distances. Permeability is rapid, and available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. These soils are subject to occasional brief periods of flooding from December through April (SCS 1987:68).

Neilton very gravelly sandy loam — These are very deep, excessively drained soils found on terraces and in glacial outwash, and they can occur to elevations of 1,600 feet. Native vegetation consists mainly of conifers and shrubs. In low slope areas (0%–5%), the surface is covered with a mat of organic material 1 inch thick. The surface layer is dark brown, very cobbly, sandy loam 6 inches thick. Permeability is very rapid, and available water capacity is very low. Runoff is slow, and the hazard of water erosion is slight (SCS 1987:48). On steeper slopes organic material is thicker. Available water capacity is very low, and runoff is low. The hazard of water erosion is severe (SCS 1987:47).

Clallam gravelly sandy loam — These are moderately deep, moderately well drained soils found on hills in compact glacial till and ranging in elevation from 40 to 1,800 feet. The native vegetation is mainly conifers and shrubs. Typically the surface is covered with a mat of organic material 2.5 inches thick. Depth to compact glacial till ranges from 20 to 40 inches. Permeability is moderate down to the compact glacial till and then very slow in moving through this level. Available water capacity is low; runoff is medium, and the hazard of water erosion is slight. The effect of the layer of compact glacial till on use and management is similar to that of hardpan (SCS 1987:23).

Vegetation

The Elwha River valley is one of the longest drainages on the Olympic Peninsula, and it experiences a climate transitional between drier conditions to the east and wetter conditions to the west, with a mix of unique plant communities that are adapted to these climatic conditions. Madrone, Douglas-fir / manzanita, and Douglas-fir / grand fir communities on dry, well drained sites represent eastern peninsula vegetation types found in the valley. Forests dominated by western hemlock with an understory of ferns occur on moist sites throughout the valley and are more characteristic of western peninsula vegetation.

Riparian and Upland Vegetation

Most of the study area consists of upland and riparian forest communities, including conifer, mixed conifer/hardwood, and hardwood communities. Upland grassland and deciduous shrub communities are sparsely distributed. Conifers, primarily Douglas-fir, comprise more than 75% of the trees in conifer forests and 25%–75% in mixed forests. Much of the conifer and mixed forest in the study area is second-growth on land that was logged or burned between 40 and 120 years ago, or is disturbed. Conifers comprise less than 25% of the trees in hardwood forests. Hardwood forests are usually dominated by red alder interspersed with big-leaf maple, black cottonwood, and willow. Hardwood forests are common in riparian areas as well.

A riparian zone is defined as the river channel and lands where vegetation is influenced by elevated water tables and flooding, or by the ability of soils to hold water (Naiman et al. 1993). It is the zone of direct ecological interaction between the forest and the river system (Swanson and Franklin 1992).

The riparian zone is ecologically important for many reasons. Long-term studies have found consistently high levels of biological diversity. For example, more species of breeding birds use riparian areas than any other habitat type in North America, and studies in the Cascades have found up to twice the species richness in riparian zones compared to upland habitats (Douglas et al. 1992; Gregory et al. 1991).

Studies have also found that nearly 70% of vertebrate wildlife species in a region use riparian corridors in some significant way during their life cycles (Naiman et al. 1993). The Elwha riparian zone provides, or could provide, important habitat for threatened, endangered, or rare species. A natural riparian zone reduces the severity of flood events, acts as a buffer to pollution sources entering the river, controls the loss of groundwater nutrients into the river, and provides important fish habitat and food sources from overhanging vegetation and associated terrestrial insects.

Riparian zone woody debris entering and accumulating in the river channel creates habitat for aquatic insects, fish, small mammals, and birds, and it influences the formation of pools, river movement, and the overall structural habitat diversity of the river system (U.S. Forest Service [USFS] 1988; Gregory et al. 1991). Extensive research into the ecological role of woody debris has concluded that it is a critical element of river ecosystems (Swanson and Franklin 1992).

In the project area for this SEIS, a riparian zone along the Elwha River from RM 2.8 to 3.7 would be affected by modifying the WDFW fish-rearing channel (RM 2.8–3.0), modifying the industrial channel and outlets for the Elwha water treatment plant (RM 2.8), replacing the existing rock diversion structure and surface water intake (RM 3.5) with a new control weir, temporary diversion, and intake facility (RM 3.65), and floodproofing the existing DCWA well field (RM 3.7) or alternative well field site (RM 3.45). Access road options for the water treatment plant include two alignments that reach the site from the north and one that would improve an existing road from the south. All lie partially or wholly within the riparian zone. An access road to the alternative well field would also cross riparian vegetation. Several pipelines would be built as part of the proposed action: (1) a pipeline to carry water from the alternative well field (if selected) to DCWA customers, (2) a pipeline from the treatment plant to the tribal hatchery, (3) pipeline modifications or additions to carry surface water to the treatment plant, and from the plant to the existing Port Angeles municipal waterline (connects the Ranney collector with the existing water distribution system), and (4) a pipeline from the tribal wastewater collection point to Port Angeles for treatment. All of these lines would lie within some portion of the riparian zone.

Vegetation surveys on both sides of the river from upstream of the existing rock diversion structure (approximately RM 3.6) to slightly downstream of the WDFW fish-rearing channel (approximately RM 2.7) found a mixed conifer / deciduous forest composed of Douglas-fir, black cottonwood, western red cedar, red alder, big-leaf maple, and grand fir. Shrubs include oceanspray, scotch broom, Oregon grape, snowberry, saskatoon, and Himalayan blackberry. Herbaceous vegetation includes false Solomon's seal, stinging nettles, Siberian miner's lettuce, and Robert geranium (for a complete listing, contact Olympic National Park).

In the vicinity of the existing rock diversion dam, vegetation and wildlife were surveyed in detail in 2004 (URS 2004b). This is the location of a proposed control weir, new intake structure, access road to the structure, and a temporary diversion channel. The Elwha River in this area flows between two mid-channel islands, one upstream of the existing rock diversion structure and one downstream of it. The floodplain between these two islands is relatively broad, particularly on the west side of the river where the temporary diversion channel would be located. This section of floodplain is about 1,000 feet wide, with many dry side channels used as recreational access roads. Much of the floodplain is disturbed, including an area of undeveloped campsites near the existing intake structure. The proposed temporary diversion channel begins near the upstream end of the southernmost island and continues northward across the floodplain (see "Surface Water Intake Plan," page 17) following one of these dry side channels through the floodplain forest. The diversion channel continues on past where the old side channel rejoins the river to a spot just west of the northern mid-channel island, a distance of about 1,500 feet. Vegetation is similar to the mixed conifer/deciduous forest that characterizes much of the area between RM 3.6 and 3.3, where the majority of development near the river would take place. Trees species include big-leaf maple, red alder, black cottonwood, bitter cherry, western hemlock, and Douglas-fir. Common shrubs include willows, cascara, trailing blackberry, Indian plum, red elderberry and salal in an understory of sword fern, Pacific bleeding heart, orchardgrass, and other species identified above. Western red cedar is the most common conifer species in the riparian forest.

Douglas-fir and western hemlock are common along valley walls and in the area above the floodplain. This type of habitat occurs on the eastern side of the river in the vicinity of the planned intake and diversion structure. The east bank is steep, with exposed rock close to the riverbank. Access to the new intake would be via a 500-foot road built parallel to the existing Crown Z Water Road along the east bank. In addition to Douglas-fir and western hemlock, which occur above the exposed rock, small madrone trees, Sitka willows, Himalayan blackberry, and Scot's broom grow in open habitat near the exposed rock. Serviceberry is abundant in the small sandy area below the existing intake structure.

A vegetation survey at the Elwha water treatment plant site found similar second-growth, mixed conifer / deciduous forest (URS 2003b). A more in-depth survey of the proposed solids pipeline corridor, which would parallel the north side of the existing overflow channel and would discharge into the river north of this channel, also found young madrone trees and aspen where the soil is relatively dry and exposed to the sun (URS 2004a). In addition to the trees identified above, the shrub layer of this forest includes willows, cascara, trailing blackberry, Indian plum, elderberries, and huckleberries. Both the existing DCWA well field and the proposed Elwha water treatment plant site have mowed grassy areas.

The preferred alternative to provide potable water to Elwha Heights subdivision homeowners is by means of a connection to the DCWA system. To provide this connection, a pipeline along Rife Road and Walker Ranch Road would be replaced with a larger line, and a new section of pipe across a privately owned piece of property would connect to the DCWA system. Vegetation along both Rife Road and Walker Ranch Road has been disturbed by the roads themselves, lawns, driveways, and other activities, with grasses and forbs such as velvet grass, tall fescue, timothy, thistle, and dandelion. Vegetation in the scrub habitat adjacent to the road is similar to the deciduous/conifer forest described above (e.g., Douglas-fir, western hemlock, red alder, big-leaf maple, salal, Indian plum). Once the pipeline veered away from the road alignment and continued toward Elwha Heights, it would cross through a tree farm growing conifers and hardwoods (Douglas-fir, western hemlock, red alder, red cedar, big-leaf maple, grand fir). Sitka spruce and other conifers have also been planted. Shrubs are typical of deciduous/conifer forest described above. The pipeline corridor would pass through a clearcut area where understory species and shrubs dominate, along with field grasses and forbs, before reentering forested habitat near the connection to the Elwha Heights homeowners pipeline at Edgewood Lane.

No development is proposed between RM 2.8 and RM 1.6.

Nearer the mouth of the river (RM 0.1 to 1.6) is the federal levee and the tribal fish hatchery. At the southern end of the federal levee is the Halberg property. This is the site the tribe is considering using for its relocated fish hatchery. Vegetation consists primarily of an ungrazed pasture with a variety of grasses and common weedy species and two shelter belts of trees on the north and south ends. Tree species in the shelter belts include big-leaf maple, red alder, Indian plum, Douglas-fir, and red cedar. Fruit trees also exist on the property. The levee road in this area and to the southeast is more heavily vegetated, with a second-growth forest on both sides of the road. The forest along the road and on the east end of the property is relatively undisturbed and does not appear to have been logged in the last 30–40 years. Surveys for protected or rare plant species found none, but botanists conducting the survey concluded that the less disturbed nature of this forest may make it habitat for some of these species.

At the north end of the levee (closest to the river mouth), a July 2003 survey found the roadway on top of the levee to be vegetated with species typical of disturbed areas. These included dandelions, pineapple weed, yarrow, and buckhorn. Vegetation in a dune area about 1,000 feet (300 meters) north of the northern end of the levee includes dune wildrye, silver burweed, beach peak, and other species specific to dune habitat. In the area east from the levee for a short distance, riparian species include big-leaf maple, red alder, and black cottonwood, as well as grass species (brome, wheat grass, and bent grass). Continuing south along the levee, the road vegetation is mowed. East of the middle section of the levee some riparian tree species grow, but the understory is grazed and less than 1 inch tall. Some grand fir seedlings have been planted in this area. Otherwise, vegetation to the east is weedy and typical of a disturbed site. Similar conditions exist east of the levee to its southern end. To the west of the levee, riparian forest species grow in the floodplain. Surveys in the spring and summer of 2003 noted that this riparian vegetation does not extend to the western edge of the levee, apparently because of maintenance.

The primary upland location that would be affected is the proposed Port Angeles water treatment plant site, which is adjacent to the city's existing landfill. This approximately 5-acre site consists of bulldozed land, regrowth forest about 20 years old or older, and a small wet drainage on the south. Numerous old roads crisscross the forested part of the site. Forest vegetation is mixed conifer and hardwood species, including Douglas-fir, western red cedar, red alder, big-leaf maple, and grand fir. Herbaceous weed species (including clovers, vetches, stinging nettles, sword fern, and Siberian miner's lettuce) occur on the site, with fewer in the forested area.

Roads and sections of pipelines could traverse upland areas. For example, a DCWA pipeline connection to the city's municipal water system would lie along Airport Road. A survey of this alignment showed that much of the area is mowed. Trees along the road included black cottonwood, Douglas-fir, aspen, and bitter cherry.

A pipeline to transmit wastewater from the tribe and Valley community residents to the city for treatment could also disturb upland vegetation, although much of the pipeline (two routes are currently under consideration) would run along existing pipeline, railroad, or road corridors. An existing pipeline climbs the bluff east of the river near the location of the WDFW rearing channel and extends along the Milwaukee Railroad right-of-way and Kacee Way. From here, it crosses Lower Elwha Road and enters the Port Angeles city limits. The route continues across Dry Creek and moves eastward along the railroad right-of-way to 18th Street and connects to the city's infrastructure. A portion of this route may be used for the tribe's wastewater pipeline. In addition, the tribe is considering part of the route for a new road that may become the primary access to the Lower Elwha Reservation (under separate project analysis in accordance with the National Environmental Policy Act through the Indian reservation roads program). If both were located in this corridor, the wastewater pipeline would follow the primary access route up the bluff to meet the railroad right-of-way, then follow that right-of-way for approximately 1.5 miles to the connection site at 18th Street. Tree species on the east side of the pipeline include big-leaf maple, red alder, Douglas-fir, western red cedar, and western hemlock. All of the trees are small because of recent maintenance. The vegetation along the railroad grade is primarily weedy species. A second pipeline route under consideration would follow the Lower Elwha Road in a southerly direction, then use the same easterly route along the railroad right-of-way, as described above.

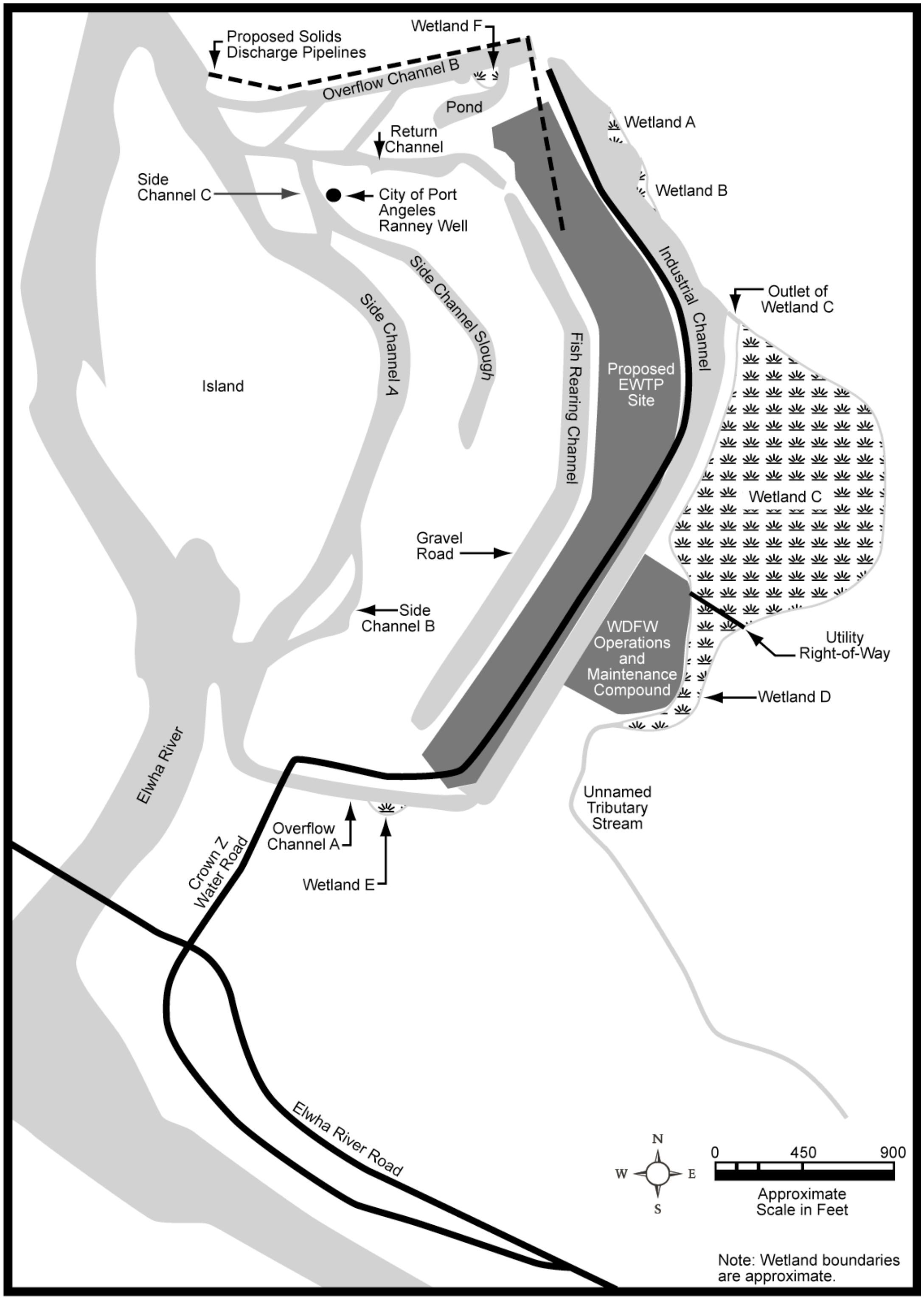
The vegetation at the location of the proposed chinook holding/rearing ponds on Morse Creek is primarily upland. The creek lies in a narrow, steep valley at this point, and vegetation is predominantly second-growth red cedar and big-leaf maple. Undergrowth consists of alder, salmonberry, sword fern, and trailing blackberry. Outside the immediate area, most land is used for grazing and other agricultural purposes.

Wetland Vegetation

Wetlands modulate river flows during storm events, stabilize banks and erosion, trap sediments, retain nutrients, provide wildlife habitat, and facilitate energy and nutrient flows (Brinson et al. 1981; Adamus and Stockwell 1983). At least three types of wetlands — forest, scrub/shrub, and emergent — are present in the study area. Willow and red alder are the dominant tree species in wetlands; common understory species include salmonberry, Indian plum, and skunk cabbage.

Elwha Water Treatment Plant. A survey in the vicinity of the Elwha water treatment plant site found six wetlands between outflow channels of the WDFW rearing channel to the north and south, just east of the industrial channel to the east, and the banks of the Elwha river to the west (URS 2003b). The classification that Clallam County uses for wetlands is I to IV, where I is the highest quality (Clallam County Environmental Policy 27.12.210).

- Two Class III wetlands at the northern end of the site are emergent wetlands dominated by reed canarygrass and are very small. (Wetlands A and B on the "Wetlands: Elwha Water Treatment Plant Site" figure.)
- Two larger wetlands (wetlands C and D) are part of the same forested and emergent wetland complex and are located east of the industrial channel. Dominant tree species include red alder and western red cedar, with salmonberry, reed canarygrass, and American brooklime present in the understory. One of these wetlands includes large patches of open water, with habitat features such as snags and floating logs, and a stream feeds the other wetland. The two wetlands are separated by a utility line right-of-way. Both are Class I because they are large, have diverse habitat features, and consist of largely native species of vegetation. They are outside the area slated for development, but they could experience indirect effects and could require a 200-foot buffer (Clallam County Environmental Policy 27.12.215). The wetlands are most likely oxbows or disconnected segments of what once was the Elwha River. It is also likely that the industrial channel separated these wet areas from the river.



Wetlands
Elwha Water Treatment Plant Site

- The fifth wetland (wetland E) is along the overflow channel at the southern end of the study area. It is a small, class III, emergent wetland dominated by spike bentgrass and American brooklime.
- The final wetland (wetland F) is at the eastern end of the northern overflow channel. It is a small strip wetland with both emergent and forested components dominated by reed canary grass and red alder. Because it is small and has lower diversity, it is a Class III wetland.

Some small wetland areas dominated by these same species were also found adjacent to some of the side channels and sloughs in the area. However, because buffers between construction and the river are mandatory (Clallam County Environmental Policy 27.12.215), they would not be directly affected. Other small wetlands may exist in the vicinity. For example, pipeline leakage along the route of the current Port Angeles municipal pipeline, and the proposed site of other pipelines or road development, has created some wetland habitat, where elodea, duckweed, forget-me-not, dock, and small flowered bulrush have become established.

Four small wetlands exist in the immediate vicinity of the proposed control weir/intake (URS 2004a). There are two small forested wetlands near seeps along the upslope portion of the county's existing access road on the west side of the river. Devil's club, lady fern, youth-on-age, and skunk cabbage grow in the wet soils of these seeps. These wetlands are also in the vicinity of the DCWA alternative well field (URS 2002b). One wetland drains into the pond described below, and the other into a culvert under the road. Both are considered Class III wetlands.

A third wetland on the west bank of the river is very near the existing diversion structure. This small wetland has both emergent and scrub/shrub components and is dominated by creeping buttercup and red canary grass. The scrub/shrub community is dominated by Sitka willow, Nootka rose, and red-osier dogwood. The fourth is another scrub/shrub wetland at the northern end of the northern mid-channel island and is dominated by Sitka willow and red alder. Both of these may have higher value by virtue of both their vegetation and location, but both are quite small and are unlikely used extensively by wildlife or able to provide much in the way of flood modulation or other function.

DCWA Alternative Well Field. Ponds and side channel habitat, including a string of three interconnected ponds about 50 to 100 feet across and less than 4 feet deep, exist in the river floodplain southeast of the alternative DCWA well field site. The northernmost pond is surrounded by emergent wetland, and sedges and rushes grow around the pond edges. Part of the ponds may be affected or need to be filled to raise the well field, although an additional survey is needed to verify this.

If the alternative well field site was selected, one of the five alternative pipeline routes to bring water across the river to users would have to be selected. Wetlands surveys for the five pipeline routes found small forested wetlands and/or riparian habitat to differing degrees. The existing access road to the new well field crosses two small forested wetlands.

- Alternative route A would not affect wetlands, but would require the removal of a few trees.
- Alternative route B would involve tree removal and would have a potential impact to forested wetlands along the cross-country portion of the alignment.
- Alternative route C would only affect the same two forested wetlands as route A, but would otherwise take place within the footprint or along an existing road right-of-way.
- Alternative route D would require a river crossing, which would involve drilling beneath the river, floodproofing the pipeline in the river, or constructing a bridge. Directional drilling for a pipeline under the bridge would result in the removal of some riparian forest or scrub/shrub habitat. Floodproofing could create a change in the function of the floodplain, with impacts to

fish or aquatic species, or wetland or riparian habitat. Bridge construction could also result in the removal of riparian vegetation.

- Alternative route E would require some construction along Elwha River Road and could require the avoidance of emergent wetlands along the road shoulder and the removal of a few trees, as well as the construction of a pipeline across the floodplain (Bureau of Reclamation 2003a).

Another option for the Dry Creek Water Association would be to abandon its well field and connect to the city's municipal water supply system. This pipeline route would follow Airport Road for about 3,000 feet. No wetlands were observed along this route, although a natural water spring exists at the upper end of Airport Road.

Elwha Heights. Several small wetlands were identified along the proposed corridor to connect the Elwha Heights subdivision to the DCWA water supply system. A scrub/shrub, class II wetland dominated by Nootka rose and reed canarygrass was found along the west side of Rife Road, and two small, class III emergent wetlands along Walker Ranch Road, vegetated with reed canarygrass, creeping buttercup, and velvetgrass. Three small emergent class III wetlands are clustered near where the pipeline would intercept Edgewood Lane in a clearcut area. One of these wetlands includes a small pool and an aquatic bed community of vegetation, including duckweed and pondweed.

Privately Owned Levee. Currently an emergent coastal wetland on the west side of the river mouth and west of the private levee is prevented from flowing into the Elwha River estuary by the 900-foot levee. This wetland is partially fed by water seeping through the levee during high flows. There may also be saltwater influence because it is separated from the Strait of Juan de Fuca by low-lying sand berms. Modification of the existing levee could result in some fill of this wetland, while relocation of the levee westward or removal could allow this area to reconnect to the river and once again become part of the estuary.

Wildlife

The majority of construction work associated with water quality and water supply mitigation in the vicinity of the Elwha River would take place between RM 2.8 and 3.7. The proposed Elwha water treatment plant would be near RM 2.8, and the existing WDFW fish-rearing channel is between RM 2.8 and 3.0. The existing rock diversion structure and intake is at RM 3.5. The crest of the replacement structure would be located about 225 feet upstream. The DCWA existing well field is at RM 3.7, and the alternative site is between RM 3.4 and 3.5. Downstream, construction would take place at RM 2.0–2.3 on the Halberg property and along the 1.5-mile federal levee. This stretch of river, as well as upland areas where the Port Angeles water treatment plant would be built, were the focus of recent wildlife (and vegetation) surveys.

As noted above, most of the wildlife habitat in this section of the river is a mix of conifer and riparian / deciduous forest with an undergrowth of riparian forbs and shrubs, including willows, blackberry, elderberry, salal, and snowberry in the shrub layer, and lower lying wild ginger, Oregon grape, and sword fern. Some drier sites and shrub/scrub vegetation exist on the valley slopes, and lawns are present at or near the DCWA well field and at the industrial channel. Some small forested wetlands and emergent wetlands exist in the vicinity. Six emergent and/or forested wetlands, including two that are larger with more diverse habitat near the industrial channel, were recently mapped near RM 2.8–3.0 (URS 2003b).

Several additional emergent wetlands, as well as some pond and side channel habitat, occur in the river floodplain near the alternative DCWA well field site and near the outflow of two overflow channels from the existing industrial channel. Wetland surveys for the five identified DCWA pipeline route options (if the well field is relocated) found small forest wetlands and/or riparian habitat to differing degrees, and the preferred alternative to connect Elwha Heights homeowners to the DCWA water system would also include a pipeline alignment that could affect six small, lower quality wetlands. One of these wetlands may serve as wildlife habitat to aquatic birds species.

Habitat in the vicinity of Morse Creek is riparian and upland forest; some previously cleared areas are dominated by grasses and brush.

Mammals

In surveys conducted in fall 2002, and spring or summer 2003, both low-lying riparian or wetland habitat and upland habitats were surveyed for wildlife species. The following descriptions are a result of those surveys and of information from the FEIS and other planning documents for the area.

In the upland areas, as well as in the riparian forests, Columbian black-tailed deer tracks and scat were observed, and their trails were common in and near forest edges throughout the vicinity of wildlife habitat from RM 2.8 to 3.7. Roosevelt elk are known to winter in the forested area adjacent to the DCWA well field and farther north (see the FEIS for more information on this species). Signs of beaver activity in one of the side channels near where the Elwha water treatment plant would be built were also noted, and a river otter was observed near the north end of the existing industrial channel. Although they were not observed, it is known that common mammalian predators in the project vicinity include coyote, bear, cougar, weasel, and mink. Small mammal species either observed or expected in habitat common in the project vicinity include Douglas squirrels, Townsend chipmunks, deer mice, Pacific jumping mice, shrews, moles, voles, bush-tailed wood rats, snowshoe hares, and mountain beavers. These same species likely occupy upland habitat near the Morse Creek site.

While no signs of mammalian life were observed in the site slated for development of the Port Angeles water treatment plant, two black-tailed does and their fawns were seen in the landfill area.

Surveys of the federal levee and options for its extension, as well as of the Halberg property on the reservation where a pump station for treated wastewater would be located, found evidence of deer browsing on cherry and apple trees.

Several species of bats, including little brown myotis, California myotis, hairy-winged myotis, long eared myotis, silvery-haired bat, hoary bat, and big brown bat are associated with forests in the area.

Birds

Between RM 2.8 and 3.7, grassy areas near the DCWA well field and on the grounds surrounding the industrial channel included robins, savanna sparrows, and dark-eyed juncos. Red-tailed hawks and violet-green swallows were observed near the DCWA well field or along one or more of its possible distribution routes. A western flycatcher, which inhabits riparian and deciduous hardwood forest, was seen at this site during a May 2003 survey. Diving ducks (such as mallards and other puddle ducks), killdeer, and red-winged blackbirds may occupy roadside emergent wetlands and side channel ponds along the Elwha River in the vicinity of the DCWA well field and areas to the north.

Surveys of both sides of the river between the existing intake and diversion at RM 3.5 and the WDFW fish-rearing channel at RM 2.8 found that both banks are well used by recreationists. Soils are severely compacted by vehicle traffic. Although some birds were heard in the canopy, none was definitively identified, and very few birds were observed. A more recent survey (URS 2004a) found a great blue heron, a family of common mergansers, and American dippers in the river or along the shoreline near the existing intake structure.

In the river near the WDFW rearing channel, the river has split around a forested island. The flow around the east side of this island was found to contain ducks and other water birds. Surveys conducted in February 2003 reported a great blue heron and a family of common mergansers, hooded mergansers, buffleheads, American dippers, common goldeneye, and belted kingfisher (URS 2003b). In the two larger wetlands east of the industrial channel mallards and a pileated woodpecker were noted. A possible pileated woodpecker roost tree was observed on the valley side slope east of the wetland complex.

Farther downstream surveyors found considerable wildlife activity at the southern end of the levee at the Halberg property. Robins were feeding on cherries from the fruit trees on site; American goldfinches and black-headed grosbeak were also foraging. A single ruffed grouse and an immature red-tailed hawk were observed. A mature red-tailed hawk was soaring overhead and calling to the immature bird, suggesting a nest in the vicinity. One route for extending the levee southeast through the Halberg property was also surveyed. This habitat is extremely dense forest with little open canopy. A pileated woodpecker and Wilson's warbler were observed in this area. Birds along the levee to the mouth of the river were primarily common species associated with urbanized areas (such as the American gold finch and the white-crowned sparrow). Near the mouth of the river and the north end of the levee, turkey vultures, crows, and shorebirds (gulls, cormorants, and a black oystercatcher) were observed. A brood of California quail nested in the vicinity. Although ravens scavenged on recently emptied fish tanks at the tribal hatchery, no other species were observed in the vicinity. Despite this, the Audubon migratory bird surveys between 1994 and 2001 have found a multitude of species at the mouth of the river and along the adjacent shoreline. These include species of special concern, such as bald eagles, Harlequin ducks, and marbled murrelets (see "Species of Special Concern"), as well as ducks (bufflehead, green-winged teal, mergansers), grebes, loons, and several species of raptors (red-tailed hawk, sharp-shinned hawk, Cooper's hawk). A variety of sparrows, finches, vireos, swallows, and warblers were also found in more heavily forested areas.

Forest birds either identified during surveys along the river or in upland areas or known to inhabit the area include American robins, song sparrows, black-capped chickadees, varied thrushes, northern flickers, and winter wrens. Other species considered likely to occur in project area forests include ruffed and blue grouse, mountain chickadees, great horned owls, western screech owls, band-tailed pigeons, red-breasted sapsuckers, and pileated and downy woodpeckers. Shrub/scrub species observed in the upland area of the Elwha water treatment plant included robins, dark-eyed juncos, song sparrows, American goldfinches, house finches, gold-crowned sparrows, and spotted towhees. Spring and summer surveys of the Port Angeles water treatment plant site found violet green swallows, robins, turkey vultures, American goldfinches, flickers, ravens, and many white-crowned sparrows. An occupied red-tailed hawk nest is located on the north edge of the plant site, just inside the forest fringe.

A May 2003 survey of Airport Road (the route for connecting the Dry Creek Water Association to the city's municipal water system) found the same or similar species as at the Port Angeles water treatment plant site — robins, flickers, violet green swallows, and white-crowned sparrows. Other road and pipeline alignments were surveyed. Roads into the Elwha water treatment plant site that would be graded or upgraded were primarily observed to have species associated with urbanized sites. A yellow warbler and cedar waxwings foraged on wild berry bushes along the Kacee Way alignment, and cedar waxwings and dark-eyed juncos were present along the Rife Road alignment. Similar passerine species were found at the Morse Creek site. A recent survey (URS 2004a) confirmed the presence of these same species of birds along the corridor where the pipeline would be replaced to connect Elwha Heights homeowners to a treated water supply. One wetland along this route in a clearcut field was considered large enough to attract birds. Although no birds were observed during the survey, species such as puddle ducks and red-winged blackbirds are considered likely inhabitants.

Lake Aldwell is used as early winter staging habitat (late November through December) by trumpeter swans (Jordan 1995). While the Pacific Coast population of trumpeter swans is neither threatened nor endangered, these birds are of local concern. The swans, which are also known to use Lake Mills, have recently numbered up to 80. Those that spend the entire winter in the Elwha / Port Angeles / Sequim area number approximately 60 (Jordan, pers. comm. Oct. 2003). The Pacific Coast population currently totals approximately 16,300 birds, with 2,000 wintering in western Washington (USFWS 1995a). The swans use a variety of habitat types, including agricultural fields, forested wetlands, ponds, lakes, and estuaries. Although trumpeter swans are outside the study area for this SEIS, they are discussed here because mitigation for the loss of reservoir habitat was not proposed or explored for effectiveness in the FEIS.

Several bird species of concern or with special protected status inhabit the Elwha River valley and may be affected by mitigation activities proposed in this SEIS. They are discussed in the "Species of Special Concern" section below.

Reptiles and Amphibians

Common reptiles in the project area include northwestern garter snakes, common garter snakes, and northern alligator lizards. Northern red-legged frogs and roughskin newts were observed in the vicinity of the DCWA existing or alternative well field sites and in forested portions of the Elwha water treatment plant site. Calls of Pacific chorus frogs and northern red-legged frogs were heard in the vicinity of the wetland complex just east of where the Elwha water treatment plant is planned. Northwestern salamanders, western red-backed salamanders, and tailed frogs (a federal species of concern) were not observed but are considered likely residents of the Elwha water treatment plant site.

Species of Special Concern

Mammals

Pacific Fisher

No federal threatened or endangered mammal species exist in the project vicinity. However, Olympic National Park contains habitat suitable for the fisher *(Martes pennanti),* a species that is listed by the state as endangered and by the federal government as of concern. The status of the Pacific fisher is not known on the Olympic Peninsula, but is presumed to be rare (Aubrey and Houston 1992). Currently, the fisher is very rare in Washington. Infrequent sightings and incidental captures indicate that a small number may be present. However, despite extensive surveys, no one has been able to confirm the existence of a population in the state. The Washington Department of Fish and Wildlife believes that any remaining fishers in the state are unlikely to represent a viable population, and without a recovery program including reintroductions, the species is likely to be extirpated from the state (Lewis and Stinson 1998).

No evidence of the fisher was reported in any of the four surveys of habitat in the affected area. Although the Elwha valley is considered good fisher habitat, particularly the riparian areas, the last reliable sighting of a fisher in the Elwha River drainage in the study area was in 1975, just outside the park boundary near Herrick Road. There is also a historic record from near RM 22 (WDFW 1995a).

Fisher biology is characterized by low population density and a low reproductive rate. They have extensive home ranges and generally avoid large openings, which suggests that viable populations would require large areas of relatively contiguous habitat. Throughout their range, fishers are generally associated with late-successional coniferous and mixed coniferous/deciduous forests. In western Washington fishers may be restricted by frequent soft snows or deep snow packs to elevations below 6,000 feet. Fishers most likely use forests that have a high canopy closure, multiple canopies, and shrubs, and that support a diverse prey base. Large diameter trees, large snags, tree cavities, and logs are an important component of suitable habitat because they are most often used for den and rest sites.

Bats

Four species of bats are considered federal species of concern; Townsend's big-eared bat *(Corynorhinus townsendii*, formerly *Plecotus townsendii),* Keen's myotis *(Myotis keenii),* long-eared myotis *(Myotis evotis)*, and long-legged myotis *(Myotis volans).* These bats are all associated with mid- to late-seral forests. Townsend's big-eared bats require caves or mine shafts for hibernation and nursery colonies. All exist in the vicinity of the mitigation projects, although none was observed during surveys in 2003.

Birds

Bald Eagle

The federally threatened bald eagle *(Haliaeetus leucocephalus)* has been observed year-round in the area. Bald eagles feed primarily on high concentrations of glaucous-winged gulls and other marine birds along the coast, chinook salmon carcasses in the lower river section, non-anadromous fish stocks in the reservoirs, and carrion, including elk and heron carcasses.

Surveys conducted for the FEIS recorded 14 sightings of eagles (James River II 1990). The survey results and discussions with regional biologists and local landowners indicate that eagle densities upriver decrease with distance from the delta, with very low numbers above Lake Mills. Substantially greater numbers of eagles were detected along the coast than anywhere along the river corridor, possibly because of high prey availability compared to the middle and upper river sections within the study area. The availability of salmon carcasses appears to be an essential food source for wintering and breeding eagle populations elsewhere in Washington (Stalmaster and Gessaman 1984). As noted in the FEIS, the distribution or number of bald eagles along the Elwha River may change when the dams are removed and salmon stocks restored.

Surveys of the sites where development would or might occur during both wintering and nesting periods found no individuals or nests. However, the Strait of Juan de Fuca from Port Angeles to Neah Bay is used by 30 to 35 nesting pairs; two of these sites are just east of the Elwha delta (McMillan, pers. comm. Sept. 1995). Development near the coast, such as for the extension of the federal levee, would have the most potential to impact bald eagles.

The Morse Creek site generally lacks habitat required by bald eagles, as the creek is small and usually partially hidden beneath a dense understory. Bald eagles may use the creek corridor to access the strait or other feeding areas.

Northern Spotted Owl

The federally threatened northern spotted owl *(Strix occidentalis caurina)* typically inhabits unlogged old-growth forests or mixed forests of mature and old-growth timber (Forsman et al. 1984). Northern spotted owl surveys have found seven pairs between the Elwha headwaters and the national park boundary (FERC 1993), two active nests within 2.2 miles of the river and Lake Mills, and at least one additional nest between U.S. Highway 101 and Lake Aldwell, 1.2 miles from Elwha Dam. "Site center" and nesting locations frequently move small distances (generally less than 0.5 mile) from year to year, so that the precise distances from owl sites to the dam sites vary annually. No nest sites in the vicinity of proposed construction of projects for water quality, water supply, flooding, or other actions considered in this SEIS have been located (see USFWS "Biological Opinion," FEIS Appendix 7). Old-growth forest habitat does not exist in the vicinity of any of the construction sites, including Morse Creek, so no owl nesting is expected anywhere in the impact area.

Marbled Murrelet

The federally threatened marbled murrelet *(Brachyramphus marmoratus)* has been observed flying in the Elwha valley and probably nests in the drainage. In western Washington this species prefers to nest in old-growth or large sawtimber forest stands within 39 miles of the coast and below 3,500 feet elevation (Brown 1985). Nesting season in Washington is between April 1 and September 15.

Surveys conducted in 1995 and 1996 within the lower Elwha drainage indicate few birds travel daily north to south through the Elwha valley. No evidence of nesting was found within the vicinity of either the Elwha Dam or the Glines Canyon Dam; the nearest activity occurs in upper parts of adjoining tributary streams such as Boulder Creek, or farther upriver (FERC 1993; Hathorn et al. 1996). No nesting in the vicinity of proposed projects is therefore considered likely. Also, Morse Creek does not have murrelet habitat in the vicinity of the state rearing ponds (Farinas, pers. comm. 2003).

Reconnaissance-level surveys indicate that the Elwha valley between Krause Bottom and the delta serves as a flight corridor between the marine environment and nesting stands along the upper reaches of the valley or tributaries, where an estimated 15 pairs of marbled murrelets bred during the 1990 season.

Harlequin Duck

The harlequin duck *(Histrionicus histrionicus)* is not listed as threatened or endangered, but it is a federal species of concern, which means it is being monitored and could be listed at some future date. Harlequin ducks typically breed in forests adjacent to swift-moving streams. During spring and summer they feed on invertebrates inhabiting the streams. Wintering harlequins feed on snails, limpets, crabs, and chitons in nearshore saltwater areas. Relatively large numbers of the ducks were found near the river mouth in winter surveys in the early 1990s (WDFW 1994). The Elwha River drainage, above and below the dams, is considered prime nesting habitat for the harlequin duck (Schirzto, pers. comm. Oct. 1994), although no nests were sighted in any of the 2003 wildlife surveys of the project vicinity.

Northern Goshawk

The northern goshawk *(Accipiter gentilis)* is both a federal and state species of concern. It is a breeding resident in the project area and occasionally observed year-round. One pair is known to traditionally nest along the Whiskey Bend trail (Sharpe 1990; WDFW 1995a). The goshawk breeds in the dense canopy of mature conifer forests or mixed stands of conifers and deciduous trees. It preys on medium-sized mammals and birds, hunting from concealed perches or while flying. Foraging often occurs at the edges of forests; grouse are an important prey item (Verner and Boss 1980). No goshawks were seen during any of the four wildlife surveys conducted for this SEIS.

Pileated Woodpecker

The pileated woodpecker *(Dryocopus pileatus)* is a state species of concern. It requires large trees and snags for reproduction, as well as for feeding (Schroeder 1983). In the project vicinity, they probably prefer Douglas-fir and deciduous riparian forests with two or more canopy layers (Bull and Snider 1993). These large woodpeckers excavate a new nest cavity each year; old cavities are used by numerous other species in the ecosystem, including saw-whet and screech owls, Vaux's swifts, flickers, chickadees, flying and tree squirrels, wood rats, and bats. Two pileated woodpeckers were identified during surveys for this SEIS — one east of the Elwha water treatment plant site, and a second in the forest east of the Halberg property where the southern end of the levee could be extended.

Amphibians

Northern Red-legged Frog

The northern red-legged *(Rana aurora aurora)* is a federal species of concern. The frog occurs widely west of the Cascade Mountains from British Columbia to California. This large frog lives in forests, damp meadows, marshes, ponds, lakes, and along streams. During rainy seasons, individuals often occupy land away from water, although they prefer mature forests with abundant leaf litter and fallen logs. Red-legged frogs tend to be restricted to lower altitudes. Northern red-legged frogs were observed in some of the wet areas near the existing or alternative well field for the Dry Creek Water Association. Red-legged frogs breed in ephemeral ponds, or perennial ponds that do not have fish. A more thorough survey of affected wetland locations would likely uncover additional individuals of this species.

Tailed Frog

The tailed frog *(Ascaphus truei),* a federal species of concern and a state-monitored species, lives in cold, clear mountain streams in the Cascade Mountains and Coast Range from southern Canada to northern California, as well as in eastern Washington and Oregon mountain ranges and the Rocky Mountains. Tailed frogs are sensitive to stream siltation and warming. They are most abundant in streams in old-growth forests, but can also occupy more open streams. Tailed frogs are likely to occur in forested portions of the site proposed for the Elwha water treatment plant, as well as other affected wetland locations.

Western Toad

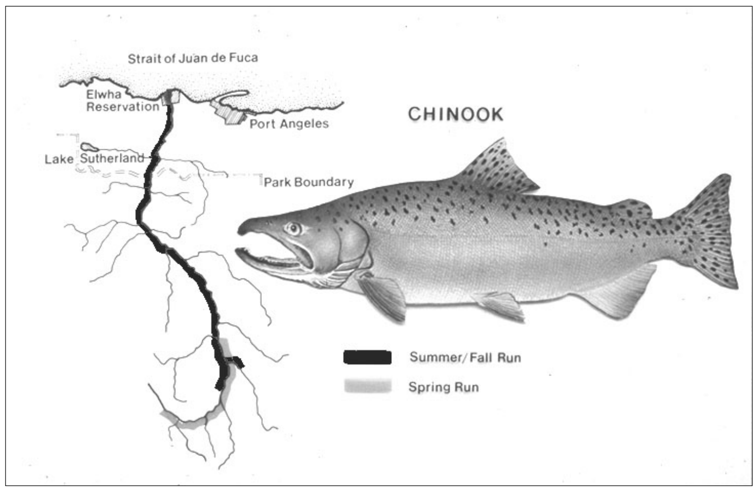
The western toad *(Bufo boreas)* is a federal species of concern. It is a large, robust animal found in all regions of Washington except for the most arid portions of the Columbia Basin. The toads are distributed widely throughout the western United States and Canada. Western toads are most common near marshes and small lakes, but may wander great distances through dry forests or shrubby thickets. Outside the breeding season, this species is nocturnal and spends the day buried in soil, concealed under woody debris, or in the burrows of other animals. Western toads were observed in forested portions of the site proposed for the Elwha water treatment plant, and a more thorough survey of affected wetland locations would likely uncover additional individuals of this species.

Fish

As noted in the “Native Anadromous and Resident Fisheries” section of this SEIS (see page 61), 10 anadromous fish species co-exist in the Elwha River, several of which are offered special protection, or are currently being monitored and considered for this protection. Chinook salmon *(Oncorhynchus tshawytscha)* and bull trout *(Salvelinus confluentus)* are both federal threatened species. Most other Elwha salmon and anadromous trout, including chum *(O. keta)*, pink *(O. gorbuscha)*, and sockeye *(O. nerka)* salmon, as well as coastal cutthroat trout *(O. clarkii)* and Dolly Varden *(Salvelinus malma)*, have been listed as Washington State species of concern, and impacts to these species are analyzed in the “Fisheries” section of the SEIS. Other freshwater or resident species of fish include the Pacific lamprey *(Lampetra tridentatus),* which is a federal species of concern. The Puget Sound / Strait of Georgia evolutionarily significant unit (ESU) of coho salmon was declared a candidate for listing by the National Marine Fisheries Service in 1995. This ESU includes the Elwha River runs of coho salmon.

Chinook Salmon

Chinook salmon are described by the season in which they enter their natal streams to spawn. Spring chinook enter fresh water several months earlier than summer/fall chinook. Before the Elwha and Glines Canyon Dams were built, it is believed that chinook entering the river in the spring swam farther upriver to spawn upstream of Carlson Canyon Falls at RM 34. Fish entering in the late summer or fall spawned downstream of RM 34.



Chinook enter the Elwha River primarily from June through September (see Table 7, page 62). Adults require cool water (below 14°C) and medium-size spawning gravel, usually laying eggs in a main channel of the river rather than its side channels or tributaries. Peak spawning occurs from September through mid-October, and adults die within days or weeks after spawning. Juveniles either migrate out their first spring or rear in the river and leave the following May and June as yearlings (Williams et al. 1975). All spend some time in the estuary as they grow and adapt to salt water. Native Elwha underyearlings move into the offshore marine environment in late July and early August (Schroder and Fresh 1985).

Table 8. Number of Hatchery Chinook Returning to the Elwha River

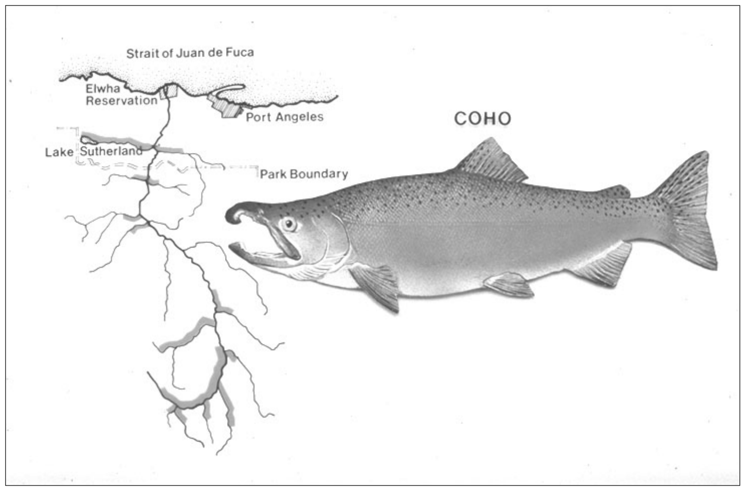
Return Year	Number of Returning Elwha River Chinook	Return Year	Number of Returning Elwha River Chinook
1992	4,002	1997	2,527
1993	1,669	1998	2,409
1994	1,580	1999	1,625
1995	1,814	2000	1,913
1996	1,877	2001	2,246

SOURCE: PNPTC, WDFW, and Makah Tribe 2003.

Chinook have been regularly stocked for many years. As early as 1930, E. M. Brannon, supervisor of the Dungeness Fish Hatchery, proposed the stocking of chinook in the Elwha. By 1945 the program was fully implemented (*Port Angeles Evening News,* Oct. 3, 1945). The major stock has been the Elwha River summer/fall chinook; spring chinook that were planted in 1973 and 1977 were from Dungeness and Solduc hatchery stocks. Since 1985, approximately 775,000 chinook yearlings have been released annually, with fry and fingerlings totaling 2.6 million fish per year (PSMFC 1995). As shown in Table 8, an average of 2,000 chinook have returned in recent years (1999–2001). The Puget Sound chinook salmon, which occurs in the Elwha River and nearshore marine areas of the river, was listed as threatened under the federal Endangered Species Act in 1995. As a result, fisheries restrictions and other measures were taken to help protect this species.

Coho Salmon

Coho salmon are a highly prized sport and commercial fish species in Washington State. Currently, Puget Sound / Straight of Georgia coho, which include Elwha runs, are candidates for listing under the Endangered Species Act. The Elwha River, because of its hatchery program, is one of the largest coho producers on the Strait of Juan de Fuca. Even though the run size is less than 1% of the total Puget Sound coho production, it accounts for approximately 35% of the runs returning to the north Olympic Peninsula (WDFW 1995b).



Adults enter the river from September through early January, with some arriving as late as February. Spawning takes place from October into January, primarily in side channel habitats. Adults die shortly after spawning. Most juveniles emerge from the gravel from late winter through mid-spring (Williams et al. 1975; Scott and Crossman 1973). Juveniles live for over a year in the system before migrating to the ocean from late March through mid-June; peak outmigration occurs in May (Wunderlich 1983). Overwintering habitat, which is critical for survival, is often associated with wooded off-channel areas such as ponds and side channels, though main channel pools also are used (Peterson 1980; Peterson and Reid 1984; Swales and Levings 1985).

Coho are typically released from the hatchery into the river as yearling fish in April and May. Recent releases (1990–94) ranged from 400,000 to 800,000 smolts per year. Since 1977, annual coho returns to the Elwha have varied from as high as 16,000 to as low as 1,100 fish, with the majority being hatchery fish. For the 1990–94 period, the average return to the river was just under 3,000 coho per year (Point-No-Point Treaty Council [PNPTC] and Makah Tribe 1994).

Native Char (Dolly Varden and Bull Trout)

In general, native char (Dolly Varden and bull trout) populations in Washington are minor sport species because of their limited abundance in most rivers (although they are quite abundant in some systems, such as the Hoh River). They are widely distributed in the state. Both anadromous and freshwater races exist. Anadromous populations migrate from the sea upriver from May to December (usually August to

September). They spawn in the fall and early winter, and fry emerge from April to mid-May. Migrations to the sea begin at age three or four in the spring, and fish return to the same river in the fall, spending only late spring to fall in the marine environment each year of their lives. Like cutthroat, char generally migrate only a short distance from the river in the marine phase (compared to other salmonids) and spend the entire time in tidal water (Scott and Crossman 1973). In systems with lakes, resident fish may similarly migrate, spending summers in the lake and other times in the river (Wydoski and Whitney 1979).

Coastal / Puget Sound populations of bull trout were listed as federally threatened in November 1999. Bull trout are generally not anadromous, but anadromy does occur in many Puget Sound and coastal river populations (USFWS 2000). Bull trout have specific habitat requirements, including cold water, complex cover, stable substrate, high channel stability, and stream/population connectivity. Water temperature influences bull trout distribution more than any other environmental factor (Rieman and McIntyre 1993). It is believed that two subpopulations of bull trout live in the Elwha River. The lower river population (below the Elwha Dam) is probably anadromous and is likely "depressed," or as determined by the U.S. Fish and Wildlife Service, to have had either a major life history form eliminated, abundance that is declining or half the historic abundance, or less than 5,000 total fish or 500 adults present. Officially, the status of this subpopulation is unknown. Available habitat for this subpopulation includes the 5 miles of the mainstem below the Elwha Dam, and three small, low-gradient tributaries. The location of spawning habitat is unknown.

An upper river subpopulation both between the dams and upstream of the Glines Canyon Dam also exists. Bull trout between the dams are assumed to be part of the upper river subpopulation, but genetic testing to confirm this has not been completed. Bull trout upstream of Glines Canyon Dam use Lake Mills as foraging habitat, as well as more than 50 miles of the mainstem and tributary habitat. Based on surveys, between 240 and 875 bull trout are estimated to live in the habitat above Glines Canyon Dam, and between 65 and 900 bull trout between the dams in the upper river subpopulation.

Pacific Lamprey and Brook Lamprey

Lampreys are jawless fish, with both resident and anadromous life histories. Pacific lampreys (*Lampetra tridentata*) spend most of their lives in freshwater rivers before entering the ocean as adults to feed. Here they grow to 16–27 inches before returning to fresh water to spawn and die. In large river systems, such as the Klamath and Eel, Pacific lamprey may have a number of distinct runs or races, like salmon. Today, Pacific lampreys are primarily concentrated in medium and large sized, low-gradient Pacific streams. The Western brook lamprey (*L. richardsoni*) is nonparasitic and does not migrate to the ocean to feed. It prefers small tributaries, rather than the mainstems of rivers. Throughout its range, the lamprey has been heavily affected by water developments, agricultural and forest land management practices, and rapid urbanization in many watersheds. Several conservation organizations petitioned the U.S. Fish and Wildlife Service to list the Pacific lamprey and three other lamprey species as threatened or endangered in January 2002. Pacific and brook lampreys have been reported in the Elwha River (URS 2002b, 2003b).

State Sensitive Plant Species

All of the areas where water, flood, fisheries, or other mitigation measures might be constructed were surveyed for protected plant species. No federal threatened or endangered species were found, but several species are considered sensitive by the state of Washington (i.e., populations are vulnerable or declining, and they could become endangered or threatened without active management). The species at risk are:

tall bugbane *(Cimicifuga elata)*
spreading miner's lettuce *(Montia diffusa)*

giant helleborine or stream orchid *(Epipactis gigantea)*
false hedge-parsley *(Caucalis microcarpa)*
Dortmann's cardinalflower *(Lobelia dortmanna)*
pink sand-verbena *(Abronia umbellata* spp. *breviflora)*
Cotton's milkvetch *(Astragalus cottonii)*
long-stalked draba *(Draba longipes)*
western yellow oxalis *(Oxalis suksdorfii)*
loose-flowered bluegrass *(Poa laxiflora)*
royal Jacob's ladder *(Polemonium carneum)*
floating bur-reed *(Sparganium fluctuans)*
featherleaf kittentails *(Synthyris pinnatifida* var. *lanuginosa)*

Bugbane and spreading miner's lettuce generally grow in moist forests (Hitchcock and Cronquist 1973). Giant helleborine is a nonshowy orchid that prefers streambanks, seeps, and lake margins. Surveys conducted in 1990 located helleborine between the road to Whiskey Bend and the Glines Canyon Dam, although this population could not be relocated in a 1995 survey. False hedge-parsley grows in rock outcrops and was located in 1995 near the Glines Canyon Dam and downriver. Surveys in February, May, and July of 2003 failed to locate individuals or populations of any of these species; therefore no impact analysis is included in this document.

Air Quality

Ambient air pollutant concentrations for the Olympic National Park region are within national, state, and local air quality standards. This attainment status may be attributed to the low population density and the lack of many major, older industrial pollution sources. Sulfur dioxide, nitrogen oxides, and suspended particulate matter from coal-fired power plants, refineries, and pulp and paper mills are the air pollutants of principal concern.

The U.S. Environmental Protection Agency has set health-based standards for six air pollutants: ozone, nitrogen oxides, fine particulate matter less than 10 microns in diameter (PM_{10}), carbon monoxide, lead, and sulfur dioxide. Clallam County and the project site are designated as attainment areas (i.e., concentrations below the standards) for all criteria pollutants. This designation is based on representative ambient air quality monitoring.

Concentrations of air pollutants in the study area are influenced by sources of emissions and the dispersion by weather patterns of the region. Major sources of air pollutants (greater than 100 tons per year or 0.907 metric tons) in Clallam County are the Nippon Paper Industries and K-Ply mills. Silvicultural burns, smoke from wood-burning stoves, dust, and other particulate matter generated from vehicles on unpaved roads, vehicle exhaust, and smoke from campfires also affect the air quality in the middle and lower Elwha valley area and Olympic National Park.

The Prevention of Significant Deterioration (PSD) program is designed to allow growth in areas of good air quality without allowing pollutant concentrations to exceed the ambient air quality standards. Because of its unique nature, Olympic National Park has been designated a PSD Class I area. Class I areas receive special air quality protection. To ensure that park air quality remains good, sulfur dioxide, ozone, and visibility are monitored within the park. Sulfur dioxide and ozone are pollutants of concern because these pollutants affect visibility, and many plant species in the park are sensitive to these pollutants. Clean offshore air flowing onto the Olympic Peninsula maintains the near pristine air quality of the national park. However, the park is subject to episodes of smoke and particulate matter pollution due to slash burning on adjacent lands and occasional forest fires. These short-term events affect visibility, but have only limited impacts on other park resources.

Noise

The study area and the surrounding region are relatively quiet, with few sources of noise. Within the study area natural quiet is affected by recreational uses and vehicle access, particularly from the existing and alternative DCWA well field sites downstream to the WDFW fish-rearing channel. Casual roads, trails, and bike paths are common in floodplains until a high flood washes them away. Picnicking, hiking, fishing, and boating all occur along the river and its edges in this vicinity. Roads down to the river, crossing the river, or along the river to access facilities such as the existing DCWA well field, Ranney collector, and fish-rearing channel all carry traffic. Farther downstream, there is a road on the top of the federal levee, and many tribal residents live east of this levee. About 25 residents live on the west side of the river behind a private levee. The lower Elwha River valley supports residential, logging, and agricultural activities. Natural sound levels are also affected by occasional aircraft overflights.

Ongoing landfill operations, as well as the nearby airport, are sources of noise at the site of the proposed Port Angeles water treatment plant.

The Morse Creek site lies in a rural valley with few sources of noise.

Cultural Resources

The Elwha River valley is rich in cultural resources that include buildings, structures, landscapes, traditional cultural properties, ethnographic resources, and archeological sites. These resources represent a long, continuous human occupation and demonstrate the importance of the Elwha River, which has provided sustenance to the valley's inhabitants while serving as a transportation corridor into the heart of the Olympic Peninsula.

The Elwha River valley is the homeland of the Lower Elwha Klallam people. Elwha Klallam villages were located adjacent to important fishing stations at Ediz Hook, the mouth of the Elwha River, and the confluence of Indian Creek and the Elwha River. Seasonal camps for fishing and other subsistence activities were located along the Elwha River and its tributaries and along the shores of Freshwater Bay and Ediz Hook. The Elwha Klallam hunted for elk, deer, and other game and gathered berries, roots, and plant materials along the bottomlands of the Elwha. Their use of the valley extended upriver through the headwaters to include subalpine and alpine landscapes deep within the Olympic Range.

Euro-Americans began to settle and acquire lands in the lower Elwha valley in the 1860s; the Elwha Klallam were not considered citizens and were not allowed to purchase land in their own homeland. In 1884 the passage of an effective Indian homestead law allowed the Elwha Klallam to acquire legal title from the United States for their homesteads. While Indian homesteaders cleared lands, engaged in farming and stock raising, planted orchards, and raised crops and animals for sale to merchants and others in Port Angeles and the surrounding region, the Elwha River fisheries remained the mainstay of their economy.

The river provided not only the resources for sustenance and lifeways of the Elwha Klallam, but was at the heart of their ceremonial, cultural, and spiritual existence. Construction of the Glines Canyon and Elwha Dams decimated fish runs critical to their livelihoods and flooded villages, fish camps, homesteads, medicinal plant and food gathering and preparation sites, and probably burial sites. Some of their most important spiritual sites were (and still are) made inaccessible by the dams or the reservoirs.

Euro-American exploration of the Elwha River valley began in the latter part of the 19th century, and by the end of the century a number of Euro-Americans were homesteading in the valley, drawn by the river and the area's resources. Conditions on the Olympic Peninsula such as dense vegetation, and a climate that restricts crop selection and shortens the growing season, limited the potential for homesteading, and farming never went much beyond subsistence. Mining, logging, and other development activities eventually declined on lands set aside for the Olympic Forest Reserve in 1897, Mount Olympus National Monument in 1909, and Olympic National Park in 1938. In the 1930s the Forest Service was charged with protecting national forest lands, which it accomplished by creating a vast network of trails, shelters, guard and ranger stations, and other buildings and structures. Devising and constructing this network of facilities was a tremendous effort in terms of human and fiscal resources. It represents an important period of growth and development of the Forest Service on the Olympic Peninsula.

The Elwha and Glines Canyon Dams, hydropower plants, and associated facilities are now listed on the National Register of Historic Places as historic districts. Ongoing research suggests that the dams are part of a larger cultural landscape that extends from the Lake Mills reservoir above Glines Canyon Dam to the Elwha Dam, including Olympic Hot Springs Road. Several other resources listed on the national register reflect the role of the federal government in the Elwha River valley (the Elwha Ranger Station and campgrounds). The Elwha Ranger Station, the Altaire campground, and the Elwha campground continue to be used for their originally intended purpose.

The Elwha Ranger Station Historic District, with its residential, administrative, and utility buildings and structures, was built between 1930 and 1936 by the U.S. Forest Service. The district represents the stewardship efforts by the Forest Service to manage its lands on the peninsula as the federal agency striving to establish a presence in the wilderness. The complex consists of 14 buildings in two main clusters bordering the Elwha River Road. The ranger station and three residential buildings with accompanying outbuildings lie just east of the road. All but one structure is wood frame. Most are capped with gable roofs and are sheathed with either horizontal half-log siding, or horizontal channel drop siding. The buildings in this group were constructed in the early to mid 1930s and express definite features of the bungalow/craftsman style of architecture. All of the buildings contribute to a sense of time and place that speaks to an earlier era of forest management rarely found today in the national park.

The Elwha Ranger Station Historic District is significant for its association with politics and USFS activities within what is today Olympic National Park. The district also is an example of the distinctive type of architectural style used by the Forest Service in its years of managing the national forest lands on the Olympic Peninsula prior to the establishment of the national park. The district has integrity of location, setting, design, workmanship, materials, feeling, and association, and it meets the registration requirements set forth for these properties in the multiple property documentation form.

No prehistoric cultural resources eligible for the national register are currently known to exist in the project area (see the "Affected Environment: Cultural Resources" in the 1996 FEIS for more detailed information on the cultural history of the study area); however, ethnohistoric and ethnographic accounts abound with details of the Elwha Klallam's use of the river valley. The lack of physical evidence of this use is due to several factors, including dense vegetation and the dynamic nature of the pre-dam Elwha River. Additionally, detailed cultural resource surveys up to this point have focused mostly on the river floodplain, where river dynamics make the preservation of prehistoric archeological remains unlikely.

Beginning in the fall of 1994 and continuing into the early spring of 1995, a detailed cultural resources survey of portions of the project area was undertaken (Schalk et al. 1996). The survey team included Lower Elwha Klallam Tribe members, tribal consulting archeologists, and Olympic National Park cultural resource staff. The survey was limited to areas of the project owned by the federal government, tribal land holdings, and some project lands. Individually owned private lands were not inspected as part of this project. A total of 18 cultural resource sites and three cultural resource isolates were recorded during the survey. All of these resources are associated with the historic period. Four properties, including two homesteads, a cabin, and a refuse dump, were determined to probably be eligible for the national register; the remaining properties were deemed ineligible.

Other cultural resource field surveys in the area include a 1983 cultural resources survey of the location where Morse Creek chinook-holding ponds would be located (Daugherty and Welch 1984). This project found no significant cultural resources.

More recently, a small survey and monitoring project for the Elwha water treatment plant found no evidence of cultural resources within its project area (URS 2003b). Additional surveys of the sites of the Port Angeles water treatment plant and the Elwha surface water intake facility, and a surface survey of the proposed pipeline alignment for Elwha Heights water connections (URS 2004b), found no evidence of archeological, historic, or other cultural resources. These 2004 surveys included 10 test pit trenches and the monitoring of eight geotechnical borings.

A 1995 survey of the entire river valley below the dams (Schalk et al 1996) found that the chances of locating prehistoric or archeological sites would be poor because most of the project area is in the floodplain. In addition, many of the proposed development sites — including the Elwha and Port Angeles water treatment plants, federal levee extension, some of the pipeline routes (notably a long portion of the tribal wastewater distribution pipeline to Port Angeles, and a pipeline connecting the existing Port Angeles water distribution system to the DCWA distribution system), and some of the possible access routes to these facilities — are already disturbed and unlikely to have any intact cultural resources. However, as noted above, cultural resource surveys or other means of protecting site-specific resources are part of the programmatic agreement between the park and the state historic preservation officer.

In a recent feasibility study, specific well field sites considered as options for the Dry Creek Water Association were visited (URS 2002b). Cultural resource studies conducted at these sites, coupled with a review of Schalk et al. (1996), resulted in the determination that no evidence of archeological materials or features was apparent at either the existing or the alternative well field site.

A 1983 cultural resource survey of the location where the Morse Creek chinook holding ponds would be located found no significant cultural resources. The Washington State Office of Archeology and Historic Preservation indicated at that time that a project similar to the proposals considered in this SEIS would have no adverse effect on archeological or historic sites eligible for inclusion on the National Register of Historic Places (Farinas, pers. comm. 2003).

Socioeconomic Environment

For the purposes of this SEIS, only information pertinent to a cost-benefit analysis is presented in this section; more information on the county's economic base is available in the FEIS. Generally, this SEIS does not update information presented in the FEIS unless there have been major changes with bearing on the selection of an alternative. Since 1996 economic changes include the purchase of the dams by the federal government and increases in the cost of electricity. However, the choice to remove the dams and the choice to manage sediments as described in the FEIS have not changed as a result. As noted in the "Purpose and Need," the focus of this SEIS is on the mitigation measures needed to prevent additional impacts to water users, fisheries, and residents in the floodplain. Because costs associated with the entire project have changed as a result of these mitigations, the SEIS presents updated information on the benefits as well.

Clallam County

Clallam County encompasses an area from just east of the city of Sequim westward along the Strait of Juan de Fuca to the most westerly point of land in the continental United States, Cape Flattery, and south to the town of Forks. Port Angeles is the largest city in the county. The county also contains a major portion of Olympic National Park. Four treaty tribes — the Elwha Klallam, the Jamestown S'Klallam, the Makah, and the Quileute — have reservation lands in Clallam County.

Most of the county's population is concentrated around Port Angeles and Sequim. Port Angeles continues to be the population center of the county, accounting for over 32% of the total. Factors that contribute to this concentration include industrial, recreational, and tourist activity associated with Port Angeles' deep water harbor; the "rain shadow" which makes the climate in the east end of the county more attractive; and landownership patterns that put most of the south and west areas of the county in large commercial timber holdings or in Olympic National Park.

The county's growing tourist industry serves many visitors drawn by Olympic National Park; ferry access to Victoria, British Columbia; salmon fishing; and opportunities to enjoy the varied scenic and recreational amenities in this area. More recently, the county's growing retirement community has created employment gains in the service sector of the economy (White et al. 1992).

The 1990 census estimated Clallam County per capita income at $12,755; county unemployment stood at 8%. Median household income increased from $16,890 in 1980 to $25,434 in 1990. Consistent with national trends, earned income from employment in the county declined from 59% to 50% of all income from 1980 to 1988.

County employment was estimated at 23,310 persons out of a potential workforce of 25,500 in May 1992 (White et al. 1992). The highest growth in employment between 1985 and 1990 was in the government, retail/wholesale, and construction sectors. Clallam County has lagged behind the state in employment growth, but has exceeded the state in the retail/wholesale and government sectors. Poverty levels in Clallam County were almost 2% higher than for Washington State as a whole in the 1990 census.

The government of Clallam County operated on a 1993 budget of $14.8 million (Gerdon 1994). Of this amount, $4.3 million came from property taxes and $2.1 million from sales tax payments to the county's general fund. The 1994 property tax from structures associated with the Glines Canyon Dam was $116,000, and with structures at the Elwha Dam, $114,000 (Gerdon 1994).

Fisheries and Fish Processing

Commercial and recreational fishing have been a cornerstone of Clallam County's economy. Three sectors exist in the commercial fishing industry — fishing, processing, and retail. The fishing sector primarily involves the direct harvesting of fish by private non-tribal and tribal fishermen. The processing sector consists of wholesale cleaning, preparing, and canning of fish. The retail sector characterizes the final sales to consumers through retail markets and restaurants. Since 1980, prices per pound for all salmon stocks analyzed have declined, in some cases dramatically. This is in large part due to the increase of salmon fish farming operations in the United States and abroad (Carr, pers. comm. Jan. 2003), which has reduced the prices for traditional commercial fishermen (Crain, pers. comm. 2001). The benefits of these three sectors to the local economy are presented in Table 9.

Table 9. Benefits of Clallam County Commercial Fishing in Real 2001 Dollars

Sector	Benefit — 3% Discount Rate	Benefit — 7% Discount Rate
Fishing	$12,177,692	$5,335,345
Processing	$ 6,461,632	$2,831,530
Retail	$ 5,557,749	$2,435,443

Economic benefits associated with sportfishing are based on the net revenue increase to the commercial sportfishing industry associated with increased harvests after the restoration of the Elwha River. Information on the average trip expenditure weighted by the number of residents and non-residents and by the type of trip each usually takes (charter, private, rental, shore, etc.) showed an average trip expenditure of $58.99 (Carr, pers. comm. Jan. 2003). Translating this into dollars per fish caught ($108.24) indicates the benefits to the region of sportfishing from the Elwha River is currently about $9.5 million in 2001 dollars (discount rate 3%).

Recreation/Tourism

Recreation and tourism play a major economic role for Clallam County and the Elwha River drainage. In 1993 annual jobs and annual payroll in the travel and tourism sector accounted for approximately 2,000 jobs and generated $21.3 million. Clallam County tax receipts from this sector were estimated at $1.4 million in 1993. These figures are expected to increase slowly over the long term. Travel and tourism expenditures in Clallam County in 1993 amounted to $116.9 million. Related payroll income was $18.8 million.

Principal visitor attractions are Olympic National Park, saltwater sport fishing in the adjacent ocean, and tourist travel to Olympic Peninsula sites and to Victoria, Canada. More than 4,000 accommodation units are available within the county, including hotels, motels, and campgrounds. This sector of the Clallam County economy is expecting significant growth in the future (White et al. 1992).

Lower Elwha Klallam Tribe

The Elwha Klallam people played a substantial role in the area's early economy: homesteading in the late 1800s, selling produce to residents, and working in the lumber camps and mills in the early 1900s. In 1910 construction on Elwha Dam began. Although this structure and the Glines Canyon Dam (completed in 1927) provided electricity for milling forest products at Port Angeles, they also preempted the greatest part of the salmon resource secured to the Elwha Klallam by the Treaty of Point No Point, severely affecting the tribe's social and economic well-being. Preemption by Elwha and Glines Canyon Dams of the treaty fisheries that were secured to the tribe has combined with an almost total lack of effective access to alternative economic opportunities, leaving the Lower Elwha Klallam Tribe today relatively economically disadvantaged.

Tribal social circumstances have paralleled economic difficulties. Tribal society exhibits significant social support for its members, particularly on reservations and through extended families; however, Bachtold

(1982), specifically referencing the Lower Elwha Klallam and other Northwest tribes, reports strong linkages between economic well-being, health, and self-worth and concludes that continuing economic deprivation creates overwhelming stress among tribal members.

The tribe continues to operate a fish hatchery for chinook, coho, and steelhead on the lower Elwha, and it considers the fishery potential of the Elwha River its most significant economic asset. Most tribal fishers presently rely on the river's fisheries to some degree to obtain a relatively small amount of income and/or food each year.

Ediz Hook

Port Angeles's deepwater harbor is protected from storms by Ediz Hook, a natural sand barrier that encircles the harbor from west to east. Ediz Hook was formed with material eroded from adjacent sea bluffs and from Elwha River sediment deposition. Over the years, construction of dams on the Elwha and erosion control measures on the sea bluffs have substantially reduced natural recruitment of material to Ediz Hook; consequently, the hook now loses more material to wind and wave action than it receives. As a result, in 1978 the U.S. Army Corps of Engineers installed a rock-based blanket to reduce erosion of Ediz Hook at a cost of $5.6 million. Repair and maintenance costs approaching $100,000 per year are expected to control further erosion.

Public Health and Safety

The 1996 FEIS noted several issues of critical importance regarding public health and safety, including earthquake potential, dam safety, and hazardous materials. Since 1996, mitigation measures related to impacts of dam removal have been developed. Measures that could affect public health and safety are those designed to address anticipated impacts to water quality / supply, wastewater utility improvements, and fish restoration. The proposed mitigation actions that could affect public health and safety relate to worker safety and the use or handling of hazardous materials.

Worker Safety

Construction activity related to proposed mitigation actions would include industrial and municipal water treatment plants, associated distribution and roadway systems, the removal and replacement of intake and diversion structures related to water treatment, and improvements of tribal wastewater systems, well drilling, and culvert replacement. These actions could affect the health and safety of construction workers.

According to the Bureau of Labor Statistics (2003), over 1,200 construction workers were killed in 2002 while on the job. These studies focus on general construction categories such as heavy construction (roads, structures, pipelines), special trades (plumbing, electrical, etc.), and transportation, all of which are involved in this proposal.

Construction activities for water quality mitigation are expected to last approximately two years. A variety of earth-moving and excavating equipment would be used, including trucks (premix concrete, flatbed equipment, materials delivery, power utility, trash), and worker transportation vehicles. According to the University of Michigan Transportation Research Institute (2003), the frequency and reasons for fatal accidents involving heavy trucks varies, depending on, among other things, factors such as drivers, equipment, time of day, and environmental conditions. Statistically, the greatest number of fatal accidents occurred in June, with about two-thirds of them in rural areas (much of the study area would be considered rural). In the United States, approximately 35% of all fatal accidents involving trucks occur on local trips (a 50-mile radius).

In Washington State approximately 57% of vehicle accidents occur in dry weather, and 33% occur in wet weather (snow and icy weather contribute to still smaller accident percentages). Based on data from the state, Clallam County had 629 vehicular accidents with eight fatalities in 1996 (Washington State DOT 2003).

Hazardous Materials

The operation of both the industrial and the municipal water treatment plants would require the handling and use of chemicals including liquid aluminum sulfate, liquid and dry polymers, liquid sodium hypochlorite, and potassium permanganate. These chemicals require safe handling, storage, and use, much of which is regulated primarily by the federal and state governments. Onsite process control and monitoring laboratories would use standard reagents necessary to monitor the water plants and ensure safe operation, worker safety, and environmental protection.

The use of motorized equipment (all types) in construction activities and routine facility operations would involve the use of petroleum products, and consequently, the potential for hazardous spills and leaks. As such, chemicals could jeopardize public health and safety, and appropriate handling and proper equipment maintenance are critical to prevent accidental releases into the environment. Adequate and timely spill containment and clean-up procedures would prevent a small accident involving hazardous materials from becoming a much larger problem for public health and safety.

Impacts

This chapter presents the results of the impact analysis for the no-action alternative and the proposed action for mitigation measures related to water supply, water quality, flooding, groundwater, fisheries, revegetation, removal of dam rubble, and trumpeter swans. As noted earlier, the no-action alternative is the same alternative that was presented in the FEIS, with some updating as needed. The proposed action is the proposed set of mitigation measures described in the "Alternatives" chapter of this SEIS. For each impact topic, pertinent regulations and policies are summarized, and the methodology used in analyzing impacts is described. The methodology discussion includes sources, approach, and impact thresholds (negligible, minor, moderate, major). Each analysis includes a discussion of cumulative impacts, which are impacts that would add to (or subtract from) the impacts of other actions, regardless of when these actions occurred (in the past, present, or reasonably foreseeable future).

The NPS *Management Policies 2001* require an analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as established by the Organic Act and reaffirmed by subsequent legislation, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within a park system unit, that discretion is limited by the statutory requirement that the agency must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to a park resource or value is more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The following process was used to determine whether the various alternatives had the potential to impair park resources and values:

1. The park's enabling legislation, the *General Management Plan,* the *Strategic Plan,* and other relevant background were reviewed with regard to the park's purpose and significance, resource values, and resource management goals or desired future conditions.
2. Management objectives specific to resource protection goals at the park were identified.
3. Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts.

4. An analysis was conducted to determine if the magnitude of impact reached the level of "impairment," as defined by NPS *Management Policies.*

The following impact analysis includes any findings of impairment to natural and cultural resources and values in the park for each management alternative.

Flooding

Summary of Regulations

Executive Order (EO) 11988 ("Floodplain Management") directs each federal agency to "provide leadership and take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The "National Park Service Floodplain Management" policies (Director's Order [DO] #77-2) specify requirements for carrying out EO 11988 in national parks. Floodplains that are subject to regulation include the 100-year floodplain, the 500-year floodplain, and the extreme floodplain

The NPS *Management Policies 2001* (NPS 2000) require that the occupancy or modification of floodplains should be avoided wherever possible. Where no practicable alternative exists, mitigating measures are to be implemented to minimize potential harm to life, property, and the natural values of the floodplains. DO #77-2 provides specific direction on developments proposed in floodplains within national parks. A statement of findings in response to DO #77-2 will be included as an appendix in the final SEIS.

Washington State regulations that affect development activities in and near floodplains and wetlands include the Shoreline Management Act (RCW 90.58.010 et seq.), the State Hydraulic Code (WAC 220-110-010 et seq.), the State Water Pollution Control Act (RCW 90.48.010 et seq.), and the state floodplain management program. The Shoreline Management Act was passed to manage appropriate uses of Washington's shorelines. The State Hydraulic Code is intended to protect fish from damage by construction and other activities in all state waters; it is carried out through a hydraulic project approval obtained from the Washington Department of Fish and Wildlife. Hydraulic project approval is required for any work within the high-water areas of state waters. Washington State's floodplain management program establishes statewide authority for floodplain management through the adoption of regulatory programs compliant with the minimum standards of the National Flood Insurance Program; such programs are administered by local governments.

Methodologies for Analyzing Impacts

The effects of riverbed aggradation for the proposed action were analyzed by the Bureau of Reclamation through computer modeling. The U.S. Army Corps of Engineers assessed impacts to flood control levees, roads, wells, private property, and other structures based on the riverbed aggradation analyses. A more recent set of analyses took into account flood levels during a larger storm in 2002 (28,000 cfs, whereas the earlier data relied on a 13,000 cfs storm) and more detailed topographic information on the floodplain, riffles, and pools in the river (USACE 2003). Hydraulic models were recalibrated to reproduce the surveyed high water marks of the 2002 flood, and split flows were taken into account. The relative magnitude of impacts is defined by the following terms:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

An impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

Both the Elwha and Glines Canyon Dams are operated in a "run-of-the-river" mode, which means that the reservoir level is held constant and very little of the water entering the drainage is stored or released differently from the way it was before the dams were built. Because of this, only short-duration storms or some periods of snowmelt are stored in the reservoirs.

Flooding now occurs along parts of the Elwha River, but at a lower elevation in some places than before the dams were built (see FEIS, Figure 9, Table 32, and Appendix 4). This is because sediment transport of coarse-grained materials was stopped by the dams, and much of the riverbed material (sand and gravel) downstream from the dams has washed out to sea. Very little coarse-grained sediment enters the middle and lower reaches of the Elwha River; the only sources of sediment now are from tributaries, landslides, and bank erosion.

The degree of degradation varies from the Glines Canyon Dam to the mouth of the river, and it is generally more pronounced in the lower reach. In general, bedrock prevents extensive degradation of the riverbed, especially in the middle reach between the two dams and for the mile of river below the Elwha Dam. This reduced water elevation translates to a reduced flooding risk that could be a minor, beneficial impact for some property owners along the Elwha River. Table 10 shows the current level of flood protection for each of the property owners and facilities affected by dam removal.

The armoring or channeling associated with the loss of bedload material in some cases has also reduced the width and amount of the river's migration. Recent remodeling of current flooding conditions by the U.S. Army Corps of Engineers found the reach of river near RM 2.3 and the Halberg property is laterally stable with a maximum meander belt width of 700 feet (USACE 2003). The right riverbank has migrated about 500 feet eastward since 1930, and the channel has braided into two threads. Near the southern terminus of the federal levee at RM 1.7, the meander belt is nearly 2,000 feet wide. Here the west bank has migrated westward about 1,000 feet since 1939. Stream power is greatest in this region at RM 2.3 and drops off sharply where the valley widens up- and downstream. Therefore, sediment deposition following dam removal would be lowest in the vicinity of RM 2.3 and greater both up- and downstream from this point.

Table 10. Elwha River Valley Structures and Existing Flood Conditions for the 100-Year Frequency Flood Event

STRUCTURE	RM	EXISTING FLOODING CONDITIONS
Locally constructed, privately owned levee (west bank)	0.0–0.1	Protects 30 acres of land for 25- to 50-year frequency flood, but is considered structurally unstable now.
Lower Elwha federal flood control levee (east bank)	0.1–1.6	Protection for up to 200-year flood.
Private tribal residences between beach berm and federal levee	0.0–0.2	Backwater from a 100-year flood inundates 114 acres and from a 200-year flood, 120 acres; between 15 and 21 structures affected.
EPHA residence and well	1.4	Private residence and private well are 2′ below the 100-year flood elevation. New wells are above the future 100-year flood level.
Tribally constructed levee located at surface water collection vault	1.8	Protection for up to 100-year flood level (needs review).
Port Angeles industrial water supply channel	2.5–3.1	Protected from the 100-year flood by an access road.
City of Port Angeles Ranney well collector	2.8	Well caisson and chlorination building are at the 100-year flood elevation.
WDFW fish-rearing facility	2.8–3.0	Shallow nuisance type flooding occurs with a 100-year flood.
Water wells at the fish-rearing facility	2.8	Wells 2.5′–2.8′ below the 100-year flood level.
West bank residences	3.5	Two structures and associated private wells are 2′–3.5′ below the 100-year flood elevation and are flooded by a 10- to 30-year flood.
East bank residence	3.5	Residence and well are 2′ below the 100-year flood levels and are flooded by a 10- to 20-year flood.
DCWA wells and access road	3.7	Floor elevation of one well house is at the 20- to 50-year flood level. Access road flooded by a 10-year flood. Highest well above 100-year flood elevation.
East bank private well	7.9	Situated near the confluence of the Little and Elwha Rivers, well lies 2′–3′ below the 100-year flood level.
East bank residences	8.4	Three structures flooded by a 5- to 10-year flood.
River training dike	8.5	Does not offer flood protection but redirects high velocity flows. Flooded by the 25-year flood.
East bank residence	9.5	Residence and well are 1.5′ below the 100-year flood elevation.
Elwha campground	11.0	Campground and well are below the 100-year flood level; currently floods at less than 5-year flood frequency.
Elwha Ranger Station	12.0	Site is 2′ above the 100-year flood elevation.
Altaire campground	12.5	Partially flooded by annual floods. Flooded by as much as 8′ during a 100-year flood.
Elwha Valley (Olympic Hot Springs) Road		1 mile inside park and 0.3–0.6 mile outside park are below the 100-year frequency flood elevation.
Bridges		None are affected by high water levels or floating woody debris during flood events.

SOURCE: USACE 1995a.

Although the effect of sediment storage behind the dams has been to lower the flood stage for downstream properties, thus providing a minor benefit in this regard, it has also had adverse effects on the river and riparian ecosystem. Flooding supplies some wetland and backwater areas such as pools and side channels, which are rare and valuable habitat. Because the flood stage is lower, several of these pools or channels, which presumably were regularly refilled by the river before the dams were built, have been inactive for the most part, and they are only refilled and functional during a moderate or larger sized flood. Also, reduced channel migration and lateral adjustment result in fewer sites for regeneration of riparian vegetation, causing a more mature and less diverse riparian zone.

Several structures identified in Table 10 are either protected by existing flood control measures to some extent, or are flood control measures themselves. For example, levees on both the east and west riverbanks near the mouth protect tribal and private residences and structures from some flooding. These structures modify the extent of the floodplain depending on their size, setback, and the floodplain characteristics. The federal levee is set back from the river channel several hundred feet, so impacts to the floodplain are minimized. However, floods in 1997 and 2002 did reach the levee, and the 1997 flood caused damage along 1,500 feet.

As noted in the "Vegetation" and "Wildlife" sections of this document, floodplains can contain riparian and wetland habitat that is diverse, rare, and required or heavily utilized by many wildlife species. Because the habitat is rare, the species that require riparian habitat are also sometimes rare. Riparian vegetation is also important to some species of fish, as it cools water temperatures, provides cover, and supplies an important food resource in the form of insects falling from overhanging vegetation. Other values associated with floodplains include their ability to mitigate bank erosion and flood stage; to filter sediments, nutrients, and pollutants in runoff for both surface and groundwater; to provide recreational and aesthetic pleasure for local residents and visitors. Floodplains are often the site where archeological or historic resources are located.

The private levee running from the river mouth upstream 950 feet on the west bank contains a low area near the mouth (beach berm) that is periodically overtopped by high waves and tides. An isolated pool has formed west of the levee as a result of these events and from seepage through the levee at high flows. In essence, the levee has removed a portion of the Elwha River estuary from its natural hydraulic connection with the river, with an unknown, but possibly important, impact to fishery habitat values of the floodplain in this localized area. Estuary habitat is critical to a number of salmonid species, including the federally threatened chinook salmon.

The federal levee (RM 0.1–1.6) on the east side of the river is much longer than the levee on the west side and is set back approximately 370 to 2,400 feet from the river channel. The floodplain to the west of the levee in this area is heavily forested. The lack of coarse sediment (sands and gravels) has resulted in a more stable and simplified (i.e., less braiding) lower river reach than before the dams were built.

The WDFW chinook-rearing facilities (RM 2.8–3.0) are currently offered some protection by an access road and a dike. The road would keep the rearing channel out of the existing 100-year floodplain, but a 200-foot-long low spot in the road would be overtopped during a 100-year flood. The dike begins just north of this low spot and runs 1,400 feet parallel to the rearing channel before it ties back into the road that ties into the industrial supply road. The dike, levee, and road alter river flow and flooding regime, with possible moderate to major localized impacts on floodplain values on both the west and east sides.

The remaining structures, wells, and bridges identified in Table 10 do not have flood protection measures in place.

Cumulative Impacts

There has always been a danger of flooding by the Elwha River, even with both dams in place. Many structures within the present 100-year floodplain could be inundated by the Elwha River since both the Glines Canyon and Elwha Dams are operated in a natural flow or run-of-the-river mode.

Statistics on flood stage compiled since 1924 show that the flood stage in the Elwha and neighboring rivers (Dungeness and Hoh) has increased over time. For example the predicted peak flow for 2002 is nearly double that predicted for 1924 (Crain, pers. comm. 2003). Some of this trend may be related to logging and other land clearing activities (primarily in the neighboring drainages), but it appears climate is having a significant effect as well.

Conclusion

The dams are currently operated in a natural flow or run-of-the-river mode, and homes, wells, and cultural resources are periodically flooded. Degradation of the riverbed, caused by the trapping of coarse-grained sediment behind the dams, has caused the flood stage from the Glines Canyon Dam to the mouth of the river to be lowered in some places. This decrease in flood stage may provide a beneficial impact for some property owners, but it has also resulted in less side channel or pool habitat, an adverse impact on the river's riparian ecosystem. The effect of the degraded riverbed would continue under this alternative, although some cumulative increase in flood stage in the Elwha and neighboring rivers unrelated to park management activities would likely offset this effect. Some existing flood control structures have minor to moderate, localized impacts on the floodplain and values it offers fish, vegetation, wildlife, and recreationists. No impairment to park resources from changes in flooding related to these structures would occur under the no-action alternative.

Impacts of the Proposed Action

Analysis

A recent re-analysis of the projected flood stage following removal of the dams incorporated information from a moderate sized flood in January 2002, plus additional topographical information (such as pools and riffle controls, and split flows), to refine the predictions of impacts for both leaving the dams in place and removing them (USACE 2003). As noted for the no-action alternative, while dam removal would not change in-stream volume or flow rate, it would result in the deposition and build up (aggradation) of coarse-grained sediments (sand size and larger) downstream of the dams. As the riverbed materials were restored, flood stages would change as well. This means some areas would be flooded more frequently, and the 100-year flood, for example, would be higher than before the dams were removed. Generally, more aggradation and more change in flood stages would occur in areas with gradual stream gradients than in steeper sections of the river.

Mitigation is geared to provide the same level of flood protection as residents or structures have now. Below is a discussion of site-specific impacts based on modeling for the 100-year flood event, beginning at the mouth of the river and going upstream (south) to the Glines Canyon Dam. Mitigation measures for each of these impacts is described below and summarized in Table 11.

Impacts of Site-Specific Mitigation Measures. *Lower Elwha Federal Flood Control Levee (RM 0.1–1.6)* — The levee was designed to be above the 200-year flood level, with a minimum of 3 feet of freeboard (the height above the recorded high-water mark). Current estimates indicate locations along the levee do not have 3 feet of freeboard, and dam removal and sedimentation would exacerbate this risk. In addition, side channels or the mainstem migrating toward the levee would be more likely with sediments returned to the river following dam removal. One historic side channel was reactivated in a 1997 flood and damaged a 1,500-foot segment of the levee. This kind of damage from increased braiding and channel migration is more likely following dam removal.

Table 11. Structural Mitigation for Flooding Impacts

LOCATION AND STRUCTURE	RM	MITIGATION
Locally constructed, privately owned levee (west bank)	0.0–0.1	Raise and armor levee; realign it along higher ground; or remove it and raise affected homes.
Lower Elwha federal flood control levee (east bank)	0.1–1.6	Raise entire levee an average of 3.3′; extend armoring up to 3,750′ south; extend the levee south and possibly north.
EPHA residence and well	1.4	Raise home, or obtain flowage easement.
Port Angeles industrial water supply channel	2.5–3.1	Raise 4,850′ of industrial supply road (Crown Z Road) by 4.5′.
City of Port Angeles Ranney well collector	2.8	Protect with ring dike levee.
WDFW fish-rearing facility	2.8–3.0	Raise 4,850′ of industrial supply road (Crown Z Road) by 4.5′ (immediately west of facility) and add flap gate to entrance channel culvert; raise wellheads at least 2.5′ to 2.8′; modify or remove spur dike.
West bank residences	3.5	Ring dike; move on site and elevate until first floor is 4.5′ higher. Alternatively, raze structure and abandon well. Pack well needs to be raised.
East bank residence	3.5	Move on site and elevate until first floor is 4.5 feet higher.
DCWA well field and access road	3.5–3.7	If existing site maintained, raise well field, one well house, two wellheads, and road grade. If alternative well field selected, raise ground level.
Private well	7.9	Raise wellhead.
Residences	8.4	Move offsite (temporary structure), elevate in place, construct a ring dike, or move to higher ground on site.
River training dike	8.5	Raise dike 1.5′ and armor with riprap.
East bank residence	9.5	Raise or floodproof home if needed.
Elwha campground	11.0	Take no active flood protection measures because use is seasonal and outside flood periods; flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.
Elwha Ranger Station	12.0	Monitor/evaluate bank erosion threat and take corrective action (e.g., bank stabilization, engineered logjams) as necessary. Wellhead may need to be raised.
Altaire campground	12.5	Take no active flood protection measures because use is seasonal and outside flood periods (campground closed from late summer / early fall to late spring / early summer); flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.
Elwha Valley (Olympic Hot Springs) Road		Raise about 1 mile of low elevation sections of the road in park 1′; raise 0.3 mile of road outside of park by 1′. Riprap select sections of road.
Bridges:		
U.S. Highway 101	7.7	Add debris deflectors to the in-water piers as needed.
Elwha Valley Road	12.6	

SOURCE: USACE 1995a and 2003.

To prevent overtopping or damage of the levee from a higher flood stage following dam removal, the levee would be raised on average 3.3 feet, as compared to 2.5 feet proposed in the FEIS. Additional armoring of the levee with a buried toe from the southern end northward for about 3,750 feet might also be provided.

Overtopping is not the only problem dam removal is expected to cause for the levee. At least one and perhaps several currently inactive side-channels in the vicinity of the upstream end of the levee and visible from the air could be reactivated during flooding after the dams were removed. Two known relict channels at RM 2 are considered more likely to be reactivated. These channels outflank the upstream end of the levee and could flood reservation lands more frequently and more severely when the dams were gone. The levee is likely to be extended southward for this reason. As noted in the "Alternatives" chapter, several alternative routes for such an extension are being considered, including a 1,600-foot levee along the floodplain terrace, a 1,200-foot extension along an existing access road to the southern end of the levee (traveling from northwest to southeast across the Halberg property), and a series of spur dikes and flow deflectors.

The northern portion of the reservation is protected by a beach berm that varies from 8 to 15 feet high. When flood elevations exceed 10 feet now, some residences are susceptible to flooding. Modeling indicates that a 100-year flood would be at 13.0 feet and would inundate about 114 acres, and a 200-year flood would be 14.2 feet and would inundate about 120 acres. The federal levee stops approximately 450 feet from the beach berm. At this time, two options for maintaining flood protection north of the levee are being considered. Homes would either be raised by 1 foot, or the federal levee would be flood proofed or extended north to tie into the beach berm. Extending the levee could include pumping facilities to remove storm water, hatchery effluent, and possibly seawater breaches.

Locally Constructed, Privately Owned Levee (RM 0.0–0.3) — A levee to protect residences on the west bank of the river extends from the river's mouth 950 feet upstream to high ground at the toe of a large bluff. Based on updated modeling about current conditions, the levee is overtopped by 50- to 100-year floods at the upstream and downstream ends. Geotechnical inspection indicates that the levee is in poor structural condition and is likely to fail by erosion or undermining in less than a 50-year flood (USACE 2003). Based on observations during recent moderately high flow events, it is estimated that the levee will protect property west of it during a 25-year flood. Removing the dams is expected to increase the 25-year flood level by an average of 3.7 feet. Available topography indicates the top of the berm varies in elevation from 12 to 17 feet. The expected flood elevations during the 100-year flood following dam removal would be between 13.5 and 18 feet. Three options are being considered to mitigate this impact: (1) raise the levee, extend it a small distance, and armor it with riprap, (2) realign the levee to follow high ground from the terminus of the county road to the beach berm, and (3) remove the levee and raise individual structures. The latter two options would each restore the hydraulic connectivity between part of the historic Elwha River estuary (now a pond and wetlands) and the river, which are now separated by the levee.

The first choice to raise the levee in place in order to maintain the existing 25-year flood level protection would require filling directly on top of the existing levee centerline and protecting it by riprap. Despite raising the levee, the protected area might still be vulnerable to flooding if the delta enlarged following dam removal because the river would be able to flood back through a low spot on the beach berm (not part of the levee), especially if the delta built up toward the strait. Extending the levee 150 feet to the southwest along the beach berm or farther north toward the strait could provide additional protection. If the levee was raised or extended, the hydraulic connection to the pond on the west and the river estuary could be restored by building a channel and culvert with a flap gate through the levee.

The second choice to realign the levee would use salvaged materials from the existing levee, which would be removed. The new levee would follow high ground south of the existing pond/estuary, from the terminus of the county road to the beach berm. Because the realigned levee would run close to several homes, it would be particularly important to protect against seepage. Complete removal of the existing levee would also hinder public access to the beach if alternate access was not provided by way of the realigned structure. If the existing levee material was unsuitable for re-construction, material would have to be hauled in. The levee realignment would cut off the local runoff drainage paths to the pond, and culverts would need to be installed through the levee fill to provide drainage; the culverts would have to be closed in the event of high tide or high river stage. Hydraulic, biologic, and geomorphic connectivity between the estuary and the area landward of the levee would be restored.

The third choice would be to remove the levee and raise the elevation of the residences now protected by the levee between 13 and 15 feet. It is estimated that under existing conditions the protected area could flood to an elevation of 14 feet if the levee was overtopped during a 100-year flood. Following dam removal, the 100-year flood elevation could increase to 16.5 feet. Homes would need to be raised to an elevation of about 15 feet to provide the existing level of protection. Estimates indicate that 25 or fewer homes would require raising. Removing the levee would restore the hydraulic, biologic, and geomorphic connection between the estuary and the wetland landward of the levee. In addition, because the floodplain in this area would be restored, residents on the east side of this same reach of river would have greater flood protection than if the private levee remained. Removing the existing levee would hinder public access to the beach.

EPHA Residence and Well (RM 1.4) — A private residence located on the west overbank of the Elwha is now approximately 2 feet below the 100-year flood elevation. Increased water elevations after dam removal would result in more frequent flooding of the residence. New wells for the Elwha Place Homeowners' Association would be located above the future 100-year flood level.

City of Port Angeles Ranney Well Collector (RM 2.8) — At a minimum, the existing Ranney collector would function as a backup supply during dam removal and would be the primary source of drinking water during clean periods and when sediment levels drop over the long term. This facility consists of a large concrete caisson, topped by a pumphouse, treatment building, and wellhead. The top of the caisson is at 69.1 feet, and the existing 100-year flood elevation is 66.4 feet. Following dam removal, the 100-year flood elevation is expected to increase 2.5 feet to 68.9 feet. This means the caisson would be at or slightly above the 100-year flood and could be affected. The treatment building is at 67 feet and would be flooded to depths exceeding 1.5 feet during the 100-year flood.

The Ranney collector is near the planned industrial pre-treatment facility and the WDFW fish-rearing channel, both of which might also require diking or other flood protection to operate during and following dam removal. One option being considered is to construct a dike to ring the Ranney collector and be part of flood protection for the other facilities in the area. The dike, constructed of sheet pile or concrete, would encircle the Ranney well for health reasons. Some buried riprap would be incorporated for scour protection. This action would likely require clearing alder trees in the southwest corner, and in-water (but not in-river) work would be required to build the ring dike. The total length of the dike would be approximately 540 feet. A ramp over the wall would be built to allow access to protected facilities. The ring dike would be located in the floodplain out of the 100-year floodway, so it would not significantly impact the flood regime of adjacent properties.

WDFW Fish-Rearing Facility and Ranney Well Collector (RM 2.8–3.1) — As previously noted, the WDFW rearing facility for chinook salmon consists of a rearing channel, access road, inlet and outlet works, fish trap, two overflow channels, three facility support buildings, and two well fields north and west of the facility. The wells, which would be required during and following dam removal to maintain clean water for the rearing facility, would be overtopped and contaminated by surface flows following dam removal. To continue to provide current levels of flood protection, four wellheads would need to be raised by 2.5 to 2.8 feet, the level the 100-year flood is predicted to increase in this vicinity following dam removal.

The rearing facilities are in the 100-year floodplain, except for the three support buildings, which are east of the channel on a high bench and just out of the floodplain. The access road, which is raised and serves as a dike, offers some protection. The road/dike, which runs 1,660 feet north before it crosses the rearing channel at its northern end and ties into the access road for the existing industrial water intake channel, keeps the rearing channel out of the existing 100-year floodplain for the most part. However, it has a 200-foot-long low spot that would be overtopped under existing conditions.

Raising the access road/dike in its present location along its entire length would not prevent flooding during a 100-year flood following dam removal unless the industrial water supply road was also raised and tied into high ground. Control structures would need to be added to the industrial water supply channel to stop backwater flooding, and the existing low section of the road/dike would need to be filled and raised. The roads would need to be raised about 4.5 feet. This would be enough to protect these facilities, accounting for uncertainty in the analyses.

The Elwha River splits at the location of the rearing channel. If the mainstem of the river re-occupied the right side channel, additional scour protection for the rearing channel and the Ranney well collector would be required. Because it took many years for the river to degrade and abandon this channel, it is likely that the river either would stay in its current path to the west of the island that splits its flow, or would take many years to aggrade and reoccupy its former channel (USACE 2003). Therefore no additional strengthening of the road/dike to withstand this degree of scour is planned other than emergency actions as needed.

Port Angeles Industrial Water Supply Channel (RM 2.5–3.1) — The current industrial water supply intake is immediately upstream of a rock diversion structure at RM 3.5. The intake supplies a 1,000-foot-long tunnel that empties into the 2,000-foot-long industrial water supply channel, which is directly east of the WDFW fish-rearing channel. Water from the industrial water supply channel flows through control works into a pipeline and then via gravity flow to the NPI mill in Port Angeles. The industrial supply road spurs off Elwha River Road to the intake facility, as well as to the Ranney collector and industrial supply channel (see URS 2003a, figure 2). About 2,400 feet of this road runs parallel to the road/dike, protecting the rearing channel as discussed above. This road segment provides additional flood protection for the industrial supply channel and the Elwha water treatment plant site. To the south of the water supply channel, the road is in the 5- to 10-year floodplain. The 100-year flood level would overtop the road in this area by 5.5 feet. North of the water supply channel, the road extends from the pipeline headworks and runs north and east parallel to the pipeline. This piece of the road is in the floodplain for 1,700 feet and is overtopped by a 10- to 25-year flood. Dam removal would increase the frequency of flooding on the southernmost segment to once every 2 to 5 years on average. In the middle segment (water supply channel), 100-year flood stages would increase an average of 2.6 feet, just enough to overtop into the supply channel in several locations. Flooding frequency on the northern segment of the road (called the pipeline road) would increase to once every 2 to 5 years.

A new control weir and intake facility are planned about 225 feet upstream from their current location. The intake facility would be designed to remain functional during passage of the 100-year flood by establishing the operating deck above the corresponding river stage, and by providing control gates at the tunnel outlets to regulate downstream water levels within the fish screen structure.

The industrial supply road (the Crown Z Road) would be raised 4.5 feet across its flood-prone length (4,850 feet) to mitigate for the impacts of dam removal. The 750-foot portion of road between the diversion dam and the supply road bridge across the southern overflow channel, and 1,300 feet of the west side of the pipeline road embankment would be armored with riprap.

West Bank Residences (near RM 3.5) — Two residences on the west bank of the river, now 2.7 to 5.7 feet below the 100-year flood elevation, are now flooded at 2- to 25-year frequencies. Riverbed aggradation following dam removal would increase the 100-year water surface elevation an estimated 2.5 feet and the frequency at which these homes are flooded to 1 to 5 years. Protecting the residences from flooding could be achieved with a ring dike. Alternatively, the structures could be moved on site, elevated, or removed completely.

East Bank Residence (near RM 357) — A residence on the east bank of the river near the DCWA wells is approximately 2 to 4 feet below the 100-year flood level and currently floods at 10- to 15-year frequencies. After dam removal, flooding would increase to an estimated 1- to 2-year frequency, with a 2.5-foot increase in the 100-year flood water elevation. Moving the structure on site and raising it so the first floor would be 4.5 feet above flood elevation would protect it.

Existing DCWA Well Field and Access Road (RM 3.7) — Three wells maintained by the Dry Creek Water Association are located on the east bank of the Elwha River. The floor elevation of the well house is at the 20- to 50-year flood level; it could be flooded more frequently with higher water elevations as a result of dam removal. The access road to the wells, flooded now at a 10-year flood frequency, also would flood more often. The highest well is now above the 100-year flood elevation, but due to sediment aggradation after dam removal, it would be flooded by a 100-year flood. As noted in the "Alternatives" chapter, the Dry Creek Water Association may move its well field to the west side of the river. If the association maintained its current well field, the wells and access road to them could both be flooded more frequently following dam removal; consequently, the road grade, well house, and one exterior wellhead would need to be raised to provide the same level of flood protection as the system has now.

East Bank Private Well (RM 7.9) — A private well near the confluence of the Little River and Elwha River, lies 2 to 3 feet below the current 100-year flood elevation. Sediment aggradation near the wellhead is expected to be 2.4 feet following dam removal, causing more frequent flooding with higher water elevations. The wellhead would need to be raised.

East Bank Residences (near RM 8.4) — Three residences on the east bank of the river, 3 to 7 feet below the 100-year flood level, are flooded on a 7- to 30-year frequency. These structures would flood more often and with higher water elevations with dam removal. Floodproofing the structures would require elevating them in place, constructing a ring dike, or moving them to higher ground.

River Training Dike (RM 8.5) — A 300-foot training dike near RM 8.5 does not offer any flood control protection but does redirect high-velocity flows away from the Elwha Valley Road (Olympic Hot Springs Road) embankment. It is now flooded by a 25-year flood and would be flooded more often with dam removal. To be above the flood level, it would need to be raised 1.5 feet and armored with riprap.

East Bank Residence (near RM 9.5) — Located just downstream from the park boundary on the east bank of the Elwha River, this structure is currently above the 200-year floodplain and would be above the 100-year floodplain after dam removal. However, the resident reports active bank erosion is endangering his property. Increased river stages (average of 0.5 feet) could increase the rate of erosion.

Elwha Campground (RM 11.0) — The Elwha campground lies below the 100-year flood level and currently floods during a less than 5-year flood level. The removal of the dams could increase water surface elevation up to 0.5 feet, which could cause more frequent flooding. No active flood protection measures would be taken because use is seasonal and outside flood periods; flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.

Elwha Ranger Station (RM 12.0) — The Elwha Ranger Station structures are approximately 2 feet above the 100-year flood elevation. Dam removal would increase water surface elevation of up to 0.5 feet, and the structures would still be above the 100-year flood elevation. Increased bank erosion could pose a threat to the ranger station following dam removal. If needed, stabilizing the bank or installing engineered logjams would provide flood protection.

Altaire Campground (RM 12.5) — The Altaire campground is partially inundated during annual floods and could flood by as much as 8 feet during a 100-year event. Flooding would increase by about 0.5 feet with removal of the Glines Canyon Dam. No active flood protection measures would be taken, as described for the Elwha campground, because use is seasonal and outside flood periods (campground is closed from late summer / early fall to late spring / early summer); flood warnings are provided and the Elwha subdistrict is closed during floods; and the campground has minimal development.

Elwha Valley Road (Olympic Hot Springs Road) — Elwha Valley Road parallels the river on its east bank from U.S. Highway 101 to the Glines Canyon Dam. Three sections of the road are overtopped by 5- to 10-year flood levels. Removing the dams would increase the frequency that flood levels would close or damage the road. The highly flood-prone areas occur between RM 8.1 and 8.4 (downstream of the training dike), between RM 9.8 and 10.2 (just upstream of the park entrance), and between RM 10.8 and 11.7 (the Elwha campground to the ranger station). Flood depths over the road during a 10-year event can approach 2.5 feet at RM 11.1. The impacts from dam removal at these locations would be relatively minor compared to existing conditions, and the following measures would provide existing levels of protection — raise about 1.0 mile of low-elevation road sections within the park, raise 0.3–0.6 mile of road outside the park, and armor select sections of the road. These actions would not alleviate all future flood risk, but would reduce the severity of floods.

Bridges — After dam removal, water flow under four bridges — the Elwha River Road near the fish-rearing facility, Highway 112 near RM 3.3, U.S. 101 near RM 7.7, and the Elwha Valley Road near the Altaire campground near RM 12.6 — would not be substantially affected by higher floodwater elevations. Increased volumes of woody debris floating down the river could affect the in-water piers of the U.S. 101 and Altaire campground bridges.

Impacts on the Natural Floodplain. For the most part mitigation measures described above and presented in Table 11 would provide the same level of protection as these structures and facilities have now, so there would be no impact to them resulting from higher flood stages or frequency after dam removal. In other words, structures would be able to withstand floods to the extent they can now. The only exceptions might be facilities inside Olympic National Park (e.g., the Altaire and Elwha campgrounds, and the Elwha Ranger Station).

However, the implementation of these mitigations could have temporary impacts to river flows and possibly to the floodplain itself. For example, the construction of pipelines that cross the river from the DCWA alternative well field site would obstruct flows during the construction period. Some flood mitigation measures would also have long-term effects on the natural floodplain, as this is the very function each serves. Examples of proposed actions in this SEIS that could affect the natural floodplain include providing flood protection for the DCWA alternative well field and extending the federal levee and the private levee at the river mouth.

The floodplain in the vicinity of the DCWA alternative well field, the proposed control weir, and the surface water intake is approximately 1,000 feet wide. On the east bank of the river between the Highway 112 bridge (RM 3.3) and the Elwha River Road bridge (RM 3.1), the floodplain is confined to a narrow strip between the river and steep valley walls except in the vicinity of the access road to the existing DCWA well field (RM 3.7).

Between the alternative DCWA well field area and the river are several side channels that begin to be inundated during moderate flow increases. Hydraulic modeling indicates that at the 2-year flood level (14,470 cfs) the majority of these side channels would flow with river water. The alternative DCWA well field location is on a field (terrace) that is inundated during large floods, such as a 10- to 25-year flood (27,850 cfs and 33,730 cfs, respectively). Raising the elevation of the entire well field to protect any infrastructure from the 100-year flood would somewhat reduce the size of the 100-year floodplain. However, hydraulic modeling indicates that the difference in flood stage would be negligible (less than ±0.2 feet) for all flood flows because the area is small relative to the total floodplain area for any given flood between the 2-year and 100-year floods, and the area is at the far end of the floodplain. Raising the ground elevations to protect the DCWA wells at this location would protect the new well area, but protection would not extend upstream or downstream. Even though the direct effects on the floodplain would be localized, this action would involve moving significant amounts of earth into place, which could fill or partially fill three large interconnected water-filled gravel pits that are directly east of the well field and that may have some wetland function.

The lower Elwha federal flood control levee on the east side of the floodplain (RM 0.1–1.6) confines the eastward migration of the river. Constructed in 1988, the levee was built to withstand a 200-year flood and to provide flood protection for approximately 300 acres in the lower Elwha River floodplain. Based on empirical relationships and historical evidence from aerial photographs, the levee was generally located beyond the limits of the river meander-belt width. However, the FEIS indicated that the levee could fail during floods if the main river channel migrated over to and against the levee, because it was not built to withstand the relatively high velocities of the main river channel (USACE 1987). In addition, as noted above, side channels could erode the levee as well. At its northern end, the area that is unprotected by the levee includes a narrow dirt roadway, a weedy band east of the levee that borders the tribal hatchery outfall, and about 450 feet of beach cobbles covered by driftwood extending to the Strait of Juan de Fuca. The southern end of the levee terminates near the Halberg property, which is primarily neglected pasture containing a variety of grasses, and a mix of conifer and hardwood species typical of lower lying forests in the area. Except for overflow during a 200-year flood, this area is outside the floodplain. Because it is outside the current meander belt, extending the federal levee to the north or south, or building it up and therefore widening it at its base (on the east and west sides) would probably not result in greater than moderate additional impacts over those described for the no-action alternative.

Lengthening the private levee near the river mouth could continue existing impacts to the floodplain and hydraulic connectivity between the Elwha River and an adjacent tidal wetland. Removing the levee and raising individual residences could help restore some of this connectivity and the natural floodplain dynamics in this area.

Relocating intake facilities would change the surface water elevations and the floodplain at their present location (RM 3.5) and at the location of the new facility (225 feet upstream). The floodplain in the area of the proposed new facility is wide, but the eastern side is constrained by cliffs, similar to the DCWA well field. The floodplain would be altered in that the western end would be filled constantly rather than just at flood stage. This would be an adverse change, but because it is localized, the impact would be no more than minor. Removing the rock diversion structure downstream would result in benefits to the floodplain function, both ecologically and as a protective space for residents or structures in the vicinity. Again, because the extent of filling behind this dam is localized and of smaller scale, benefits would be minor.

The remaining flood control mitigation measures described above would have little or no impact to the floodplain compared to the no-action alternative. This is because they would maintain flooding frequency at their current levels.

Cumulative Impacts

No cumulative impacts beyond those described above for the no-action alternative are expected.

Conclusion

All structures and facilities would be protected from any impact associated with dam removal and increased aggradation of riverbed sediments through the use of mitigation measures. However, cumulative increases in flood stage unrelated to dam removal or other NPS activities appear to be an ongoing trend. A re-analysis of the potential for flooding has resulted in changes in some of the proposed mitigation measures. The placing of flood control measures would have minor adverse impacts on the natural floodplain over the long term, in particular along the federal levee. No impairment to park resources would occur from implementing the flood control actions described in this alternative.

Surface Water

Summary of Regulations and Policies

The Clean Water Act controls discharge to waterways and the dredge and fill of wetlands. The permits required to discharge to waterways are obtained from the Washington Department of Ecology (NPDES permit), and to dredge and fill wetlands, from the U.S. Army Corps of Engineers (Federal Water Pollution Control Act, section 404 permit).

The Safe Drinking Water Act controls requirements and standards for public drinking water supplies.

The Washington Department of Ecology has established water quality standards for surface waters consistent with public health and enjoyment, and the propagation and protection of fish, shellfish, and wildlife (WAC 173-201A). The Department of Ecology also controls water withdrawals by the issuance of water rights for the state.

The Elwha Act provides for the protection of existing quality and availability of water from the Elwha River for municipal and industrial uses from possible adverse impacts of dam removal.

Methodologies for Analyzing Impacts

The same methods as described in the FEIS for determining the effectiveness of water quality mitigation measures in reducing turbidity, the amount of chemicals and treatment residuals, the length of time treatment would be required, and all other facets of dam removal were used to assess the new set of mitigation measures described in this SEIS.

Qualitative information, or quantitative information from similar projects (on order of magnitude), was used to assess impacts of construction activities and specific operations of the pre-treatment and other facilities affecting surface water. The relative magnitude of impacts is defined by the following terms:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

An impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant planning documents.

Impacts of the No-Action Alternative

Analysis

Discharge. Since the dams are operated in run-of-the-river mode, river flows are little different from pre-dam conditions.

Water Quality. Lake Mills and Lake Aldwell, the reservoirs created by the Elwha and Glines Canyon Dams, act as large settling basins, removing all of the coarse sediment and some of the fine sediment that is transported from upstream. Consequently, turbidity peaks are reduced downstream of the dams, a minor to moderate beneficial impact on water quality. However, the water remains turbid longer than it does upstream, as Table 12 illustrates.

Table 12. Elwha River Turbidity Measurements Upstream and Downstream of the Dams during a Storm

Date	NTUs Upstream of Lake Mills*	NTUs Downstream of Both Dams**
02/01/95	570.0	125.0
02/02/95	200.0	148.0
02/03/95	75.0	136.0
02/04/95	15.0	119.0
02/05/95	10.0	82.9
02/06/95	7.0	68.7
02/07/95	7.0	50.9
02/08/95	7.0	68.7
02/09/95	6.3	39.3
02/10/95	6.5	39.7
02/11/95	4.8	34.4
02/12/95	3.6	33.6
02/13/95	2.4	28.2
02/14/95	2.6	26.4
0215/95	2.1	28.0
02/16/95	1.6	22.5
02/17/95	12.6	19.7

* New USGS gauging station 12044900.
** Port Angeles monitoring program.

The dams have also prevented silt and clay, which carries iron and/or manganese on the particle surfaces and in the pore spaces between the particles, from washing through the system. The iron and manganese particles settle out due to their density and concentrate in the silt and clay deposits in each reservoir lakebed, where conditions are right to cause the particulates to partially dissolve. Normally, this material would wash out to sea in low concentrations, affecting neither human users nor aquatic life. The storage of dissolved metals in lakebed sediments has therefore had a negligible to minor impact on water quality (see Table 13).

Table 13. Water Quality Impact Indicators

IMPACT INDICATOR	NO-ACTION ALTERNATIVE
DO (% saturation)	95–110
Total Suspended Solids (fines) (mg/L)	1–1,500
Turbidity (NTU)	1–2,800+
Total Iron (µg/L)	20–2,300
Total Manganese (µg/L)	4–210
pH	6.7–10
Total Organic Carbon (mg/L)	0–10

SOURCE: USGS water quality data and NPI

The dams have prevented particulate organic plant material from flowing downstream because it settles in Lake Mills and Lake Aldwell. Also, the absence of salmonid fish carcasses, which supply carbon, nitrogen, and phosphorus, has resulted in a reduction of these nutrients. Low levels of organic matter generally limit aquatic invertebrate diversity and production in the river below the reservoirs (FERC 1993).

The reservoirs have also affected downstream water temperatures, which are 4°C–8°C higher (McHenry 2002) than normal during some parts of the late summer and early fall (FERC 1993). The increased temperature is a result of surface releases of reservoir water, which has warmed over the summer. Increases in disease and mortality in fish populations in the lower river have been correlated with and are major adverse impacts of these increased temperatures.

Under the no-action alternative silt and clay-sized material with traces of iron and manganese would continue to build up behind the dams, and temperatures downstream would continue to be higher than under pre-dam conditions for several months of the year. Water quality downstream of the dams would continue to be more turbid following high-flow events than under pre-dam conditions, although withdrawals would likely increase as the population grows. Episodes of high turbidity during floods or upstream landslides would continue to occur periodically. Within several hundred years, the reservoirs would fill with sediment, resulting in a return to natural conditions including more turbid water and higher concentrations of iron and manganese downstream.

Water Quality Treatment. Some surface water users treat water now. Nippon Paper Industries uses settling channels, flocculants, and/or filtering to prevent adverse impacts from turbidity. The Lower Elwha Klallam tribal fish hatchery uses groundwater and a shallow infiltration gallery to help maintain a less turbid supply.

The City of Port Angeles currently uses a Ranney well and chlorination to treat municipal water. Turbidity in the Ranney well water is lower than in the river because alluvial sands and gravels filter out a large portion of particulate matter in the river. High turbidity in the river is therefore not usually reflected in water collected from the Ranney well. However, if the river rises quickly following a prolonged drought, soil around the base of the Ranney collector caisson dries and cracks, allowing surface water to bypass the filtration provided by the riverbed. During these "short-out" periods, turbidity in the Port Angeles municipal supply can be quite high. The 1994 measured mean turbidity of 0.08 NTU normally does not exceed drinking water standards of 1.0 NTU. The maximum turbidity detected in the city's well from 1983 to 1993 was 4.8 NTUs.

The armoring of the riverbed with coarse cobbles and gravel, along with the removal of sand and fines, has contributed to an increased hydraulic connection between the river and the underlying aquifer. The Port Angeles Ranney collector, and other high-yield wells, depend on the induced recharge from the river to maintain high yields. The quality of water from the collector has also been found to be more closely connected to that in the river than is appropriate for a true groundwater source. As noted in the "Alternatives" chapter, water collected by the Ranney well has been reclassified as groundwater under the influence of surface water. This means the water must be treated as if it came from a surface source, with additional disinfection and/or filtration requirements aimed at removing *Giardia* cysts, Cryotosporidium, and viruses to meet EPA and state health department requirements. Under the no-action alternative the city would need to add to its current chlorination to comply with regulations regarding the new status of water from its Ranney collector.

Iron was detected above maximum contaminant levels twice in the Port Angeles Ranney well samples taken from 1983 to 1993. Although the mean iron concentration of 200 μg/L was below state drinking water standards of 300 μg/L, the maximum concentration detected was 1,000 μg/L.

Cumulative Impacts

As noted in the "Affected Environment," water in the Elwha River is of very high quality. The reservoirs further improve quality by acting as large settling basins, removing all coarse sediment and some fine sediment transported from upstream. Adverse cumulative impacts to water quality in the Elwha River basin include natural factors, such as sedimentation from landslides.

Conclusion

The reservoirs have moderately reduced turbidity, have trapped iron and manganese particles, and have increased temperatures downstream of the dams. These conditions would continue under the no-action alternative. Treatment of the Port Angeles municipal water would change to comply with standards related to the reclassification of its water source as "under the influence of surface water." While the increase in temperature has had a particularly major adverse impact on water quality in the Elwha River, this impact does not constitute an impairment of Olympic National Park resources or values.

Background Information on Impacts of Dam Removal

The following information is from the Implementation FEIS. It is used as background material only to help make this a stand-alone document. As noted in other sections of this document, the decision to remove the dams has already been made and formalized in a "Record of Decision."

The primary impacts to surface water would be the increase in concentrations of total suspended and dissolved solids, measured in milligrams per liter (mg/L) or parts per million (ppm), released from the reservoirs by the processes of erosion and transport downstream. The timing and rate of removal of the dams and the river discharge would have the greatest influence on downstream total suspended and total dissolved solids concentrations. Increases in both short- and long-term concentrations would result from dam removal, although short-term concentrations would be several orders of magnitude higher. In the short term (three to five years after dam removal started), while peak suspended sediment levels in the river could still occur occasionally (as much as seven times current peak levels), mitigation would ensure that surface water users would continue to receive water meeting current standards.

Turbidity levels would be very high during dam removal and would have major adverse impacts to water quality, as well as to users if proposed water quality mitigation measures were not integrated into the project design. However, since municipal and industrial supplies of water must be protected against adverse impacts of dam removal, measures to ensure that standards would not be exceeded were built into the dam removal alternative. There would, therefore, be no impact to surface water industrial and municipal users from dam removal. In the long term, the water quality protection facilities would be left in place for city use in the future.

As noted in the "Alternatives" chapter, additional testing of reservoir sediments has shown that some fine materials might settle out in the coarse riverbed material, decreasing infiltration into the alluvial aquifer. A decrease in yield, or blinding, particularly for the Port Angeles Ranney collector, could result.

Water quality might also be degraded by the release of dissolved iron or manganese from lakebed sediments. Analyses of reservoir bottom sediment samples (collected in March 1995) indicate these metals are in the lakebed sediment pore water (i.e., spaces between sediment grains) in high concentrations. The actual concentration of dissolved iron and manganese in waters released during and immediately following dam removal would be a function of the inflow volume, prevailing chemical conditions in the water, and erosion rate. Short-term impacts from the release of iron or manganese would be major adverse effects to water quality. In the long-term, these impacts would be minor.

A sufficient volume of these dissolved minerals could be released over the short term, which would aesthetically and/or physically affect downstream water users. Potential effects are bad tasting and tinted drinking water, iron and manganese staining, and precipitation plugging water supply plumbing. Again, because of required mitigation, users would experience no impact to their water quality from dam removal. Current and predicted measurements for the impact indicators of concern without mitigation measures are shown for each alternative in the following tables. Table 14 lists the short-term impacts to water quality for up to five years following dam removal with no mitigation.

Table 14. Short-term, Unmitigated Water Quality Impacts from Dam Removal

Impact Indicator	Up to Five Years Following Dam Removal	No Action
Dissolved Oxygen (% saturation)	90%–100%	95%–110%
Peak Total Suspended Solids Concentration (fines only) (ppm)	20,000–40,000*	5,500
Average Total Suspended Solids Concentration (fines only) (ppm)	880–11,000*	7
Peak Turbidity (NTU)	6,000–11,000*	2,000–3,000
Average Turbidity (NTU)	440–530	8
Total Iron (μg/L)	30,000–50,000*	20–2,300
Total Manganese (μg/L)	500–10,000*	4–210
Maximum Daily Temperature (^{o}C)	15–19	19
pH	5–9	6.7–10
Total Organic Carbon (mg/L)	100–1000	0–10

* Concentrations are expected to vary with removal activity and flow; these numbers represent maximum anticipated ranges of short duration (1–3 days) as lakebed sediments are eroded.

Table 15 lists the unmitigated long-term impacts that would result from the return of the natural upstream sediment supply. When river flows are lower than 1,000 cfs, suspended sediment concentrations are expected to exceed 1,000 ppm between 140 to 170 days during dam removal. Suspended sediment concentrations are expected to exceed 5,000 ppm between 27 to 42 days, and to exceed 10,000 ppm between 4 and 8 days when the river flows are less than 1,000 cfs.

***Table 15. Long-term, Unmitigated Water Quality Impacts from Dam Removal** (natural ambient conditions)*

IMPACT INDICATOR	BEGINNING TWO TO FIVE YEARS FOLLOWING DAM REMOVAL	NO ACTION
Dissolved Oxygen (% saturation)	95%–110%	95%–110%
Peak Total Suspended Solids Concentration (fines only) (ppm)	5,800*	5,500*
Average Suspended Solids Concentration (fines only) (ppm)	22	7
Peak Turbidity (NTU)	2,000–3,000	2,000–3,000
Average Turbidity (NTU)	21	8
Total Iron (µg/L)	10–5,000	20–2,300
Total Manganese (µg/L)	10–700	4–210
Maximum Daily Temperature (^{o}C)	15–17	19
pH	6.8–8.5	6.7–10
Total Organic Carbon (mg/L)	10–200	0–10

* Concentrations are expected to vary with removal activity and streamflow; these numbers represent maximum anticipated ranges of short duration (1–3 days) as lakebed sediments are eroded.

Impacts of the Proposed Action

Analysis

Water Quality Mitigation. Water quality mitigation measures proposed as part of the SEIS are described in Table 16. In some cases, they are similar to those in the FEIS (such as for industrial treatment, or for maintaining high quality water for the tribal hatchery), and in others, they are very different (such as for both supply and treatment of Port Angeles municipal water).

Table 16. Mitigation Measures Included in the Proposed Action

SURFACE WATER USER	MITIGATION MEASURE
Industrial — NPI Mill	Surface supply continues. Flocculation and sedimentation treatment.
WDFW Fish-Rearing Facility	Surface supply continues with water treatment at the Elwha water treatment plant during dam removal erosion period. Flocculation and sedimentation treatment.
Lower Elwha Klallam Tribal Fish Hatchery	Relocate on the Halberg property (preferred alternative), supply with surface water and on-site wells; or expand and upgrade at existing site, supply with surface water, and add two or more new wells for dilution when needed.
Port Angeles Municipal Supply	Surface supply during high turbidity dam removal period, Ranney well otherwise; use of surface water for extra capacity or to supplement the Ranney well supply possible. Actiflo, filtration, and disinfection treatment plant.

Industrial Water Treatment — As noted in the “Alternatives” chapter, the WDFW fish-rearing facility would remain open during dam removal, and both it and the industrial water treatment facility (the Elwha water treatment plant) would be supplied with surface water collected by means of a diversion and intake facility. After solids were removed, this same supply would be used for the tribal hatchery, and after treatment water would feed into the Port Angeles water treatment plant. The existing rock diversion structure would be removed and replaced with one able to pass both fish and sediment.

Water for these users would be provided via a surface diversion and an intake facility, as described in the “Alternatives” chapter. It would be treated through a conventional treatment process consisting of chemical addition, flocculation, and sedimentation. The chemicals added would include aluminum sulfate (alum), caustic soda, and small quantities of a polymer (polyacrylamide or PAM) to increase the efficiency of the coagulation process. Three clarifiers are proposed with related chemical storage and feed, rapid mixing, and sludge pumping. The treated water leaving the clarifiers would flow to a splitting structure for distribution to the Port Angeles municipal water treatment facility, Nippon Paper Industries, the WDFW fish-rearing channel, and the tribal fish hatchery. As with the proposed action in the FEIS, the Elwha water treatment plant would be directly adjacent to the rearing channel (see the “Elwha Water Treatment Plant” map). The expected effectiveness of treatment is shown in Table 17 below.

Table 17. Water Quality Before and Following Industrial Treatment — Elwha Water Treatment Plant
(critical impact indicators, industrial diversion water)

IMPACT INDICATOR	DURING DAM REMOVAL (RIVER WATER)	LONG TERM (RIVER WATER)	WITH MITIGATION (AFTER TREATMENT)
Peak Turbidity (NTU)	6,000–11,000	2,000–3,000	≤20–100
Average Turbidity (NTU)	440–530	21	<20
Total Iron (μg/L)	30–50	0.010–5	≤4
Total Manganese (μg/L)	0.5–10	0.010–0.7	≤1.5
pH	5–9	6.5–8.5	6.5–7.5

NOTE: The facility is designed to limit turbidity to 20 NTUs or less Short-term spikes above 20 NTUs (duration limited to a few hours) might be infrequently experienced as a result of rapid changes in river turbidity.

An estimated 46 tons per day of residual coagulated solids would be produced on average, although on a peak turbidity day as much as 1,786 tons per day would result from treatment for industrial and fisheries purposes. Because of this high volume, the only feasible option for disposal of these solids is to return them to the river during dam removal and the subsequent three to five year sediment erosion period when turbidities in the river would already be very high.

Lower Elwha Klallam Tribal Fish Hatchery and WDFW Fish-Rearing Channel — The tribal hatchery and WDFW rearing channel would be supplied by a combination of water from the Elwha water treatment plant and groundwater.

Two options are being considered for the tribal hatchery — improving the existing facility or building a new one farther south and east on the Halberg property (which is preferred at this time). If the tribal hatchery remained in its current location, construction of a pumping station with redundancy and emergency backup power could be part of the proposed action to help direct outflow following aggradation associated with dam removal.

The pipeline to the hatchery (regardless of location) from the Elwha water treatment plant during high turbidity periods during and following dam removal (and from the Elwha surface water intake when sediments had stabilized) would be along the industrial water pipeline route to the reservation boundary. From the reservation boundary the pipeline would follow the chosen route for the extension of the federal levee and would continue along the existing levee directly to the hatchery.

Effluent from the Halberg hatchery site would be discharged into the Elwha River by way of a 400-foot channel. Total instantaneous discharge at maximum biomass loadings at the hatchery would be 20.7 mgd. Relocating the hatchery to the Halberg site would reduce flooding impacts currently experienced because hatchery effluent would be re-routed during high-water events. Hatchery effluent could be stripped of hatchery-origin organic materials so as to not adversely impact water quality in the Elwha River.

Port Angeles Municipal Supply — As noted in the "Purpose and Need" and "Alternatives" chapters of this SEIS, concerns over the possible reduction in yield to the city's existing and proposed second Ranney collector during dam removal is one of the reasons a surface supply is now the preferred alternative. The proposed action in this SEIS includes a full-scale permanent surface water treatment plant, instead of a temporary plant proposed in the FEIS. A conceptual design of the Port Angeles water treatment plant is discussed in more detail in the "Alternatives" chapter. The facility would not be near the city's existing Ranney well (as it is in the FEIS), but several miles away at the city's existing landfill staging area, where it would occupy about 5 acres.

A study evaluating treatment options indicated the coagulation and sedimentation process using Actiflo, filtration, and disinfection would meet federal and state surface water treatment standards, even for surface water (URS 2002c). The plant would treat water from the Ranney collector, and if needed from the Elwha surface water intake, during and following dam removal.

Because the majority of water used in the process would already be filtered through the Ranney collector or treated at the Elwha water treatment plant, the volume of sludge or solids produced would be far less than in the industrial treatment process, ranging from 2,786 dry pounds/day during average flow to 4,680 dry pounds/day at peak flow rates (URS 2003h). At average flow rates, this translates to about 1,241 cubic yards of material composed of 20% solids each year. Dried sludge from the drying beds would be combined with composted wastewater biosolids or hauled to a landfill from the city's proposed solid waste transfer station.

Water Quality Monitoring — A sediment management monitoring plan administered by the National Park Service would include sampling for critical and basic water quality parameters. Sampling sites include the new station above Lake Mills (to be relocated to Goblins Gate), the historic McDonald's bridge gage, and a new site to be established just below the Elwha Dam. Sampling parameters and frequency would ensure adequate data coverage of water quality impacts before and after dam removal. Information gathered from the sites would be used to help determine the dosing frequency of flocculent at the treatment facility and other treatment parameters during dam removal.

The established historic baseline from the McDonald bridge station would be used for comparison during the deconstruction period. After the dams were removed, data from the new upper station (at Goblins Gate) would be compared with data from the new lower station below the Elwha Dam site to determine dam removal impacts to water quality and how to reestablish natural conditions.

Construction Impacts — All mitigation measures discussed in this SEIS, with the exception of the Port Angeles water treatment plant and Morse Creek fish-holding ponds, would be built along the banks or very near the Elwha River. The majority of construction and construction-related impacts would occur from RM 3.7 to RM 2.8. In this 0.9-stretch, from south to north, the following projects would take place

(1) providing flood protection in the vicinity of RM 3.5–3.7 for the existing DCWA well field or for an alternative well field and access road on the opposite bank, a pipeline along one of five routes to distribute water from the alternative DCWA well field, or a pipeline to connect the association to the city's municipal distribution system

(2) replacing the existing rock diversion structure with a new diversion and intake structure between RM 3.5 and 3.6

(3) raising and strengthening roads and an in-river dike to allow access to the Elwha water treatment plant, Ranney collector, and WDFW fish-rearing channel between RM 3.3 and 2.8

(4) building a ring dike around at least the Ranney collector and possibly more at RM 3.0

(5) constructing the Elwha water treatment plant at RM 2.8–3.0

(6) raising and strengthening an in-river training dike paralleling the rearing channel

Downstream from this stretch of river the following projects would take place:

(1) constructing a new tribal hatchery, wastewater pumping station, and distribution pipeline at RM 2.0

(2) possibly raising and extending the federal levee on the east side of the floodplain both north and south from RM 0.1 to RM 1.6

(3) raising or removing a private levee on the opposite side of the river between RM 0.0 and RM 0.1

To the extent possible, construction would take place in the two dry seasons before dam removal began to avoid impacts to water quality and other resources. If construction exceeded the dry periods, work in water would be required, which would have a direct and adverse impact on water quality (such as from adding material to the top of the levees). The extent of this impact would be somewhat lessened by standard best management practices. When in-river work was required, such as for the construction of a cofferdam to replace the existing diversion and intake structure, impacts would likely range from minor to moderate. They would not be more severe than this because the riverbed is primarily made up of large rock and cobble, without the many fine sediments common to an undammed river.

Heavy equipment would be used for earthwork, the delivery of construction materials, and the erection of the facility. Equipment would also be used to upgrade existing roads to the site of the Elwha water treatment plant, and/or to grade new roads to access the federal levee, extend and raise the levees, floodproof the DCWA alternative well field, construct a cofferdam to redirect the river to remove the rock diversion structure, and build a new control weir and intake facility. In-river work to replace the dam and intake facility, repair and strengthen the training dike, install distribution pipelines, and for other reasons might also be required. Constructing a ring dike around the city's Ranney well would occur in and around the existing side channel in that area, as well as the rearing channel fish collection pond. Work would occur during low-flow conditions so the side channel should be dry. Alternatively, a temporary barrier (rubber dam, gravel bags, etc.) could be used to separate the work area from the river to minimize impacts to water quality. No impacts to surface water from construction of the Port Angeles water treatment plant are anticipated.

Best management practices would be applied during construction to minimize soil lost to the river and increases in turbidity; however, some increases in turbidity would inevitably take place. Examples of standard mitigation measures that would be used include maximizing construction during the dry season;

disposing of excess materials 300 feet away from the river; using straw bales, silt fences, or other erosion control measures during construction; and stopping work during rain. These measures are standard ones that have proven effective in stopping soil loss from construction sites. Some small amount of sediment could sometimes make it past these barriers during heavy rains. The extent is unknown, but it would probably not be detectable even a short distance downstream from the construction area. Disturbed ground around the Elwha surface water intake and the Elwha and Port Angeles water treatment plants would be reclaimed by planting or seeding with native and drought resistant vegetation, which would reestablish current conditions within a year or less. Immediately following the completion of water quality facilities, dam removal would begin, and turbidities would periodically exceed 25,000 NTUs.

The impacts of these increases in turbidity would be temporary, and construction of cofferdams during the low-flow season would allow work to occur during higher flows while limiting sediment erosion from the construction site. Loose soil on site and any residual petroleum products from leaks or spills could be washed into the river with the return of the fall rains, causing a short-term pulse of increased turbidity or toxicity. The extent of this increase in turbidity could range up to 1,000 NTUs for a short distance downstream, or less than conditions sometimes reach in the river under natural conditions now (river turbidity reached 2,800 NTUs below the Elwha Dam in October 2003). Because the river is less turbid than under pre-dam conditions, an increase of 1,000 NTUs could be readily detectable, or have a moderate impact on surface water quality. Before revegetation was fully effective, additional increases in turbidity resulting from soil erosion at construction sites would be likely. However, these would coincide with much larger increases from dam removal and would be comparatively negligible.

Fuel leaks or spills of fuel or other chemical contaminants, should they occur, would be minimized by inspecting machines for leaks, having spill kits on site (with absorbent material), and conducting machine maintenance outside the riparian area (at least 150 feet from the river's edge). Even with these mitigation measures, it is possible that a small spill or leak would contaminate the river from the construction site a few miles downstream, and possibly even to the marine environment. The impact to water quality would be temporary, but could range in intensity in the Elwha River from negligible to moderate for a short time.

It is possible that actions associated with fisheries mitigation or revegetation could also have temporary adverse effects on water quality before, during, or after dam removal (for a period of three to five years). For instance, heavy equipment could be used to grade the reservoirs, move heavy debris, or arrange logs. The National Park Service might need to apply herbicides, fertilizers, and soil treatments, such as mulch or other additives. Mitigation for bull trout would include installing larger culverts on some of the tributaries to the middle section of the river. These actions could result in the same kinds of impacts as described above; that is, increases in turbidity or small concentrations of fuels or chemicals. Using best management practices would minimize the impacts of these activities, but impacts could still be detectable.

These same types of construction-related impacts are possible on Morse Creek, where temporary chinook-rearing facilities are planned as backup to production on the Elwha. The Washington Department of Fish and Wildlife is estimating the need for four rearing ponds, which at this time would most likely be located about 200 meters from the stream at around RM 5.5 (near the Morse Creek hydropower facility). An adult collection trap would be placed annually in the lower section of Morse Creek within 300 to 1,000 meters downstream of U.S. 101. Again, although best management practices would be required, the water quality of Morse Creek is designated as a "salmon and trout spawning, core rearing, and migration" area, reflecting extraordinary water quality. Mitigation beyond the normally mandated best management practices might be needed to prevent contamination of Morse Creek due to increased turbidity, petroleum products, or other construction-related chemicals.

Operations Impacts — Unlike the FEIS alternative, users would not experience interruption of supply or long-term decreases in yield, since water would be supplied by means of a surface diversion. This is a benefit of the proposed action considered in this SEIS.

Operating the Elwha water treatment plant would require the use and disposal of treatment chemicals, including alum and polymers, in the form of settled solids. As high turbidity would often correlate to high-flow conditions in the river, the system would remove the most sediment at the highest river flows, and the return of settled solids would not induce a measurable increase in downstream turbidity. However, even during lower flows, the solids in the flow returned to the river would be small compared to the average river flow, and impacts would be negligible to minor. Due to the anticipated total suspended solids concentrations and the required industrial treatment efficiency, the sheer volume of solids produced would preclude separation and removal to a landfill site, although ocean disposal might be possible.

The vast majority of residuals from the Elwha plant would be solids removed from the river by the treatment process itself. On average the facility would return nearly 50 tons/day of these solids to the river or ocean following treatment. The actual daily values would vary widely and could be as high as 1,786 tons on a peak turbidity day (URS 2002c, p. 7-28). Early tests indicated 13 mg/L of a polymer in combination with 10 mg/L of alum could reduce 30,000 mg/L of suspended solids to a turbidity of 5 NTUs. The treatment objective for use by hatcheries is to provide water that does not exceed 20 NTUs on a continuous basis. Surges of 80–100 NTUs could be tolerated for short periods. The polymer concentration in treatment residuals is not anticipated to be harmful to aquatic life, because they are disposed of with a large volume of water, but high doses of both polymers and alum can have adverse effects on fish and other aquatic life. (See "Native Anadromous and Resident Fisheries" for more information.)

Given the proximity of the Elwha water treatment plant to the river, and the significant increase in river turbidity (as well as iron and manganese) anticipated during and for several years following dam removal, it is likely that the addition of alum or polymers to the Elwha River during this time would essentially have no more than a minor effect (URS 2002c). As the dewatered reservoirs stabilize upstream over time, turbidity would return to natural levels and vary between 0.1 and 3,000 NTUs. This is expected to occur within three to five years during and following dam removal (see Table 17). When turbidities stabilized to the range expected under natural conditions, it is anticipated that ownership of the facility would transfer to the City of Port Angeles. Treatment residuals would likely be put in a landfill if the facility continued to be operated after ownership was transferred.

Surface water quality would continue to be affected by hatchery operations, which would contribute organic material and low concentrations of chemicals (e.g., formalin) that are used to keep fish disease-free, as they do now. Both the Elwha River and Morse Creek would experience minor increases in these contaminants. In the Elwha River increases would occur during dam removal and for three to five years following removal, at a time when the river water quality would already be severely degraded from increased turbidity. The impact to water quality would be negligible. Although the hatcheries would continue to operate when turbidities returned to natural conditions, the impact of releases to the surface water quality would not be noticeably different from the impacts ongoing now, e.g. they would continue to be negligible or minor. However, the waters of Morse Creek would not experience any degradation related to dam removal. The operation of temporary chinook-holding ponds could result in fish fecal material or other organic waste, which could violate water quality criteria and result in short-term, major impacts to water quality in Morse Creek. At this time, the state Department of Ecology has indicated that it would require mitigation measures to ensure that organics or chemicals from operation of the hatchery did not exceed these standards, including consideration of a pollution abatement pond or wetland to act as a nutrient filter (DeMond, pers. comm. September 2002). If these mitigation measures were as effective as anticipated, they could reduce impacts to negligible or minor.

It is possible that actions associated with fisheries mitigation or revegetation could also have temporary adverse effects on water quality before, during, or after dam removal (for three to five years). For instance, heavy equipment would be used to grade the reservoirs, move heavy debris, arrange logs, etc. The National Park Service might need to apply herbicides, fertilizers, and soil treatments, such as mulch or other additives. These actions could result in the same kinds of impacts as described above; that is, increases in turbidity or small concentrations of fuels or chemicals. Using best management practices would minimize the impacts of these activities, but impacts could still be detectable.

Cumulative Impacts

As described above under "Background Information on Impacts of Dam Removal," the increases in turbidity, manganese, and iron resulting from dam removal would have major, short-term effects on surface water quality. In particular, turbidity increases from dam removal would overlap with the disposal of residuals into the river from the operation of the Elwha water treatment plant and so would have an additive or cumulative effect on water quality. However, these residuals would be nearly all solids that had been removed from the river during treatment, so additive impacts would be very small.

Conclusion

Surface water users would not be affected in the long term by dam removal because mitigation measures would be taken to protect them from adverse impacts. Water quality monitoring during and following removal would help identify and mitigate any additional unknown or unanticipated impacts.

Constructing water quality and supply mitigation facilities, as well as those associated with mitigation of flood impacts and impacts to anadromous fisheries, would result in increased erosion of soils at construction sites and possible contamination of those soils by petroleum products for two years. Periodic pulses of turbidity following construction, with impacts ranging from negligible to moderate, would be likely, even with the use of best management practices. Replanting and reseeding sites after construction of mitigation facilities would return erosion rates to pre-construction conditions within one year. The long-term impact of construction on water quality would be negligible. During dam removal and for three to five years following, turbidity levels would be high enough to have major adverse impacts on water quality. At the same time, operation of the Elwha water treatment plant would require re-injecting solids removed from the water back into the river, with negligible cumulative effects.

Providing users with surface water during dam removal would ensure adequate supply, a benefit compared to water supply mitigation proposed in the FEIS. This alternative would return treatment residuals from the Elwha water treatment plant to the river during dam removal; consequently, the impact would be barely detectable, e.g. a negligible to minor impact on water quality. Short-term releases of organic material and chemicals from the hatcheries during dam removal would have negligible impacts on water quality because of ongoing impacts from dam removal. In the long term these releases would decrease to current levels, with a negligible to minor impact on Elwha River water quality. Before dam removal and following the return of turbidities to near pre-dam conditions, the impacts on water quality from the disposal of this effluent could be minor or moderate. Construction and operation of a fish pond on Morse Creek could result in exceedances of water quality standards, a major adverse impact. With mitigation, these impacts could be reduced to negligible to minor.

No impairment of park resources or values related to the Elwha River would occur as a result of the mitigation measures described in the proposed action.

Groundwater

Summary of Regulations and Policies

The Safe Drinking Water Act provides requirements and standards for public drinking water supplies.

The Washington Department of Ecology and the Department of Health Drinking Water regulations apply to existing water supplies.

The Elwha Act (PL 102-495) requires the protection of existing quality and availability of water from the Elwha River for municipal and industrial uses.

Methodologies for Analyzing Impacts

Groundwater-related impacts and appropriate mitigation are discussed in detail in the FEIS. Since the release of the FEIS, the number of affected residents and structures on the Lower Elwha Klallam Reservation and the type of mitigation desired by the Dry Creek Water Association have changed. Both the tribe and the association have worked with engineering staff to develop options that were not evaluated in the FEIS but that are presented in this SEIS. Methodologies to assess suitability of the groundwater mitigation include feasibility and appraisal level hydrogeology and engineering analyses conducted by consultants to the interagency team. Impact thresholds were defined as:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

Because this SEIS is focused on changes that are relevant to either the proposed action or its impacts, the discussion of groundwater impacts is focused on the DCWA water supplies and the Lower Elwha Klallam Tribe septic systems, which in many cases are rendered ineffective by changes in groundwater levels. As noted in other parts of this document, the Port Angeles Ranney collector was considered a groundwater source until recently. Impacts to the Ranney collector from dam removal are discussed in the FEIS, and mitigation for these impacts is proposed and analyzed in the "Surface Water" section above. Therefore, no additional discussion of the Ranney collector is presented in this groundwater analysis.

Groundwater Quality. The Elwha River reservoirs act as large settling basins, removing all of the coarse sediment and some of the fine sediment that is transported from upstream. Therefore, water is on average slightly less turbid downstream than above the dams. During high flow events, water downstream of the dams is less turbid than upstream, but it remains turbid for longer periods of time. Wells that are hydraulically connected to the river (such as two older wells belonging to the Dry Creek Water Association and some individual wells) may have less turbid supplies with the dams in place because of this phenomenon. The riverbed materials are capable of filtering out fine-grained sediment that could enter wells hydraulically connected to the river. Following dam removal, it is possible that the river could migrate closer to the wells and remove some of the material that had previously filtered out these fine-grained sediments. The armoring of the riverbed with coarse cobbles and gravel and the removal of sand and fines have contributed to the increased hydraulic connection between the river and the underlying aquifer.

Groundwater Levels. As explained above under "Flooding," the dams have trapped sediment that would otherwise be distributed as riverbed material, resulting in the degradation or lowering of the river's surface elevations. In some cases this has allowed the settlement of portions of the floodplain, and it has also kept groundwater levels lower than under pre-dam conditions. While a return to pre-dam water levels might not be problematic for well owners, it could be for septic systems, such as those serving the Lower Elwha Klallam Reservation residents near the mouth of the river.

Dry Creek Water Association. The Dry Creek Water Association was formed and incorporated in 1964 to serve the water needs of residents to the south and west of the City of Port Angeles. In 1994 the association had 392 members, consisting of 349 residential connections and 43 commercial ones. This increased to 450 connections in 2002. Water is provided through two groundwater wells on the east bank of the river near RM 3.7. A third well is maintained for backup use. Current pumpage from the two wells averages about 223 acre-feet per year. The no-action alternative over the planning horizon of dam removal in the FEIS would include growth rates projected over the next several years. Based on recent growth rates, annual usage by DCWA customers might increase to 644 acre-feet in 10 years, and to 818 acre-feet in 20 years. The association currently has a 50-year lease for the existing well field; the lease, which is administered as an Indian family trust property by the Bureau of Indian Affairs, is scheduled to expire in 2014.

The existing DCWA well field provides water at 135 to 148 gpm with adequate pressure, and only chlorination treatment is required.

The current road to the well field is in accessible condition with no apparent erosion problems, although the last 750 feet are located on the valley floor within the river's floodplain. The geology of the well field consists of alluvial materials (sands, gravels, and cobbles) that provide adequate hydraulic capacity to meet the current DCWA demand. Based on water quality data, the state considers this water supply to be groundwater, rather than groundwater under the influence of surface water.

Lower Elwha Klallam Tribe. The Lower Elwha Klallam Reservation, tribal trust lands, and individual trust lands include about 1,262 acres near the mouth of the Elwha River. The reservation comprises two distinct areas: the "Valley" areas along the river and the "Heights" areas above a steep escarpment that physically bounds the valley. A total of 208 homes and other facilities on these lands generate wastewater, which is treated by individual septic systems. A majority of these systems are either conventional septic or modified versions. The depths for the drainfields range from 6 inches to 10 feet, depending on the type of system used.

Growth on the reservation is expected to continue at about 5% per year (Ridolfi Inc. 2002). Given this growth, and the rising groundwater and return of shellfish habitat to the coastline along the reservation expected following dam removal, the tribe has examined a community approach to wastewater treatment. Treating water throughout the Valley community in a centralized fashion rather than continuing to use individual septic systems makes economic, technical, and environmental sense.

Because a community wastewater treatment system might be built regardless of whether the dams are removed, it is considered a likely part of the no-action alternative. However, it is not analyzed in this SEIS as part of the no-action alternative because there would be no Elwha project connection to the building in this case. One of the reasons the tribe is considering centralized wastewater treatment is because of rising groundwater levels following dam removal, which would render low-lying septic systems unusable; therefore, impacts of a centralized system are discussed as part of the proposed set of mitigation measures.

Cumulative Impacts

As noted above, the presence of the dams and reservoirs has altered the groundwater hydrology, turbidity, and the hydraulic connectivity of surface and groundwater in the Elwha River. These are cumulative impacts that would continue under the no-action alternative. The use of groundwater by residents along the river, and the disposal of wastewater by individual septic systems may have had negligible to minor adverse impacts on groundwater in the study area as well.

Conclusion

The dams have affected groundwater users by decreasing turbidity during peak flows, holding back manganese and iron that would normally flush through the system, and increasing groundwater tables for some well users and artificially decreasing it for lower Elwha valley users. Migration and flooding frequency have been reduced through the elimination of sediment transport to the middle and lower reaches, resulting in the armoring of the downstream channel. This has increased yields for some wells and allowed well users to drill wells in the floodplain. Slight additional impacts on groundwater from well users have also occurred and would continue under this alternative. No NPS groundwater resources would be affected by the no-action alternative; therefore, no park resources or values would be impaired.

Impacts of the Proposed Action

Analysis

The extent of the impact to water quality degradation would depend on the method and timing of sediment releases during dam removal. Fine sediments from the turbid river could infiltrate the well screens of near-river wells and the coarse riverbed substrate, potentially decreasing hydraulic continuity between the river and the aquifer. The increased bedload of the river would promote renewed channel migration and bank erosion, which might also impact near-river wells. As the riverbed aggraded, the river stage, flood levels, and water table levels would be higher as well.

Dry Creek Water Association. The primary impact of dam removal on wells, including those of the Dry Creek Water Association, would be both short- and long-term increases in turbidity, and long-term aggradation of the riverbed. Some of the fine sediment might settle out in the interstices (spaces between granules) of the coarse riverbed material and decrease the rate of infiltration from the river to the alluvial aquifer. However, even with a slight decrease in the infiltration rate, the wells should not have a decrease in yield. Rather, the area affected by the well drawdown (cone of depression) would just expand until it equaled the pumping rate.

The DCWA wells are often affected during periods of high river turbidity. Projected levels of suspended sediment with the river erosion alternative could exceed 50,000 mg/L for short periods during dam removal; this would likely cause water in these wells to exceed the regulated turbidity levels. As noted above, fine lake bottom sediment from Lake Mills contains high pore water concentrations of iron (average of three samples was 27,500 µg/L) and manganese (average of three samples was 4,670 µg/L). These metals would be released into the river as the dams were removed and for three to five years afterwards, and they could cause iron fouling of water delivery systems and mineral staining of fixtures and clothing. Because this form of iron and manganese is dissolved, it could move with the groundwater into the aquifer. More likely, the iron would oxidize and precipitate out of solution and be transported with the majority of the sediment to the strait. Because the wells at the existing location are not considered to be under the influence of surface water for treatment purposes, only chlorination and filtration following dam removal would be required to maintain quality.

Changes required at the existing well field to mitigate impacts related to dam removal include raising the wellheads and access road to a minimum elevation of 90 feet (the access road is currently at 83 feet elevation and the well field at 86 feet elevation). One well would be abandoned, and a new control and chlorination building would be constructed in the elevated area. The road is in an accessible condition with no apparent erosion problems, although the last 750 feet are located on the valley floor within the river's floodplain.

Because the well field lease is due to expire in 2014, the Dry Creek Water Association is considering an alternative well field site on the opposite bank about 0.25 mile downstream plus options to bring water from this field to its users (see URS 2003a).

The geology of the alternative well field consists of alluvial materials and appears adequate for DCWA water requirements. Water quality appears to be good and not under the influence of surface water (e.g. low risk for microscopic particulates), but this is based on one well and must be corroborated with production well data. A concern with water quality at this site is related to a residence and its septic system drainfield, which is adjacent to the well field site. In order for the alternative well field to be permitted, the septic system would need to be removed, and either the residence would need to be provided with an alternate method of wastewater disposal or it would have to be removed. The Dry Creek Water Association is currently working with the property owner on removal of the residence and septic system. The area receives moderate use and shows evidence of vandalism; therefore, development of the alternative well field would include a perimeter fence.

The alternative well field site would require drilling two wells, constructing a new control and chlorination building, installing pumps and a new chlorination system, and providing a new electrical supply for these facilities. This alternative would also require the demolition and abandonment of the existing well field and associated facilities.

Development of the alternative well field must meet Washington State Department of Health drinking water regulations and provide a level of service equal to the existing system. The required delivery rate for an alternate water source would be 250 gpm at the connection point to the DCWA distribution system. Regardless of which well field the association used, access roads must be above the 100-year flood elevation and pipelines must consider contamination potential and soil stability. Either the existing or the alternative well field must be protected from flooding and river migration (see the "Flooding" section for more information). To minimize potential for damage from river migration, either well field site would also require armoring with rock. Either well field would require site improvements such as excavations and filling using heavy equipment.

Distributing water to users from the alternative well field would require crossing the river, and each of the pipeline route alternatives would make use of existing structures or rights-of-way to the maximum extent possible.

- Alternative route A would follow the site access road to Elwha River Road, proceed west to the intersection with Highway 112 and cross the river on the Highway 112 bridge.
- Alternative route B would follow an overgrown access road and travel cross-country to intersect with Highway 112 and would also cross the river on the Highway 112 bridge.
- Alternative route C would follow the site access road to the one-lane bridge (Elwha River Road) and use it to cross the river. The one-way bridge is scheduled for replacement in 2006 (according to the Clallam County Engineering Department).
- Alternative route D would travel south along the floodplain and cross the river by way of the existing powerline right-of-way. This alternative would not make use of any existing bridges or other structures, and it would require excavating through the riverbed, directionally drilling beneath the riverbed, or constructing a pipe bridge over the river.
- Alternative route E would cross a new proposed diversion structure, located just upstream of the existing rock diversion structure (if it was located in such a way that the pipeline could connect to it).

Under another option the association would abandon the existing well field and tie into the Port Angeles municipal system. This alternative would require replacing the existing DCWA line and tying into a 6-inch iron Port Angeles water supply line, both of which are located along Airport Road. A booster pump station would also be needed for this option.

Use of existing bridges or the new industrial intake facility for river crossings must consider the feasibility of safely attaching a pipeline to these structures and the ability to maintain the pipeline and associated equipment once it was attached. Using existing bridges would also require coordination with the Washington State Department of Transportation and Clallam County regarding current and future plans for the structures. River crossings (such as for route C) would require permitting and more in-depth analysis to determine whether they are environmentally compatible.

Lower Elwha Klallam Tribe. Hydraulic and sediment transport studies have indicated that groundwater in the vicinity of the river mouth is hydraulically connected to the Elwha River; therefore, it is expected to rise in elevation as the river rises as a result of aggradation of the riverbed. It is estimated that the river water surface elevation could rise 2 to 5 feet (average of 2.5 feet) in the vicinity of tribal lands. Piezometric testing of wells in the Valley area indicates the ratio of river level change to groundwater change could be as high at 1:1. This means the groundwater could rise the same amount as the river level in some areas. Up to 109 tribal septic systems, and an additional 13 nontribal septic systems, could be rendered ineffective by rising groundwater following dam removal.

Because the tribe is growing, and because a substantial number of existing residences and structures in the Valley area will require upgraded treatment, the Lower Elwha Klallam Tribe has studied community wastewater treatment for the entire Valley community. Three alternative treatment and disposal alternatives were examined in detail — a community drainfield, a system for community treatment and disposal, and a connection to Port Angeles wastewater treatment facility (Berryman & Henigar 2003). The study found that the community drainfield would be inadequate for full build-out of the reservation, and that the community treatment option would have greater environmental impacts, potential public health impacts, cost, and maintenance than would the Port Angeles connection. The tribal community held three meetings to share information, to discuss the alternatives, and to vote on their preferred alternative; 57% voted in favor of the Port Angeles connection. A Port Angeles connection would require a vacuum collection system, a central pump to pump the wastewater, and 2.5 miles of pipeline to connect to the nearest Port Angeles sewer line. Existing drainfields would be abandoned, and the septic tanks would be filled with sand and overlaid with soil.

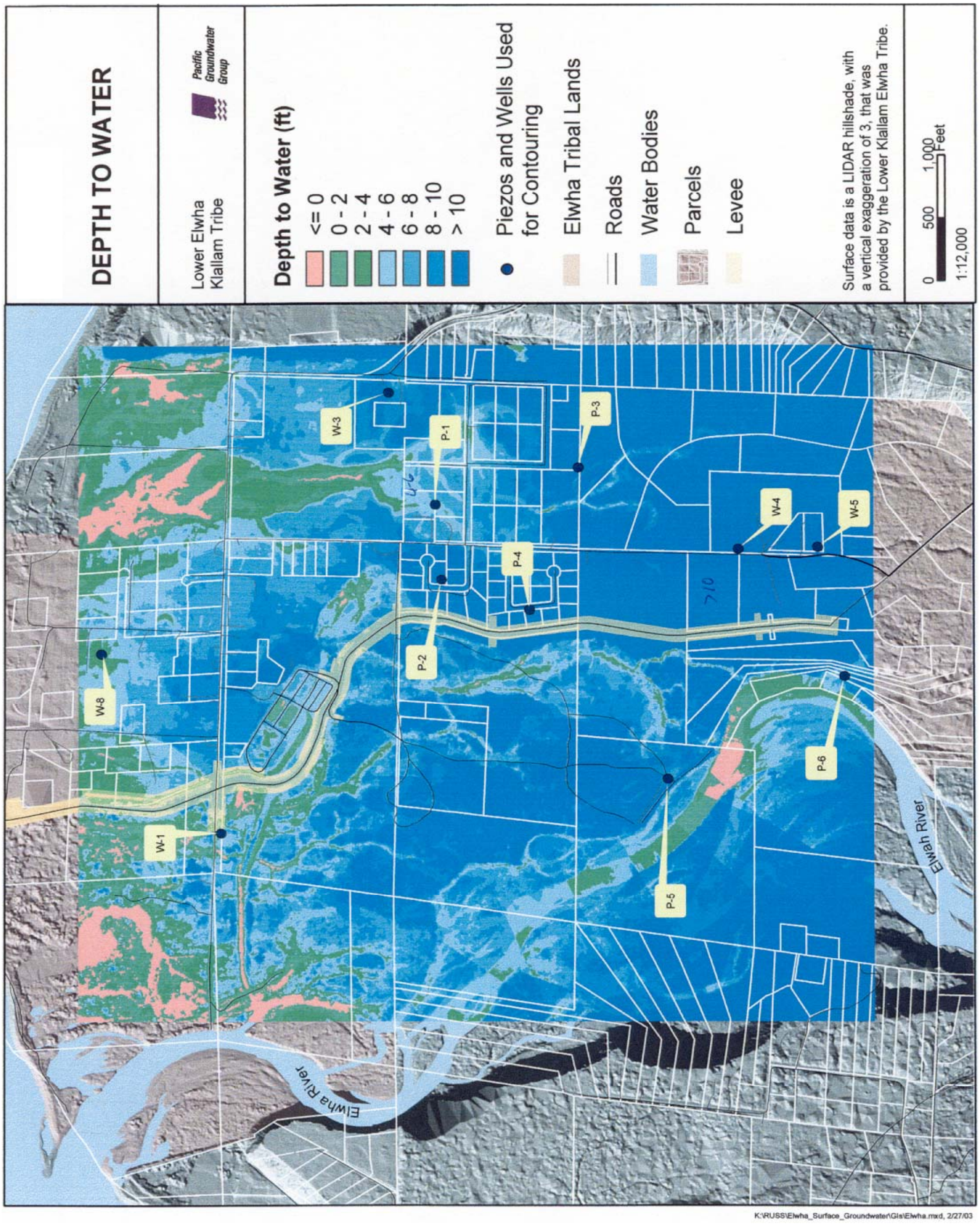
The central pump station (including a vacuum pump for the collection system and a lift station to initiate the force main conveyance system) would be in the central portion of the Valley community at an elevation above the lowest elevation home (5.4 feet above sea level) but no more than 20 feet above sea level. The collection system would consist of pipes from 4 to 6 inches in diameter that would generally run along existing streets and driveways. Terrain of the collection system is generally level, with a slope of 0% to 3% on soils with moderately low permeability.

The collection system would deliver wastewater to a pump station and odor control facilities that would occupy a building approximately 20 feet by 30 feet surrounded by chain link fence on an appropriate lot at a maximum elevation of no more than 25 feet above sea level (for example east of Stratton Road at the north end of North Hupt Lane). All considered sites have similar soils (of moderate permeability), are level or nearly level, and support a grassy vegetative cover without rare or endangered plants. Ground-disturbing activities should be monitored by an archeologist to ensure the protection of cultural resources. A 20-horsepower pump lift station location would pump wastewater in a 2.5-mile pipeline to the city's system along one of two routes:

- *Pipeline route 1* — After initially following Lower Elwha Road, the conveyance pipeline would travel along the existing roadbed under one lane of the pavement to the intersection with the Milwaukee Railroad right-of-way (owned by the City of Port Angeles). It would travel east along the railroad grade, across Dry Creek, and terminate at the point the grade crosses 18th Street, where it would connect with the city's sewer.
- *Pipeline route 2* — From the pump station the pipeline would extend south along Stratton Road to the Army Corps Road, then southeast to the toe of the valley wall. Here it would follow the route the tribe is considering as a new primary access route to the reservation and then traverse the Elwha Valley bluff to the Milwaukee Railroad right-of-way. It would then follow the railroad grade across Lower Elwha Road and across Dry Creek, terminating at the point the grade crosses 18th Street, where it would connect with the city's sewer.

A manhole at the city connection point and air scrubber units at both the pump station and discharge manhole would be installed. Scrubbers are typically 85-gallon drums set on a concrete pad, filled with filtering media and topped by a suction fan that pulls gases from belowground structures through the filter media. The pipeline would be sized to carry 300 gpm. The initial phase as planned for this project would serve existing tribal homes in the Valley with flow expected to be 21,000 gpd.

Thirteen homes on the northeast portion of the Elwha River delta outside tribal lands and within Clallam County could be added to the collection system or receive individual mound systems as possible mitigation for rising groundwater. Five of these homes are on property contiguous to the reservation on small parcels (1 acre or less) in an area of more intense rural development. Because 50% to 70% of each lot is on the steep valley wall, space could dictate mitigation through a community wastewater hook-up as the only practical solution. The most cost-effective alternative would be used to serve these homes and other more remote non-tribal homes.



Lower Elwha Valley Reservation Community Groundwater Resources

A meeting with the City of Port Angeles on September 20, 2002, indicated that a connection would be welcome because the city's wastewater plant is currently underutilized. On March 4, 2003, the Port Angeles City Council approved the concept of accepting wastewater from the Lower Elwha Reservation, and on March 6, 2003, it approved the easement along the Milwaukee Railroad right-of-way. The tribe hosted a meeting May 19, 2003, with state, county, city, and federal stakeholders to discuss the details of this interjurisdictional project. Final agreements are now in progress, subject to review by the Washington State Office of Community Trade and Economic Development and the Department of Ecology.

The crossing of Dry Creek could require additional permitting from the U.S. Army Corps of Engineers under section 404 of the Clean Water Act.

Construction-Related Impacts. Construction-related impacts include increased turbidity and possible contamination from fuels or lubricants, as described under "Surface Water." As a result, well water quality for downstream users could be temporarily degraded. Since much of this construction would occur before the dams were removed, pulses of turbidity might be detectable in some downstream wells, particularly between RM 3.3 and 2.8, where the majority of construction would take place. These wells include those associated with the WDFW rearing channel, the Port Angeles Ranney collector, and the Elwha Place Homeowners' Association (at RM 1.2). However, as noted in the discussion of construction impacts on surface water, best management practices would be used to stop nearly all soil or chemicals from entering the river at the construction sites. Some overflow could occur during storm events, but turbidities are not expected to reach more than 1,000 NTUs. This is within the range of turbidities experienced in the river now; therefore, impacts would be negligible to minor and would not be detectable very far downstream or for more than a period of hours or days.

Cumulative Impacts

Dam removal might cause short-term degradation of water quality in the alluvial aquifer. Over the long term groundwater levels would rise as a result of channel aggradation. Additional growth along the river or on the reservation would increase demand from groundwater resources.

Conclusion

The impacts of dam removal on groundwater include temporary increases in turbidity, manganese, and iron in wells, as well as an increase in river stage and associated groundwater levels in some areas. Without mitigation, users would experience minor to major impacts from dam removal. Mitigation for most wells would remain the same as that analyzed in the FEIS; however, the Dry Creek Water Association is considering an alternative well field and distribution system. Because additional homes beyond those identified in the FEIS would be affected by rising groundwater levels, the Lower Elwha Klallam Tribe is building a wastewater collection and pumping facility to carry wastewater to Port Angeles for treatment. With these mitigation measures, impacts from changes in groundwater following dam removal would be kept to negligible. No park values or resources related to groundwater would be affected by this alternative; therefore, no impairment would occur.

Native Anadromous and Resident Fisheries

Summary of Regulations and Policies

Fisheries management in the national park system is directed by policy and guidelines with roots in the NPS Organic Act of 1916 (16 U.S.C. 1 et seq.). The act directs the Secretary of the Interior and the National Park Service to manage national parks and monuments to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." These general powers were broadened by the Redwood National Park Expansion Act of 1978 (16 U.S.C. 79a-79q), in which the Congress gave further direction to the secretary to ensure that the management and administration of the national park system "shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by the Congress." Consistent with these broad authorities, current NPS fisheries management policies emphasize the preservation and, when necessary, restoration of natural assemblages of native species.

The National Park Service manages all park resources with an emphasis on protecting fundamental ecological processes, species, and communities. Fisheries management is focused on preserving or restoring the natural behavior, genetic variability and diversity, and ecological integrity of native fish populations. Management of resources and users in parks with anadromous or other migratory species must include provisions for the preservation of these species and their habitats inside park boundaries and for cooperation with other management authorities to ensure the preservation of populations and habitats outside the parks.

The restoration of depleted fish stocks and threatened or endangered species is a high priority for fishery management in the national park system. The restoration of native fishes often involves the control or eradication of nonnative or exotic species. The restoration of migratory fishes, such as Pacific salmon, may require the removal of barriers to upstream spawning areas or the restoration of freshwater wetlands to provide critical nursery areas. The development of new laboratory techniques for genetic analyses provides park managers with tools to identify and restore endemic fish strains. These techniques, when integrated with fish culture, improve the chances of restoring native fishes in natural areas of parks.

Other state, federal, and tribal agencies also establish fishery management policies and regulations affecting the Elwha River. For the Strait of Juan de Fuca fisheries, including the Elwha River, policies and regulations are established through the cooperative efforts of the Washington Department of Fish and Wildlife and various tribes, including the Lower Elwha Klallam, the Jamestown S'Klallam, the Port Gamble S'Klallam, and the Makah Tribes. The Lower Elwha Klallam Tribe administers tribal freshwater fisheries in an area from the Hoko River to Morse Creek, including the Elwha River.

The Pacific Fisheries Management Council is responsible for the management of all U.S. salmon fisheries in the Conservation Management Zone along the coastal marine waters of Washington, Oregon, and California, which could potentially impact fish stocks in the Strait of Juan de Fuca. Each year management guidelines are adopted by the Pacific Fisheries Management Council based on projected run sizes and fishery objectives.

Other state and federal regulations affecting fisheries include:

- *State Hydraulic Code (Revised Code of Washington [RCW], Chapter 75.20.100–140)* — Its purpose is to protect fish life from damage by construction and other activities in all waters of the state. It is carried out through a permit, referred to as the hydraulic project approval, obtained from the Washington Department of Fish and Wildlife.

- *Fish and Wildlife Coordination Act* — It requires that equal consideration be given to wildlife, including fish, when there is a proposal to control or modify any stream or other water.
- *Rivers and Harbors Act, Section 10, and Clean Water Act, Section 404* — These acts require U.S. Army Corps of Engineers permits for construction and disposal of dredged material in waters of the United States.

Methodologies for Analyzing Impacts

The impacts to fish of the mitigation facilities analyzed in this document are discussed in two sections, as are those on wildlife. This is because some species of fish and other wildlife are protected under the federal Endangered Species Act or by the state of Washington. The analysis of impacts to fish and wildlife with this special protection is covered in "Species of Special Concern." Fish without special status are discussed below.

Construction and operation of the water quality, water supply, or flood mitigation facilities can have impacts on fish. Fisheries management experts were consulted on the types and degree of impacts that the new protection and restoration efforts, as well as construction and operation of the water and flood mitigation facilities, might have on stocks in the Elwha River. Standard threshold definitions were applied as follows:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

Marine and freshwater harvest, ocean conditions, land use practices, water use, hydropower, flood protection measures, and stormwater management all have cumulative, or additive, effects on the status of fish populations. In the Elwha River the largest single factor affecting anadromous fish populations has been the construction and operation of the two dams. Building the dams had an immediate and devastating impact on the 10 runs of Elwha anadromous fish. The river went from producing more than 390,000 salmon and sea-run trout in 1910 (based on habitat available to the fish and fish production modeling) to fewer than 3,000 wild native anadromous fish today. Hatcheries now provide the vast majority of salmon and steelhead in the river, and existing stocks in the lower river unsupported by artificial propagation would decline to extinction under the no-action alternative.

Approximately 70 miles of the river's mainstem and its tributaries are assumed to have been available to anadromous species before the dams were built. All but the lowest 4.9 miles, or 93%, of this habitat was eliminated when Elwha Dam was completed in 1913. Steelhead and possibly other species could have traveled as far as 43 miles up the 45-mile main channel before encountering impassable stretches (James River II 1988). Carlson Canyon Falls at RM 34 may have blocked some species, depending on timing and condition of the fish. It is unknown but widely speculated that the relatively poor jumping ability of pink and chum salmon may have restricted them to the region below Rica Canyon (RM 16) (James River II 1988).

In the middle reach of the river the current quality and quantity of potential habitat are degraded because the Glines Canyon Dam has held back the gravels fish require for spawning (James River II 1988; WDF 1971). In addition, the 2.8 miles of the mainstem currently inundated by Lake Aldwell are wholly unavailable for spawning. The channel is also migrating less, resulting in less pool and side channel habitat that fish need to successfully rear.

The Elwha Dam has had a similar influence on habitat in the 4.9 miles of the lower river. In its present condition the Elwha's lower reach has limited salmon spawning and rearing areas due to shrinking gravel bars and fewer side channel habitats.

Spawning gravel and large woody debris important for cover during the rearing period are largely absent in both the middle and lower reaches of the river because of the dams. Particulate organic matter, which is required to sustain the invertebrates on which the fish feed, is present only in very low concentrations in both the lower and middle reaches. Water temperatures are $4^{o}C$–$8^{o}C$ higher on average during late summer and early fall because of solar heating of the reservoir waters.

Flood control activities in the late 1940s and early 1950s likely hastened the loss of lower river habitat. Bulldozers were used to straighten the river channel and build dikes, thus increasing river flow energy and reducing backwater habitat. In the Elwha, the federal levee has eliminated access to or quality of some side channel habitat. Where the river or side channels do flow, contact armoring along the levee slope could be adversely affecting the quality of spawning, rearing, and shelter habitat. Natural shade from riparian vegetation, woody debris recruitment, and sediment transport would be negatively impacted by rock armoring along these areas.

The dams have also reduced the size and complexity of the Elwha River estuary by as much as 0.5 square mile because coarse sediment and nutrient transports were blocked. This adversely affected anadromous fish, which use the estuary as a nursery.

Overall, the effects on anadromous fisheries of the Elwha and Glines Canyon Dams have been major, adverse, and long term.

Pink Salmon. The dams have also severely degraded or blocked traditional spawning grounds for pink salmon, which are believed to have used the first 16 miles of the mainstem of the Elwha River and 9.7 miles of tributaries. The substrate now available for spawning below the dams consists of embedded cobble that is of little use to pink salmon. The rock diversion structure at RM 3.5, which impounds water for the industrial intake, may be impassable by pink salmon at certain flow conditions. Juvenile fish passing downstream on the right channel at this location are swept into the surface water intake and are bypassed back to the river via the existing vertical fish screen and bypass facilities. Potential impacts from this screen and bypass system are unknown, although juvenile fish have been documented within the industrial pipeline (past the screens).

There has never been a hatchery program for Elwha pink salmon. In-river harvest has been negligible. The peak run to the river since 1959 was nearly 40,000 fish (in 1963), but the returns dramatically decreased in subsequent years. By 1989 surveys of the river did not find any spawning adult pink salmon. Returns in recent years (1999, 2001, and 2003) seem to be building slightly, although abundance remains at critically low levels. In 2001 several hundred pink salmon were observed to spawn. Under the no-action alternative Elwha pink salmon would not recover.

Chum Salmon. The historical upstream distribution of chum salmon is not known. However, chum are the poorest jumpers of all Elwha River salmon, and it is thought that chum used only the lower 16 miles of the river. Currently, the lack of spawning gravels in the lower river makes it largely unsuitable for chum, although they use side channel areas. Since chum salmon rearing occurs mainly in the estuarine or marine environment, the decreased size of the Elwha River estuary may have played a particularly critical role in reducing the population.

During recent years runs to the Elwha River have typically been less than 1,000 fish, with a peak of 1,500 in 1980. Recently, the Lower Elwha Klallam Tribe has been collecting eggs from chum salmon, fertilizing them, and burying them in egg trays in the gravel within lower Elwha River side channels near the tribal hatchery as a pilot project to maintain population numbers. Without hatchery intervention, this stock would likely remain at critically low levels and could eventually be extirpated under the no-action alternative.

Sockeye Salmon. All major stocks of sockeye require a river system with a connected lake. The only lake in the Elwha River drainage is Lake Sutherland, now inaccessible because of the Elwha Dam. Harvest records from 1982 to 1991 show an in-river harvest of only eight sockeye total over the 10-year period (Hoines 1994). These fish were probably strays and could have come from coastal (Ozette or Quinault), Puget Sound (Baker or Lake Washington), or Fraser River runs.

Under the no-action alternative sockeye in the Elwha River would not recover.

Steelhead. Steelhead numbers in the lower reach of the river are probably most limited by rearing habitat. The tribal hatchery releases an average of 120,000 hatchery smolts each year (PSMFC 1995) and about 3,100 adult fish return. Under the no-action alternative natural production would continue to decline; eventually, all steelhead production would become dependent on artificial propagation. Hatchery dependence would impact fish because of disease, genetic problems, and breakdowns, as mentioned above.

Cutthroat Trout. Cutthroat densities in the lower river (i.e., the anadromous component of the stock) have declined during the last decade primarily because spawning substrate quality is poor and the lower Elwha has limited amounts of the small tributaries with low gradient areas that this species requires.

Under this alternative numbers of cutthroat in the lower river would continue to decline or remain extremely low. Resident populations would continue where they are now found in the middle and upper reaches of the Elwha River.

Resident Rainbow Trout and Sturgeon. Rainbow trout are the most abundant game fish in the river and reservoirs above the Elwha Dam based on historical (Mausolf and Sundvick 1976) and recent surveys (Morrill and McHenry 1995; Collins 1983). The dams may have resulted in an increase in rainbow and other resident trout, as competition for food and habitat from anadromous species has been eliminated.

Factors that may be controlling rainbow populations below the Glines Canyon Dam include poor spawning gravel quality, which would affect abundance, and low food supply, which would affect fish growth and possibly survival.

The historical presence of sturgeon in the Elwha River is unknown. Factors controlling the Elwha sturgeon population are not known. Compared to other major sturgeon-producing streams, the Elwha River estuary is small and may limit sturgeon production.

Under the no-action alternative, resident rainbow trout would continue where they are now found in the middle and upper reaches of the Elwha River. Estuary habitat would continue to provide only minimal habitat for sturgeon.

Cumulative Impacts

Marine and freshwater harvest, warmer than normal waters, logging, development, water diversions, agricultural activities, removal of riparian vegetation, and bank hardening to protect roads and private and public property, all have a cumulative effect on fisheries. Dwindling salmon populations in spots along the entire West Coast are largely because of habitat loss or degradation. In the Elwha River the largest single factor affecting anadromous fisheries has been the construction and operation of the dams.

The impact of harvest and other cumulative actions is evident in reduced catches and the more frequent listing of anadromous fish species as threatened or endangered. As an example, the National Marine Fisheries Service (now NOAA Fisheries) proposed in March 1995 that wild steelhead runs from the Klamath River, California, north to Port Orford, Oregon, be listed as threatened under the Endangered Species Act because of population declines. The Puget Sound evolutionarily significant unit of coho salmon was declared a candidate for listing by the agency in 1995. Two stocks of Elwha anadromous fish — the bull trout and the chinook salmon — have been listed as threatened under the federal Endangered Species Act. Most other Elwha salmon and anadromous trout, including chum, pink, and sockeye salmon, as well as coastal cutthroat trout and Dolly Varden, have been listed as Washington State species of concern.

Cumulative effects on pink and chum salmon include the increased hatchery outplanting of juvenile coho, steelhead, and chinook, which may feed on newly emerged pink and chum salmon (Crain 1992; Fresh and Schroder 1987; Johnson 1973). Poor ocean conditions, little or no estuary habitat, and high water temperatures in the Elwha River also have adverse effects on pink salmon.

Some marine fishing of chum salmon takes place, as has in-river harvest. Reported tribal in-river harvest for 1985–95 ranged from 820 to fewer than 50 fish per year; no directed in-river harvest of chum has taken place since 1987. From 1988 to 1992 incidental catch of chum during other river fisheries averaged just over 100 fish annually (Hoines 1995). Ocean and British Columbia harvest of Elwha River chum salmon is considered minor, at less than 5% (WDF 1984).

Tribal in-river commercial fishery of steelhead averages 1,450 fish per year (PNPTC and WDFW 1994). Sports anglers harvest an additional 1,150 winter and 355 summer steelhead on average each year (PNPTC and WDFW 1994). Very few steelhead are harvested in the marine environment, largely due to a lack of fishing effort in saltwater during their return migration period (December through April). Steelhead also tend to stay close to the surface and near shore during their final marine migration, thus avoiding a majority of the commercial fisheries in Puget Sound and the Strait of Juan de Fuca (Graves, per. comm. Oct. 1995).

The impact of commercial fishing and sportfishing of salmon stocks extends beyond the national border since Pacific Coast fish produced in one area not only traverse the waters of many states, but are captured by Canadian anglers as well, and U.S. anglers capture fish produced in Canada. Because of this, harvest is managed on the international level through the Pacific Salmon Treaty, on the national level through the Pacific Fisheries Management Council, and on the local level through Washington State and treaty tribes. The purposes of the Pacific Salmon Treaty, which controls the number of fish of U.S. origin caught by Canadian anglers, are to "prevent overfishing and provide for optimum production" and to "provide for each Party to receive benefits equivalent to the production of salmon originating in its waters."

Regional, national, and international fisheries management has helped prevent overharvest of most stocks, although this sometimes occurs. Additional regional harvest reductions to protect runs would likely be sufficient to help restore the Elwha River if the dams were removed.

Conclusion

The Elwha Dam confines native anadromous fish to the lower 4.9 miles of river habitat and prevents their access to more than 70 miles of usable habitat in the middle and upper reaches of the Elwha River. The two dams degrade habitat in the lower river by increasing water temperatures to levels that contribute to disease outbreaks, trapping large woody debris important for instream cover, reducing nutrient flow necessary for invertebrate (food) production, and trapping spawning-sized gravels essential for successful natural reproduction. The trapping of coarse sediment and nutrients also adversely affects the size and quality of the estuary near the river mouth, which serves as a nursery for juvenile salmonids. In addition, the lack of bedload in the lower river prevents the formation of side channel habitat used by chum for spawning and coho for rearing. Elwha salmon have also been subject to a number of cumulative impacts unrelated to park management activities, including ocean fishing and hatchery production.

Under the no-action alternative there would be no new wild production of native anadromous fish, and hatcheries would continue to provide the vast majority of Elwha anadromous fish. Existing stocks in the lower river unsupported by artificial propagation would likely decline to extinction.

Overall, the effects on anadromous fisheries of the Elwha and Glines Canyon Dams have been major, adverse, and long term. However, because fishery resources in the Elwha River are not called out by the enabling legislation for Olympic National Park, or mentioned as a resource for which the park is deemed significant, no impairment to park resources or values would occur.

Background Impacts of Dam Removal

This information is from the Implementation FEIS and is presented as background to help make this document stand alone. As noted in other sections of the SEIS, the decision to remove the dams has already been made and formalized in a "Record of Decision."

Dam removal would result in temporary, high concentrations of suspended sediment and turbidity that would cause moderate, short-term habitat degradation and direct losses of fish in the middle reach of the river. More severe impacts, including avoidance by immigrating adults, would be seen in the lower river. The highest levels would coincide with each notch opening during dam removal and subsequent flood flows. Since fine sediment is expected to wash downstream quickly, that available for transport from the reservoir areas would rapidly decrease following dam removal. Some increases in suspended sediment concentrations and turbidity would be expected with high flows in the years following dam removal, but the portion attributable to fines from reservoir areas would decline with each subsequent high flow.

Between 4.9 and 5.6 million cubic yards of fine sediment would be released during and following dam removal, adversely affecting 16 miles of fish habitat from the upper end of Lake Mills to the river mouth for up to four years. However, sediment releases would be intermittent and of decreasing duration following dam removal. Peak concentrations of suspended sediment could exceed 50,000 mg/L during high flows or during drawdown. Between 1 and 3 million cubic yards of sand and coarser material also would be released from the reservoirs, causing abnormal bedload concentrations.

Modeling showed that the reservoir drawdown period would last an estimated 500 to 600 days, during which suspended sediment concentrations would exceed 200 mg/L 60%–70% of the time, 1,000 mg/L 40%–60% of the time, and 10,000 mg/L 1%–6% of the time (mg/L and ppm are nearly equivalent for concentrations up to 10,000 ppm) (Bureau of Reclamation 1996). While the dams were being removed, there would be three long periods of high sediment concentration separated by two periods of low sediment concentration. Following complete dam removal, two or three large spikes of suspended sediment concentration would be anticipated; these would likely occur during the high flows in the first fall or winter after dam removal.

Hatchery support, outplanting, harvest management, and optimal timing of dam removal would help protect anadromous fish populations during the dam removal process and accelerate restoration. These actions are required both to meet the restoration goals set out by the Elwha Act and to comply with Washington State regulations (State Hydraulic Code). They are described in the FEIS and remain unchanged except for chinook and bull trout, both of which have been listed as threatened species. The changes are described in the "Alternatives" chapter, and elaborated on in "Impacts to Species of Special Concern."

Impacts of the Proposed Action

Analysis

Construction Impacts. The primary impact to Elwha River fisheries from the actions described in the "Alternatives" chapter would be increases in turbidity associated with construction. Studies have found that direct effects of suspended sediments on fish begin to occur between 50 and 100 mg/L, while lethal and sublethal effects begin at concentrations of 10,000 mg/L for more than four days, or 1,000 mg/L for six weeks or more (see FEIS for more information and references). Chronic (more than six weeks) exposure to concentrations of 100 mg/L have been shown to adversely affect feeding and to cause reductions in growth rates, as well as avoidance and downstream displacement of individual fish. Adult anadromous fish may avoid concentrations greater than 350 mg/L, impeding upstream migrations (Brannon et al. 1981; Whitman et al. 1982). Stress, as measured by changes in blood chemistry, was reported in fish exposed for short periods to sediment concentrations as low as 50 mg/L (McLeay 1983).

As noted above under "Surface Water," all mitigation measures discussed in this SEIS, with the exception of the Port Angeles water treatment plant, would be built along the banks or very near the Elwha River. The majority of construction-related impacts would occur between RM 3.7 and RM 2.8. In this 0.9 stretch, from south to north, the following projects would occur:

- providing flood protection for (1) the existing DCWA well field; or (2) for an alternative well field site and access road on the opposite bank, plus a pipeline along one of five routes to distribute water from the alternate DCWA well field; or (3) a pipeline to connect the association to the city's municipal distribution system (RM 3.5–3.7)
- replacing the existing rock diversion structure with a new diversion and intake structure (RM 3.5–3.6)

- raising and strengthening roads and an in-river dike to allow access to the Elwha water treatment plant, Ranney collector, and WDFW fish-rearing channel (RM 3.3–2.8)
- building a ring dike around at least the Ranney collector and possibly more (RM 2.8)
- constructing the Elwha water treatment plant (RM 2.8–3.0)
- raising and strengthening an in-river training dike paralleling the rearing channel

Downstream from this stretch of river the following projects would take place:

(1) constructing a new tribal hatchery, wastewater pumping station, and distribution pipeline (RM 2.0)

(2) possibly raising and extending the federal levee on the east side of the floodplain both north and south (RM 0.1–1.6)

(3) raising or removing a private levee on the opposite side of the river (RM 0.0–0.1)

Heavy equipment would be used for virtually all of this work.

To the extent possible, these facilities would be constructed in the two dry seasons before dam removal began in order to avoid impacts to fish. Best management practices would be applied during construction to minimize soil lost to the river and increases in turbidity; however, some increases in turbidity would inevitably take place when the river refilled during the fall and winter. If construction exceeded the dry periods, turbidity, fuels, lubricants, and chemicals could threaten water quality and fish for short periods of time, such as during high storm events. Because turbidity would already be higher than normal during these events, the washing into the river or side channel of loose soil or other pollutants might not be a detectable change. However, if an accidental release took place, a pulse of increased turbidity would be noticeable.

In addition to construction work near the river, some in-river work would be required to replace the diversion and intake facility, to install or replace some flood control measures, and possibly to lay pipelines. Sediment release from these activities could be minimized by working during low-flow or dry seasons, or constructing a cofferdam or other barrier, but eventually a pulse of sediment would be released downstream. In addition, a temporary channel would be built to divert water around the site of the weir control and water intake so construction could take place in the river channel for a longer season. The channel might also serve to reduce impacts to fish. Because river substrate below the dams is primarily embedded cobbles rather than fines, sediment release would be less than in a similar undammed river. The rock diversion structure also has accumulated gravels that would be released when the dams were removed. This would cause a loss of spawning sized gravel from behind the dams, a minor, short-term, adverse impact to fish using this gravel for spawning. The gravels would be replaced following dam removal.

It is unlikely that fish would experience turbidities related to construction of more than 1,000 mg/L. This is a sedimentation level already experienced during storm events in the Elwha River, with no known or apparent increases in morbidity or mortality among fish. If a storm added sediment from upstream, turbidities could be higher in the vicinity of the mitigation facilities during construction, up to a maximum of about 2,000 mg/L. As noted above, these turbidity levels can affect fish feeding and behavior if they occur over a longer period of time (more than six weeks). However, because theses levels should not last more than a few hours or days, only negligible to minor localized impacts, confined to the lower 3.7 miles of the main river stem, are expected.

These same types of construction-related impacts are possible on Morse Creek, where temporary chinook-rearing facilities are planned as backup to Elwha production. The Washington Department of Fish and Wildlife estimates four rearing ponds would be needed. Again, although best management practices would be followed, Morse Creek is home or potential habitat for anadromous steelhead, cutthroat, coho, pink, chinook, and chum salmon, as well as resident cutthroat and rainbow trout. Because turbidity impacts would be temporary and within the range normally experienced on Morse Creek, pulses of turbidity related to construction are not expected to have more than a negligible to minor impact on fish stocks.

In addition to increases in turbidity, construction could remove riparian vegetation or prey used by fish species. In-stream work particularly would disrupt the riverbed and any invertebrate prey. However, this impact is expected to be of short duration as aquatic invertebrates rapidly recolonize relatively small, depopulated areas (Somer and Hassler 1992). Overhanging vegetation would regrow for the most part following construction, although permanent loss of streamside habitat would be likely at the diversion and intake site, as well as along the access road. Other permanent, localized losses of this type of fish habitat are also possible if roads or an access was built down to the river's edge, or if the ground level was raised for wellheads (such as either DCWA well field). Because the losses would be localized, they would likely only have minor adverse effects on fish species.

As noted above, juvenile anadromous fish have difficulty navigating the rock diversion structure and intake facility at RM 3.5. Juvenile pink and chum salmon, because they are very small, have a particularly difficult time with this barrier to upstream navigation. Even adult pink and chum salmon might not be able to clear the dam during some flow conditions. Most juvenile fish passing downstream on the right channel now are swept into the surface water intake. Although most are bypassed back to the river by way of an existing vertical fish screen and bypass facility, some injury or mortality can result. A new intake facility designed for a location about 225 feet upstream from the current location would incorporate state-of-the-art fish screen and bypass facilities, resulting in less injury and impact and greater bypass success.

The planned control weir and Elwha surface water intake upstream from the rock diversion structure would be built with several features designed to minimize impacts to fish. These include designing a section of the control weir to reduce flows passing by the intake structure, a modified section of river downstream from the control weir to provide a roughened channel that would mimic a natural river reach and allow for fish passage, a fish screen, and a bypass facility. Compared to the rock diversion structure, this control weir and intake facility would have a moderate, beneficial, long-term impact on pink and chum salmon, and a negligible to minor, beneficial, long-term impact on other anadromous stocks in the Elwha River.

Federal levee mitigation activities would occur outside any active river channels. However, in recent years a historic side channel has periodically activated during moderate flood events and made contact with the midsection of the existing levee near the hatchery. Consequently, the existing levee could be armored with 2-foot rock from the top of the 3,750-foot levee (river side) to the elevation of the river thalweg to address this channel and any future shift in the mainstem. Proposed levee extensions include a 450-foot northern extension to the beach berm and 600- to 1,600-foot extensions or spur dikes on the south end of the reservation. These extensions could also include 2-foot rock armoring from the top of the levee to the elevation of the river thalweg. As noted in the FEIS, replenishing the riverbed with sediment would restore fish spawning, breeding, and rearing habitat in the river. It would also mean the return of a more dynamic river that moves across the floodplain or that creates more side channel habitat. Where flood control structures, such as the 1.5-mile levee, block the meander of the river, these benefits from dam removal would be more limited. In addition, the natural shade, habitat complexity, and woody debris recruitment that could take place in a relatively flat and wide portion of the river, such as along the levee, would not be part of the ecosystem here because of the unnatural slope, rock armoring, and maintained face of the levee. The extensions north and south would exacerbate the impact the levee would have on fish habitat after dam removal. Options of mitigating these potential impacts, such as large woody debris placement, are being investigated.

Operations Impacts. Operating the Elwha water treatment plant would require the use and disposal of treatment chemicals, including alum and polymers, in the form of settled solids. As high turbidity would often correlate to high flow conditions, the system would remove the most sediment at the highest river flows, and the return of settled solids would not induce a measurable increase in downstream turbidity. However, even during lower flows, the solids portion of flow returned to the river would be small compared to the average river flow, and impacts to fish would be negligible or minor.

In addition to sediment, the solids returned to the river from the Elwha water treatment plant include coagulants containing alum. Disposal would result in acute doses of aluminum of up to 0.75 mg/L, and chronic doses of up to 0.087 mg/L. The polymer used by the Elwha water treatment plant to coagulate solids is polyacrylamide (PAM). It has been shown to have adverse effects on fish at doses of 300 mg/L. Recent tests have shown no adverse effects on aquatic life at 10 mg/L and have indicated that the addition of sediments to PAM reduces toxicity (URS 2002c). The use of PAM at the Elwha water treatment plant is expected to be less than 10 mg/L, and probably in the range of 1 to 5 mg/L. The residuals are also going to be at their highest volume when dam removal is ongoing. During this period, aquatic invertebrates and fish would experience very high mortalities, and the disposal of additional solids, alum, or PAM would not have much additional effect. Ultimately, high river flows would disperse this material within the marine environment to levels that would not be toxic or otherwise adverse.

As the dewatered reservoirs stabilized upstream over time, turbidity would return to pre-dam conditions, varying between 0.1 and 3,000 NTUs. This is expected to occur within six years of the dams' removal (see Table 17, page 110). Because turbidities would be ever lower in the river, the volume of treatment residuals would also continue to decrease. When turbidities have stabilized to the range expected under pre-dam conditions, it is anticipated that facility ownership would transfer to the City of Port Angeles. Treatment residuals would likely be put in a landfill at that time.

Operation of the hatcheries would also contribute organic material and low concentrations of chemicals (e.g., formalin) used to keep fish disease free to surface water, as they do now. However, fish do not show any impact now from these releases, and they are not expected to be affected by continued use.

It is possible that actions associated with fisheries mitigation or revegetation could also have temporary adverse effects on water quality before, during, or for a period of three to five years following dam removal. For instance, heavy equipment could be used to grade the reservoirs, move heavy debris, arrange logs, etc. The National Park Service may need to apply herbicides, fertilizers, and soil treatments, such as mulch or other additives. These actions could result in the same kinds of impacts as described above (i.e., increases in turbidity or small concentrations of fuels or chemicals). Using best management practices would minimize the impacts of these activities, but impacts to fish could still be negligible or minor. Fish species most likely to be affected would be those rearing year-round in the river, including juvenile coho salmon, rainbow and steelhead trout, and bull trout (see "Species of Special Concern").

Cumulative Impacts

The same adverse cumulative impacts described for the no-action alternative would apply to the proposed action. However, anadromous fish species would also experience major adverse impacts initially and then major long-term benefits from dam removal and the restoration of spawning and rearing habitat to pre-dam conditions under this alternative.

Conclusion

Fish in the Elwha River or Morse Creek could experience some short-term pulses of turbidity from accidental releases at construction sites, during storm events, and from in-river work. The impacts would be short term and negligible to minor. Additional negligible to minor impacts from the short-term or permanent loss of streamside vegetation as fish habitat would be possible from construction, as well as from extending the federal levee. Replacing the rock diversion structure would cause temporary, minor, adverse impacts from turbidity and the loss of spawning gravel, but it would ultimately result in minor to moderate benefits for anadromous fish because of the installation of fish passage and state-of-the-art bypass facilities. Operation of the Elwha water treatment plant would have no more than negligible additional effects from the release of solids and coagulation chemicals over impacts from dam removal, which would occur simultaneously with these releases. Cumulative major adverse impacts from sediment released during dam removal over a three to five year period would occur. Long-term cumulative impacts from ocean fishing, climate changes, and hatchery production would continue. No impairment of park fish resources would occur as a result of the mitigation activities described in the proposed action.

Soils

Soils in the project area have experienced a variety of impacts related to the construction of the dams, roads, utilities, fish hatcheries, and residential development. Please refer to the "Affected Environment" chapter for a description of the soils that occur in the study area.

Methodologies for Analyzing Impacts

Data from NPS and consultant's reports, as well as the "Soil Survey for Clallam County Area," (SCS 1987), were reviewed in order to assess impacts to soils within the study area. For this analysis, impacts and benefits of proposals are described in terms of intensity and duration. General definitions related to intensity and duration of impacts to soils are presented below.

Negligible — The impact would be barely perceptible or measurable; it would be confined to small areas.

Minor — The impact would be perceptible, measurable, and localized.

Moderate — The impact would be clearly detectable, and it could have appreciable localized effect on the resource and the potential to become major.

Major — The impact would have a substantial, highly noticeable influence on the resource over a large area.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or

- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

It is likely that the construction of the Elwha and Glines Canyon Dams and the resulting reservoirs created major adverse impacts to soils in the area addressed in the 1996 FEIS both because of the size of the project and because large construction projects in the early 20th century did not typically employ measures designed to protect resources. Construction activities at and around the dam sites and the filling of the reservoirs resulted in major changes to soils, including displacement, filling, compaction, and inundation.

Implementation of the no-action alternative would continue these large-scale, adverse impacts to soils, and no mitigation measures would be taken to protect downstream users from water quality or other adverse effects. Under the no-action alternative the redistribution of sediments up and down the Elwha River and the revegetation of the portion of the river now inundated by the reservoirs would not take place.

The continuing use and maintenance of roadways and other developments that support dam operations contribute to ongoing soil erosion, particularly in areas characterized by steep and/or unstable slopes. However, as a result of the use of appropriate drainage, slope stabilization, and erosion control measures in maintenance and improvement activities (currently required by federal, state, and county regulations), it is likely that localized, long-term impacts to soils would be minor in intensity.

Several facilities would continue as they are now. These include the DCWA well field and access road, the existing WDFW fish-rearing channel, the industrial channel and the Port Angeles Ranney collector and treatment facility at RM 2.8–3.0 (and the access roads), the access to and development of the existing rock diversion structure, and the development of the tribal hatchery. In addition, many thousands of cubic yards of soil were displaced from the east side of the Elwha River to build the 1.5-mile-long federal levee and private levee at the river mouth. Each of these has already had some impact on soils.

Cumulative Impacts

Developments on the slopes of roads or other facilities have often been at risk of landslides or other soil loss due to the relatively saturated nature of the soils in the area. In addition, other developments at the dam site or in the study area, including residences and utilities, have resulted in the removal and in some cases destabilization and loss of soils.

Conclusion

Building the dams and inundating the reservoirs resulted in major changes and adverse impacts to soils as a result of excavation, compaction, and inundation. These impacts would continue, as would minor to moderate impacts from several existing facilities. Because the affected soils are not parkwide, the effects would not result in an impairment of park values or resources.

Impacts of the Proposed Action

Analysis

The types of impacts on soils include:

- *Erosion* — the loss of soil from a site or its natural location, typically through wind, rain, gravity, etc. Erosion is a common impact resulting from ground disturbance activities associated with development and is hastened by clearing and grading activities.
- *Displacement* — stockpiling or removing soil from its natural location, typically resulting in the loss of the nutrient surface layer and soil profile/structure disruption. Activities that result in displacement include ground disturbance such as excavation, grading, and drilling.
- *Compaction* — compression of soils. Compaction can cause reduced water infiltration / permeability, decreased water storage capability, reduced aeration of the soil, and increases in surface runoff and soil erosion (Cole and Landres 1995). The use of heavy equipment can result in soil compaction.
- *Filling* — introduction of new materials over existing soils, typically to raise or level grade.
- *Contamination* — introduction of toxic/hazardous materials to the soil. The presence of toxic / hazardous materials associated with facility and construction equipment operations increases the likelihood of accidental soil contamination. Leaks and breaks in equipment and hazardous material containers can contaminate soils as well as adjacent vegetation and waterways, although standard best management practices (including frequent machinery inspections and the implementation of established emergency procedures for spills) substantially mitigate the possibility for adverse effects to soils by contamination.

In addition, the timing of construction activities could substantially mitigate impacts to soils in the study area. Soils are most susceptible to damage during spring when they are saturated and easily disturbed. Avoiding areas prone to adverse soil impacts during these times can mitigate potentially harmful effects to soils. Best management practices would be implemented during implementation of the proposed action (see appendix A).

Proposed actions with the potential to impact soils would include the following:

- water quality/supply mitigation for industrial customers and fisheries, the Port Angeles municipal water supply, and the Dry Creek Water Association
- flood control mitigation and Lower Elwha Klallam Tribe wastewater treatment
- fish restoration
- revegetation

Water Quality / Water Supply. *Industrial Customers and Fisheries* — Proposed mitigation measures related to industrial customers and fisheries include design changes to the Elwha water treatment plant, removal of existing diversion and intake structures, construction of new diversion and intake structures, and construction of new distribution pipelines. Their description and potential impacts to soils follow.

Soils in the vicinity of RM 2.8–3.0 would be graded, removed, and compacted through the use of heavy equipment to build the Elwha water treatment plant, splitting structure, pipelines to the hatchery and the Port Angeles water treatment plant, and other smaller scale support features for the treatment plant or the rearing channel. The rearing channel would remain in place, and the Port Angeles Ranney collector would be floodproofed. New wells to support the use of the rearing channel during dam removal would be drilled. In addition, the portion of the access road to both the Ranney collector and the rearing channel buildings (which parallels the rearing channel) would be strengthened and elevated in some spots.

Potential impacts to soils as a result of these actions include vegetation clearing, grading or excavation, compaction, filling, and contamination. Soil loss from excavation and grading would be a permanent impact, and compaction from heavy equipment would be a long-term impact, but other impacts would be temporary and could be mitigated. Heavy equipment expected to be used on site includes excavating equipment, concrete trucks, flatbed equipment and delivery trucks, power utility trucks, trash trucks, and worker transportation vehicles. Up to 50 truck trips per day would be required to complete construction of the Elwha water treatment plant. Compaction of soils from the use of heavy equipment for construction would result in minor, site-specific impacts, but the effects would be long term in duration.

The use of heavy construction equipment, as well as the transport, use, and storage of chemicals (such as alum, polymers, and caustic soda) at the new plant, could result in soil contamination as a result of spills or leaks. Such impacts would most likely be site-specific, negligible to minor, and short term as long as appropriate spill cleanup and remediation procedures were employed (see appendix A). Erosion of loose soils during construction would also be likely. The use of best management practices, such as berming the site to capture eroded soils or fuel leaks, would mitigate these effects. Construction contractors would be responsible for erosion control plans; resident construction inspectors would monitor their effectiveness and would alert the contractor of problems. If the best management practices were effectively implemented, soil erosion and contamination could be minimized to negligible to minor, site-specific, short-term impacts. Timely and appropriate revegetation of the construction areas would further minimize erosion at the site.

The removal of the existing rock diversion structure and intake structures at RM 3.5 would require earth-disturbing activities to be conducted in the water as well as on the streambank, where erosion would be likely. The use of heavy equipment to remove the structures would have the potential to result in soil displacement, erosion, and contamination. The appropriate use of erosion control techniques as addressed in the best management practices (appendix A), coupled with the likely state and federal permitting requirements for erosion and sediment control for work in and around water, would limit the adverse impacts to soils in the area to minor, site-specific, and short term.

Constructing a new control weir and intake structure 225 feet upstream of the existing rock diversion structure would have similar effects as the removal of the existing facilities. A cofferdam would be used to construct new facilities “in the dry” and to the extent it is possible, work would be completed during lowest flow conditions. However, excavation of the streambed and area where the control weir would tie into both the east and west banks of the river would be required. Excavated soil would be permanently lost; however, since the loss would be localized, the impact would be minor. Implementation of best management practices and reseeding where possible on the riverbanks and along the associated pipeline or access routes would keep impacts from erosion to a minimum.

Construction activities at both of these in-water sites would require state and federal permitting, which could include conditions beyond the best management practices designed to minimize soil erosion and water quality impacts. These efforts, coupled with the monitoring activities of the construction inspector, are expected to result in minor, site-specific, short-term impacts to soils. Timely and appropriate revegetation of the construction areas would further minimize erosion at the site.

Municipal Customers — The proposed Port Angeles water treatment plant would be on the southern end of the city’s existing landfill site, which is scheduled for closure in 2006. This approximately 14-acre site has undergone substantial modification, and it currently contains a borrow pit, piles of yard waste and mulch, two stormwater detention/sediment settling ponds, one 1,000-gallon underground storage tank (related to dewatering of biosolids), and asphalt-paved and dirt access driveways. A single-story metal frame and shell structure used for storage and processing treatment plant biosolids and composted yard waste is also located on the southwest portion of the property (URS 2002a). The topsoil in the northern section of the site has been bladed off, exposing sands and gravels, while the central and southern portions are covered by topsoil with some vegetation (URS 2003h). Construction debris from demolition of a grocery store was buried beneath the western potion of the site, although no evidence of this is apparent today. No evidence of hazardous materials or wastes was found during a 2002 survey of the site (URS 2002a).

In general, the soil profile at the site consists of 2 to 5 feet of fill soil of variable nature and condition underlain by a native deposit of dense silty sand and gravel to a depth of at least 40 feet. The native soil appears to be glacial outwash or glacial drift. The central and southern portion of the site is covered with 1 to 2 feet of topsoil consisting of black silt with root mats. Along the northern portion of the property this topsoil has been stripped away. Samples near the future sludge drying beds indicate low permeability. The soil is generally dense, and liquefaction during a seismic event is not anticipated. On-site soils are generally re-usable as fill for the recycle storage pond.

Potential impacts to soils at the proposed water treatment plant site include displacement (grading, leveling), compaction, contamination, and filling activities, all of which could create adverse impacts to soils. These impacts could occur at the actual construction site, as well as within offsite staging and access areas, should any be necessary. Compared to the substantial impacts from past development, effects from construction on disturbed soils would likely be negligible to minor and site-specific. The soils at the site are considered slightly or moderately erodible (URS 2003e). On- and offsite erosion impacts could be minimized through the use of appropriate drainage and erosion control techniques and regular monitoring (see appendix A).

The use of heavy construction equipment, as well as the transport, use, and storage of chemicals at the completed treatment facility, would both carry the potential for soil contamination through spills and leaks. Alum, caustic soda, and sodium hypochlorite would be stored on site and used to treat municipal water. Standard design practice provides for both structural and operational containment of spills wherever the chemicals are stored or used. This is generally accomplished by grading the floor surface, providing small berms around equipment, providing storage for absorbent materials immediately nearby, as well as other measures so that there would be no escapes under normal circumstances.

The best management practices specifically address such accidental contamination. During construction, hazardous spill cleanup materials would be on site at all times, and machinery maintenance would be conducted well away from the river. Prior to starting work each day, all machinery would be inspected for leaks, and repairs would be made before the equipment was used again. Impacts to soils would likely be site-specific, negligible to minor, and short term if the contamination was quickly contained and remediated. In addition, a process control and monitoring laboratory on site once the plant was operational would further decrease the possibility of chemical contamination of soils.

Dry Creek Water Association — As noted in the “Alternatives” chapter, three options are available for the Dry Creek Water Association during and following dam removal:

1. Floodproofing Existing Well Facilities: Constructing floodproofing features, such as raising the existing well field and access roads, would involve ground-disturbing activities (soil displacement, vegetation clearing, erosion, filling, compaction, etc.). However, due to previous disturbance (grading) at the well site and along the access road, impacts to soils would probably

be site-specific, negligible to minor, and long term under this option. In addition, the implementation of best management practices would further minimize impacts to soils.

2. <u>Constructing an Alternative Well Field</u> — The alternative well field location is on a low terrace on the west bank of the Elwha River. Much of the area consists of exposed cobbles scoured by the Elwha River, with small areas of sediment and vegetation (URS 2002b). Use of this site would require the floodproofing of any building structure (new control and chlorination building, new electrical supply), wellheads, and access roads (all to be elevated above the 100-year flood). Building structures might be located on the hillside above the 100-year flood area. Drilling, access, and staging activities could result in soil displacement (grading), vegetation clearing, filling, and drainage improvements along the access road. Typical well construction could include the use of a variety of heavy trucks (well drilling, premix concrete, flatbed pipe, equipment delivery, power utility, trash, and worker transportation), all of which could cause soil compaction. As the area is situated in a floodplain which either now sustains substantial scouring or would increase following dam removal, impacts to soils as a result of using this site would probably be minor, site-specific, and long term.

   Selection of this option would also require the demolition of the existing well field and facilities, as well as raising or removing an adjacent residence and septic system. Demolition activities, particularly with the use of heavy equipment, would have the potential to cause erosion, displacement, and compaction. If appropriate erosion control methods were employed, impacts from this action would likely be negligible to minor and site-specific. Where appropriate, revegetation of the disturbed area would further minimize impacts.

   In addition, a new distribution pipeline would have to be constructed. Five optional distribution routes are currently being examined (URS 2003a). All of them would result in impacts to varying degrees related to slope stabilization, erosion, soil displacement (trenching), filling, vegetation clearing, and soil contamination (at construction sites and staging and access areas). Depending on the route selected and the methods of construction, adverse impacts to soils could range from minor to moderate. Appropriate use of drainage and erosion control techniques, as well as the implementation of the best management practices (appendix A) and onsite monitoring, could minimize impacts to soils. If the pipeline was constructed in an existing road right-of-way, impacts to soils would be negligible, localized, and long term.

3. <u>Connecting to the City of Port Angeles Water System:</u> This option includes the construction of a pump station and installation of 3,000 feet of waterline, both of which would be in the Airport Road right-of-way (URS 2003a). No access improvements are anticipated, although road repairs might be necessary as a result of installation. Due to the impacted nature of the Airport Road right-of-way, this option would result in negligible, site-specific impacts to soils.

Flood Control. During the original construction of the federal levee in 1988 a gravel road was built from the southern terminus of the levee southeast to the valley bluffs. As described in the “Alternatives” chapter, one option for providing existing levels of flood protection for residents and for the tribal fish hatchery following dam removal would be to modify this road as a flood control facility sufficient to resist outflanking of the river. The levee might be extended south along an existing terrace or be extended as a series of spur dikes and deflection structures. The levee would also be extended north to provide protection from an increased flood stage for residents near the mouth of the river. A large section of the levee would need to be reinforced to withstand erosion forces from the river once sediment was restored to this part of the floodplain. Across the river from the northern portion of the federal levee, modifications to a private levee to maintain existing flood protection would be needed. Raising and strengthening, or removing the levee and raising homes, are options for this area.

Each of these actions would involve impacts to soils through excavations and grading, but primarily from filling and the compaction of filled material. Strengthening or raising the levees would be conducted in areas where soils have been previously modified. In this case, impacts to soils on site are expected to be negligible and site-specific, although impacts to borrow pits where additional soil would be taken could be more substantial. Extending the levee to the north and south would cross land where such disturbance currently does not exist. The impact to the soils would be clearly noticeable along the river side, where an armored toe would be installed to the elevation of the river thalweg. Because impacts would remain localized, they would be moderate, but would be very long term or permanent. Compaction of soils underneath the extended levee would also be a permanent or very long-term impact. Some of the gravel used to extend the levees would likely come from borrow pits, primarily those within a 25-mile radius of the building site. The volume of gravel needed to provide current levels of flood protection by extending the federal levee to the north and south, and to extend the private levee a few hundred feet would depend on the selected alternative. Use of appropriate drainage and erosion control measures (see appendix A) would minimize the potential impact to soils. Existing levee access roads would be maintained.

The impact to the soils in these areas would probably be no more than minor, however, as they would primarily be covered, rather than excavated or removed, and the extent of the impact would remain localized.

Lower Elwha Klallam Tribe Wastewater Treatment. As noted in the "Alternatives" chapter, additional development on the reservation and the expected rise in groundwater tables following dam removal have led the Lower Elwha Klallam Tribe to decide to hook up with the Port Angeles treatment facility. A collection system would send collected wastewater to a pumping facility east of Stratton Road (see the "Proposed Wastewater Alignments" map, page 36). From here, a pipeline would carry the wastewater to a connection point with the city's sewer. As with other construction projects identified above, installing a collection system and approximately 2.5 miles of pipeline would result in the excavation and removal of soils. To minimize soil compaction, excavation would occur to the extent possible during the dry season. On the valley floor alluvial soils range from Puget Sound silt loam to typic xerofluvents. On the bluffs glacial till soils (predominantly Clallam) have a compacted hard pan layer ranging from 20 to 40 inches thick and lying approximately 28 inches below the surface. The filling of existing septic systems with sand could have some localized negligible to minor benefit to soils.

It is possible, but unlikely, that the pipeline could malfunction during its lifetime, with resulting contamination of the surrounding soils. Construction setback between the wastewater and drinking water pipelines and pipe design specifications would comply with the Washington State Department of Ecology standards. Pipeline construction activities would comply with Clallam County stormwater regulations off the reservation and would be consistent with those regulations on the reservation. Due to the belowgrade construction, surface environmental impacts would be short term and minor.

Actions Related to Fish Restoration. Since the publication of the 1996 FEIS, the bull trout and Puget Sound chinook salmon have been listed as threatened under the federal Endangered Species Act. As a result, additional mitigation measures for the fish are now required, some of which have the potential to impact soils within the study area.

To ensure stock production of the chinook salmon, some hatchery operations would be shifted to Morse Creek during dam removal, including the annual installation of an adult capture weir (fish trap) likely located 1,000 to 3,300 feet downstream of U.S. 101. This activity could involve the construction of structures at the new site, along with any required access roads and staging areas. These actions would likely involve vegetation clearing and soil displacement (grading, minor excavation), which have the potential to adversely impact soils in and around riparian areas. The magnitude of impacts would depend on the methods employed, equipment used, and activity location. Implementation of best management practices would likely result in negligible to minor, site-specific, and short-term impacts on soils in the area. It is also likely that Washington State and federal permitting requirements would include conditions that substantially limit the potential for erosion and sediment transport, further mitigating the impacts.

Mitigation measures included by the U.S. Fish and Wildlife Service in its "Biological Opinion" for the incidental take permit for bull trout require the replacement or modification of Hot Springs Road culverts that limit/block access to tributaries that could be used by the fish (USFWS 2000). These actions would involve vegetation clearing and grading/excavation activities, with the potential to adversely impact soils at these sites, primarily through erosion. Depending on the method of construction, the equipment used, and the location of these activities, the potential for minor, site-specific adverse effects to soils exists. Best management practices, on-site monitoring, and revegetation of the impacted area would further mitigate these effects. Moreover, state and federal permitting requirements for work in and around waterbodies would likely also reduce the potential for soil impacts.

Options for continuing to provide tribal fish hatchery support for fish restoration include modifying the existing location or building a new hatchery on the Halberg property. Soils just to the north of this addition were surveyed and found to be Puget silt loam underlain by permeable, gravelly coarse sand. The soil is quite permeable and ranges from a few inches to several feet thick (Berryman & Henigar 2003). As with other construction activities, either adding on to the existing hatchery and improving drainage, or building a new facility, would require excavation. A new facility would require grading, and heavy equipment would result in compaction and possibly some small contamination of soils from fuel leaks or spills. Erosion at the construction site would be likely, but best management practices would contain eroded soils and minimize any erosion that did take place. Impacts would be minor because of the implementation of these practices.

Actions Related to Revegetation. Since the publication of the FEIS, studies show that more intense revegetation efforts might be required than originally believed (e.g., manual labor might be inadequate). The proposal for a greater use of mechanized equipment and additional helicopters for revegetation has increased the potential for soil impacts in the area because additional ground disturbance is likely.

The use of heavy equipment and helicopters to apply soil amendments, transport crews, and perform other actions might require construction staging areas, access roads, and/or landing pads. Clearing vegetation, grading, or filling in these areas could result in adverse impacts of unknown magnitude to soils, depending on location. Implementation of best management practices during construction, including onsite monitoring of earth-disturbing activities where appropriate, would mitigate these effects to minor, site-specific, and short term.

Cumulative Impacts

Cumulative impacts of an unknown magnitude, possibly minor to moderate in intensity, are possible as a result of proposed mitigations. These ongoing effects would be long term and local to possibly regional in scope. A beneficial impact is that the city would not need to import soil to help close the landfill facility since that material would be mined on site and stockpiled prior to construction of the municipal treatment plant and the city's planned solid waste transfer station.

Conclusion

Nearly all proposed mitigation activities would result in some type of ground-disturbing impact to soils. Impacts from excavation and removal of soils would be permanent, but because they would be confined to either particular locations or because the removals would occur in already disturbed areas, they would primarily be minor in intensity. Some pipeline routes proposed for the Dry Creek Water Association and possibly for the transmission of wastewater from the Lower Elwha Klallam Tribe could have up to moderate effects from the removal of soil because of their length or location. Installing a toe to strengthen the federal levee would result in moderate localized impacts. Compaction of soils from heavy equipment at the Elwha and Port Angeles water treatment plant sites, as well as from extending the federal levee to the north and south, would also be very long-term or permanent impacts. These would be localized and minor as well. Erosion, which would occur at nearly all construction sites, and contamination, which would be possible from fuel leaks or transport or use of treatment chemicals at the Elwha and Port Angeles water treatment plants, would be minimized through the use of best management practices and a spill response plan. With best management practices in place, impacts to soils from erosion or contamination would be minor, site-specific, and temporary.

Cumulative impacts of the proposed action as a result of new facility development would likely create minor impacts to soils, primarily in its ongoing contribution to erosion.

The proposed actions would not result in impairment to any park soils.

Vegetation

Summary of Laws, Regulations, and Policies

Relevant NPS *Management Policies* for biological resources, including vegetation, state that human impacts to native plants, populations, communities, and ecosystems, and the processes that sustain them, are to be minimized (NPS 2000, sec. 4.4.1). NPS managers are allowed to manage biological resources when intervention is needed to protect other park resources (sec. 4.1) or to accommodate necessary development in parks (sec. 4.4.2). Most of the development proposed in this SEIS is outside Olympic National Park boundaries, and NPS policies would not necessarily apply. Inside the park, the revegetation of the reservoirs is consistent with NPS policies that encourage the restoration of native plant species to parks (sec. 4.4.2.2).

One of the purposes of the park, as stated in a congressional report accompanying the park's 1938 enabling legislation, is to preserve the finest sample of primeval forests of Sitka spruce, western hemlock, Douglas-fir, and western red cedar in the entire United States (NPS 1989). The combination of abundant moisture and a cool though moderate climate provides ideal circumstances for coniferous trees. The first of the park's five primary management goals is to conserve, maintain, and restore, where possible, primary natural resources and those ecological relationships and processes that would prevail were it not for the advent of modern civilization (NPS 1989). Individual management objectives within this goal include the development of programs to reverse or mitigate adverse impacts from human actions, to revegetate areas affected by human impacts, and to eliminate or control exotic plants that threaten native plant communities.

Wetlands are regulated separately from other vegetation, both by the National Park Service and Clallam County. Clallam County imposes buffers between construction and wetlands, which vary in size depending on the quality of the wetland.

The National Park Service follows the provisions of Executive Order 11990 and section 404 of the Clean Water Act. The executive order requires no net loss of wetlands, and section 404 regulates the filling of wetlands. The National Park Service's Director's Order #77-1 requires a statement of findings if wetlands will be adversely affected by a project. In this case, because affected wetlands are low quality and/or maintained or created through human intervention, no statement of findings is required. In addition, since dam removal would create hundreds of acres of wetland and riparian vegetation, the overall impact is a beneficial one. This is in keeping with Executive Order 11990 and with the National Park Service's implementation of that order, which strives for not only no loss, but a net gain in wetlands.

Methodologies for Analyzing Impacts

Vegetation at specific sites affected by the proposed actions of the SEIS was examined through site visits conducted by contractors to the Bureau of Reclamation and the National Park Service in February 2003 and by the Bureau of Reclamation in May and July 2003.

The following definitions of impact thresholds were applied:

Negligible — The impact would be at the lower levels of detection throughout the study area, or it would be slight, but detectable over a small and localized area.

Minor — The impact would be slight, but detectable throughout the study area, or it would be apparent over a small and localized area.

Moderate — The impact would be apparent throughout the study area, or it would be noticeable and quite adverse or beneficial over a small and localized area.

Major — The impact would be severe or highly beneficial throughout the study area.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

The dam reservoirs inundated more than 5 linear miles or an estimated 534 acres of riparian habitat along the Elwha River. Riparian habitat is a critical component of the overall hydrologic processes of the Elwha ecosystem; its loss has been a major and adverse impact to park vegetation. In general, a natural riparian zone connects montane headwaters with lowland terrains, providing avenues for the transfer of water, nutrients, sediment, organic matter, and aquatic and terrestrial organisms (Gregory et al. 1991). A natural riparian zone reduces the severity of flood events, acts as a buffer to pollution sources entering the river, controls the loss of groundwater nutrients into the river, and provides important fish habitat and food sources from overhanging vegetation and associated terrestrial insects. An additional 150 acres of upland communities also were lost.

As noted in the “Affected Environment,” riparian vegetation lies along the Elwha River both in the stretch between RM 2.8 and 3.7, as well as in the floodplain to the west of the federal levee, and at the southern and northern ends of the levee where extensions are proposed. Some of this vegetation is intact and relatively undisturbed; for example, the floodplain west of the federal levee has no development. Recently a side channel of the Elwha River carried enough water and was forceful enough to erode several hundred feet of the levee during a 10-year flood event. The west slope of the access road from the single vehicle bridge to the river passes by two seeps (see “Affected Environment”) where wetland species such as skunk cabbage, Devil’s club, and Pacific bleeding heart grow.

Although the forest and understory species on both banks between RM 2.8 and 3.7 indicate it is riparian and flooded during high stage floods, the condition of the vegetation is spotty and generally poor. Directly west of the rearing channel and industrial intake channel, the forest has been somewhat disturbed by the development of facilities associated with the Ranney collector. To the north and east of this area, and between the rearing channel and the industrial intake channel, the ground bears a cultivated lawn. To the south of the Ranney collection facilities, and east of the industrial intake channel, some riparian forest remains.

Plant surveys of the eastern riverbank between RM 3.6 and 2.8 (from the proposed surface water intake facility downstream to the north end of the proposed Elwha water treatment plant) found that it was well used and somewhat disturbed by human trampling. The forest is very open, and much of the understory is trampled and composed of nonnative, weedy species. In some areas of the riverbank, pulloffs and parking areas have been created through use, and soils are quite compacted. Very young trees are also trampled, and mature trees occur only a short distance away from the roads, facilities, and lawns. The condition of vegetation on the western shore is similar. Although some intact riparian vegetation exists in patches where thick vegetation limits human access, this stretch of river is generally easily reachable and well used. Under the no-action alternative, these conditions would remain or worsen over time as recreational use continued or increased.

The existing DCWA well field has been clear cut and is mown routinely around the pumping station. Mixed forest exists around the perimeter of the site. These conditions would continue under the no-action alternative until the lease expires on the well field. If the lease is not renewed, the mown area would be periodically flooded and would return to riparian forest. The alternative well field location on the west bank is also in the floodplain and is periodically overtopped during flood stage. As noted in the “Affected Environment,” wetland ponds (former gravel pits) exist in this area of the river (RM 3.5–3.6).

Farther downstream at the site of the federal levee, conditions are again variable. West of the levee riparian forest on the floodplain comes close to reaching the levee’s western toe. The Lower Elwha Klallam Tribe has designated 300 acres in this area as community forest land for natural flood abatement and limited subsistence firewood use. East of the levee vegetation is mowed or grazed, or the area has been developed. Farther east the property is covered with hardwood species, with an understory of common weedy species. The no-action alternative would continue these conditions, as the area would be maintained for hatchery use in the foreseeable future.

North of the levee a roadway, the tribal hatchery outfall, and other development exist. To the south is the Halberg property with second- and third-growth forest. As noted in the “Affected Environment,” forestland on the east side of this property has been relatively undisturbed and has not been developed for housing. Native vegetation on the west side has been disturbed by a ranch, corrals, and an orchard. Under the no-action alternative the area would either remain as it is or be developed for housing.

Wetlands modulate river flows during storm events, stabilize banks and erosion, trap sediments, retain nutrients, provide wildlife habitat, and facilitate energy and nutrient flows (Brinson et al. 1981; Adamus and Stockwell 1983). A total of 48 acres of vegetated wetlands were inundated by the reservoirs, and an additional 122 acres of unvegetated wet river channel and gravel bars were also covered. In addition, armoring the river channel between the reservoirs and below the Elwha Dam has reduced overflow areas and backwaters that create and maintain small riverside wetlands. These are considered major losses to the ecosystem, and they would continue under the no-action alternative.

Known wetlands in the project area analyzed for this SEIS, as described in the "Affected Environment," include two large, high-quality wetlands east of the existing industrial intake channel and several smaller wetlands along proposed pipeline routes, access roads, or in the vicinity of the DCWA well field, the alternative well field site, or along pipeline locations. Four smaller wetlands near the industrial channel (where the Elwha water treatment plant would be built) are lower quality wetlands, primarily because they are smaller. This is also true of the forested and emergent wetlands along road or pipeline corridors. A series of water-filled gravel pits near the alternative DCWA well field site are generally not vegetated, although the northernmost one is surrounded by emergent vegetation. Because they are in the floodplain, vegetative growth may be periodically removed; therefore, diversity of plant and animal life may be quite low. These water-filled gravel pits are not within the impact area for the DCWA alternative well field. The no-action alternative would, in effect, preserve these isolated wetlands, but it would also continue the inundation of hundreds of acres of former wetlands. Additional information on the impact of the dams and their removal on wetlands (such as backwater wetlands and side channels) is available in the "Flooding" section of this SEIS, as well as the FEIS.

Vegetation at the site of the Port Angeles water treatment plant is upland regrowth mixed forest, and vegetation at the Morse Creek hatchery site and along proposed pipeline routes is generally disturbed and weedy. At the water treatment plant a graveled private road separates a small wet drainage on the south side from the remainder of the site, and numerous old roads crisscross the forested part of the plant site. Under the no-action alternative these conditions would likely continue, although it is unknown how the City of Port Angeles would manage the water treatment plant or Morse Creek sites in the future.

The upland area near the Morse Creek hydropower plant is about 650 feet from Morse Creek and is dominated by grasses and a few deciduous trees.

Cumulative Impacts

Beyond the impacts described above, vegetation in the project area has been altered through logging and may have been changed through clearing for development, agriculture, roads, or other reasons.

Conclusion

The reservoirs have had major adverse effects on vegetation through the inundation of more than 700 acres, much of it riparian and wetland vegetation. Vegetation in the study area for this SEIS is mostly disturbed, although small patches of riparian forest are relatively unaffected and may be restored following dam removal. Two large, high-quality wetlands and several small, less diverse wetlands are also in the study area. The no-action alternative would continue the current state of each of these vegetation types. Although the impacts of the dams on riparian vegetation have been severe, no impairment of park resources or values has occurred as a result.

Impacts of the Proposed Action

Analysis

In general terms, mitigation actions could affect vegetation as a result of ground disturbance (trenching, clearing, grading, drilling) and filling. Site-specific impacts are discussed below.

Dry Creek Water Association. Farthest south along the river in the study area are the existing and proposed DCWA well fields (RM 3.6–3.7). As previously described, options under consideration for DCWA water mitigation include floodproofing the existing well field, developing an alternative well field site, and connecting to the City of Port Angeles system. The alternative well field site is on the opposite side of the river from DCWA users, so a pipeline would be required along one of five routes currently being considered.

1. *Floodproofing the Existing Well Field* — Required floodproofing and elevation of the wellheads at the existing well field would result in filling some riparian floodplain habitat (URS 2003a). In addition to fill, trees and brush would be cut, and soils would be graded and excavated for the placement of scour protection. Impacts would be localized, minor to moderate, and long term (i.e., for the life of the well field).

2. *Constructing an Alternative Well Field* — The alternative well field would occupy a low terrace on the west bank of the Elwha River within the 100-year floodplain. The area might require floodproofing, which would involve elevating an area for a building and well(s), plus an access road. Structures could be located on the hillside above the 100 year flood area. The floodplain contains a riparian forest dominated by western red cedar. The use of this site would not be likely to impact any upland areas, but two small forested wetlands along the access road would be disrupted. These wetlands likely formed from the impounding of upslope seeps caused by the road itself; they are both small and have little natural functionality. Using this site would have more severe effects on the floodplain riparian zone because the site would have to be raised several feet to provide flood protection. Vegetation would need to be cut, soils graded and excavated, and fill placed in the floodplain. Water-filled gravel pits in the vicinity could be filled and permanently lost. The extent of the impact to the floodplain riparian and wetland vegetation would likely be permanent and moderately adverse. Constructing an access road would have a minor, permanent, adverse impact on forested wetland vegetation.

   Under this option a new pipeline would be needed along one of five routes to carry water back across the river to users.

   - Alternative route A (along existing shoulders and rights-of-way that are already disturbed to the Highway 112 bridge) would have negligible impacts to upland vegetation. Construction along Elwha River Road could require removing a few trees adjacent to the road due to a narrow shoulder. This alignment would also disrupt two small forested wetlands along the site access road, resulting in negligible to minor impacts that would be long term or potentially permanent.
   - Alternative route B (similar to route A but along a cross-country route to the bridge crossing at Highway 112) would require the removal of a few trees and could affect small forested wetlands along the cross-country portion of the alignment, with negligible to minor, short- to long-term impacts to this vegetative type.
   - Alternative route C (along the site access road to the one-lane bridge to a DCWA connection point at Laird Road) would have limited impacts because construction would take place primarily within the footprint or shoulder of road rights-of-way. Construction could require the avoidance of some emergent wetlands along the Elwha River Road shoulder and the

removal of a few trees due to the narrow shoulder. This route is not likely to impact any riparian areas, and impacts to vegetation would be negligible or minor, but potentially long term.

- Alternative route D (a new river crossing, either under the river or on a bridge) would traverse riparian forest for a small section of pipeline and require the removal of brush along the powerline corridor as it crossed to the river in the vicinity of the well sites. Otherwise impacts would be primarily to aquatic vegetation in the riverbed. This pipeline route would have no more than negligible, short-term impacts to vegetation.
- Alternative route E (along the route of a new intake structure for the Elwha water treatment plant) would likely not have any additional detrimental impacts to wetland or upland vegetation beyond those associated with the intake structure, with the removal of a few trees required. It would also require avoidance of emergent wetlands along Elwha River Road. This alignment would affect riparian vegetation, as the removal of large riparian trees and excavation near the river would be required. Impacts to vegetation would be minor and long term until the trees could re-grow.

3. *Connecting to the City of Port Angeles Municipal Water System* — This option would require a connecting pipeline along Airport Road, which is already disturbed according to a May 2003 plant survey by Bureau of Reclamation staff. Species include a mix of conifers and hardwoods, as well as understory typical of this mixed forest. A pipeline along the road would require the removal of some of this vegetation. Weedy species would recolonize the area within the first year after construction. Overall, impacts to vegetation would be minor and temporary.

Elwha Heights Subdivision. The proposed action includes replacing an existing 4-inch pipeline with a 6-inch pipeline for a distance of about 4,000 feet. Because the replacement would take place along an existing highly disturbed road, the impact to vegetation generally would be negligible or minor. Displaced species would primarily be exotic species, or grasses and forbs that would grow back quickly.

Six small wetlands as described in the "Affected Environment" would also be potentially disturbed. Three of these small wetlands lie along the side of the roads where the pipeline would be replaced. Two are very small emergent wetlands that do not likely retain much function as wildlife habitat or other values. A third is also quite small, but contains species of shrub and scrub that may be more unique. The remaining three small wetlands lie in the clearcut field between DCWA residences and the Elwha Heights subdivision. Careful routing could avoid these wetlands, although Clallam County does require buffers for natural wetlands of higher quality (75 feet for class III wetlands), which could make alignment more difficult. Imposition of the buffers for all six wetlands would require realignment and the installation of new pipeline around the wetlands that lie along Rife and Walker Ranch Roads, as well as realignment of the proposed new section of pipe through the clearcut field. Offsite mitigation would also be possible. Either would reduce impacts to vegetation to negligible. However, not undertaking mitigation and using the existing proposed alignment might result in temporary disturbance or even permanent loss of five class III wetlands and one class II wetland, a negligible to minor adverse impact.

Diversion, Surface Water Intake Facility, and the Elwha Water Treatment Plant. As previously noted, several mitigation facilities would be built to supply industrial and hatchery customers with water during and following dam removal, including constructing a new Elwha water treatment plant, replacing a diversion and surface water intake facility, and constructing distribution facilities.

The site of the existing intake and diversion structure is vegetated with mixed conifer / deciduous forest. The proposed replacement control weir and intake would be about 225 feet upstream, and vegetation on the west side of the river at this point is similar. On the east side the shoreline is a sheer unvegetated cliff. Staging areas to remove the existing diversion and intake structure would be near the river and would result in the temporary loss of some riparian vegetation. Constructing the new control weir and intake structure would require blasting and work in the river channel. However, water would be diverted during this work through the use of a temporary channel on the western shore. Several individual trees (hemlock, Douglas-fir, and western red cedar) would be removed to dig the temporary channel. This could be a noticeable, minor to moderate impact in this location. In addition to the impact of the construction of the diversion channel, riparian vegetation on the western shore of the river in this location would be trampled by heavy equipment, but would grow back within one to two years. The loss of shrubs and understory riparian vegetation from staging and the use of equipment to construct the intake channel would be a minor, short-term impact. Riparian vegetation could regrow along the banks now flooded by flows upstream of the existing diversion facility, and it could be flooded on the western bank upstream of the new control weir. Compared to the no-action alternative, the impact would be negligible.

Two small shrub/scrub wetlands grow in the vicinity of the proposed intake facility. One is on the west bank of the river near the current intake. Removal of the existing intake would likely result in the destruction of the wetland, which may be located here because of the intake itself. Fill might also be required in this area to prepare it for the construction of the new intake. The second wetland lies on the north end of a mid-channel island downstream from the current rock dam. Excavation of the island would be required to achieve the needed grade for the fish control weir. The wetland would be lost as a result. However, it is likely that this wetland is “man-made” in the sense that the island itself was formed from material in the upstream scour hole, which is directly downstream of the rock diversion structure. Loss of both this wetland and the one adjacent to the existing diversion structure would have negligible or minor impacts on vegetation.

Vegetation in the area of the proposed Elwha water treatment plant primarily consists of a second-growth, mixed conifer / deciduous forest. There is a narrow strip of scrub/shrub habitat along the west side of the gravel road that parallels the fish-rearing channel. The west slope of the access road from the one-lane bridge down to the river has a very wet area fed by springs or seeps dominated by herbaceous species. Vegetation around the fish-rearing channel, the industrial channel, and the pipeline is mowed or maintained from the edge of the access roads down into the channels or to the pipeline. The proposed action would require clearing/grading, trenching/excavating, and filling, which would result in the removal of mature trees, shrubs, and herbaceous species. In areas affected by construction activities, there would be minor, temporary, adverse effects on vegetation. Because most of the species are common both up- and downstream, shrubs and herbaceous species would become reestablished within a few years. In areas covered by permanent facilities, the proposed action would have minor to moderate, site-specific, adverse impacts due to the permanent loss of vegetation.

Wetlands occur on site or very nearby the Elwha water treatment plant. Four of these wetlands (at the northern end of the existing industrial channel, along the eastern bank, along the southernmost overflow channel, and at the eastern end of the northernmost overflow channel) are small and of lesser quality. They may be fed by the industrial channel and overflow channels and are probably unregulated by Clallam County or the U.S. Army Corps of Engineers as a result, so no permit would be required to alter them. Two additional larger and higher quality wetlands lie to the east of the industrial intake channel, outside the area slated for development. However, construction could have indirect effects on these wetlands as a result of increases in turbidity, engine emissions, leaks of petroleum products, and the noise and presence of humans during construction. It is because of these indirect impacts that Clallam County imposes a 200-foot buffer between Class 1 wetlands and any construction or operation activities. If such a buffer was imposed, impacts to wetland vegetation would be negligible to minor. Eliminating these wetlands, reducing their size, or averaging the required buffer among wetlands to facilitate construction, could result in temporary, moderate impacts.

Levees, Tribal Hatchery, and Wastewater Treatment. Raising, strengthening, and/or extending the federal levee on the Elwha River's east bank and the much shorter private levee on the west bank would be required to provide existing levels of flood protection for area residents. In the vicinity of a proposed southern extension of the levee, a new tribal fish hatchery could be built, and a sewage pumping station for tribal and private residents could be installed.

Plant surveys in the immediate vicinity of the federal levee were conducted in the spring and summer of 2003 to determine the extent of impacts related to raising the levee. Adding material to the top of the levee would also require material to be added to the sides to maintain a given slope. Riprap or other strengthening material, and a buried toe along at least a 3,000-foot section of the levee, would be required as well.

From north to south, the survey team made the following conclusions about the impact of these actions on vegetation. Raising the northernmost part of the levee would likely result in negligible local impacts on vegetation due to the removal of weedy herbaceous species to the east. Vegetation would recover quickly after construction (three to five years), even without active revegetation programs. A small amount of old field grassland could be lost due to raising and strengthening the levee. The levee would also likely be extended northward to the beach berm to prevent river backflooding. Vegetation that would be removed includes some dune species, such as wild rye, silver burweed, and beach pea.

The eastern side of the middle section of the levee is vegetated with grass and herbaceous species. Raising and widening the levee would result in the loss of all vegetation along the top and sides, and to some extent those species in the immediate vicinity of the toe of the levee. Raising the levee would have negligible adverse impacts on this continually maintained vegetation. Riparian forest trees in the floodplain in the vicinity of the western toe of the levee in this section would be largely unaffected, although some understory brush or trees might need to be removed to widen the levee base or to install scour protection. A forested area along the western toe of the levee in the middle portion of this section would be largely unaffected by the proposed action. A small amount of pastureland on the southern end of this section would be buried.

Vegetation at the north end of the southern third of the levee consists primarily of various grasses and weeds. The roadway on top of the levee and the eastern slope are mowed. Raising and widening the levee in this location would have negligible impacts. The Halberg property lies in this area, the potential location of the new tribal fish hatchery. Vegetation in the northern portion of the Halberg property is a neglected pasture with grasses and weedy species, the same species as on the road. The pasture includes a few orchard trees and small buildings. Construction impacts from the hatchery would be confined to a small area where nonnative vegetation would be removed. Construction activities would increase the prevalence of weedy species for a few years, but impacts to vegetation overall would be negligible to minor.

The Army Corps of Engineers constructed a gravel haul road that proceeds to the southeast; here vegetation is less maintained and regrowth forest exists on both sides of the road. This part of the levee road is approximately 1,800 feet long. Some less common plant species occur in the forested perimeter east of the levee road, south and east of the Halberg property. This vegetation would be affected a minor to moderate degree from extending the levee because it is relatively undisturbed. Widening would require the removal of numerous trees.

The levee would likely be extended south along a natural raised bench bordering an overflow channel of the Elwha River. The habitat along this route (RM 2.2) and continuing all the way south to the City of Port Angeles pipeline from the Ranney collector (RM 2.8) is a relatively undisturbed mixed conifer /

hardwood forest. The habitat is extremely dense, with little open canopy, and in many areas ground cover vegetation is limited to ferns and true mosses. Construction of a new portion of levee in this area would result in moderate, permanent impacts on vegetation through the loss of trees and division of the forested area.

The Lower Elwha Klallam Tribe has decided to collect wastewater from homes in the Valley community of the Lower Elwha Reservation and possibly the lower river area and pump it to the City of Port Angeles for treatment. At this time, the pumping facility would likely be in the field east of Stratton Road, and construction could have temporary, negligible impacts on grass or weedy vegetation at that site. Trenching or excavation along the streets of the Valley community might result in the removal of some weedy or herbaceous vegetation, with negligible to minor impacts. The pipeline from the pumping station would be routed along the shoulder of Lower Elwha Road or the Milwaukee Railroad right-of-way. Both are highly disturbed, and impacts to vegetation would be negligible.

Port Angeles Water Treatment Plant. In order to assess vegetation impacts related to the treatment plant, an approximately 5-acre area was surveyed in May and July 2003 by the Bureau of Reclamation. This area is adjacent to the landfill and includes part of the landfill. It consists of bulldozed land, approximately 3 acres of regrowth mixed conifer / deciduous forest that is roughly 20–30 years old, and a small, wet drainage on the south end of the site. As noted under the no-action alternative, the forest has been disturbed by roads that crisscross the property. Because it is already disturbed and limited in size, the impact of grading and removing forest and understory vegetation at this site would be minor, adverse, and permanent.

Fish Restoration. Since the publication of the FEIS, the bull trout and Puget Sound chinook salmon have been listed as threatened under the federal Endangered Species Act. As a result, additional mitigation measures for the fish are now required, some of which could affect vegetation.

Chinook Salmon — The proposed aerial transport of adult fish to restore chinook salmon in the Elwha River could require the use of a helicopter, and ground disturbance required for landing pad(s) and possible access road(s) could adversely affect vegetation. Impacts are expected to be negligible to minor and localized in scope. Site-specific surveys would be conducted for any species of concern.

Vegetation at Morse Creek, where chinook holding/rearing ponds would be developed for use during dam removal, is upland mixed forest. Some small amounts of forest vegetation would either be removed or inundated to create the holding ponds, with negligible to minor impacts.

Bull Trout — Measures included by the U.S. Fish and Wildlife Service in its "Biological Opinion" for bull trout require the replacement or modification of Hot Springs Road culverts that limit or block access to tributaries that could be used by trout (USFWS 2000). This action would likely involve ground disturbance (grading/clearing/excavation). Depending on the method of construction and location of these activities, the potential for adverse effects to vegetation would vary. Impacts are expected to be negligible to minor and localized in scope. Site-specific surveys would be conducted for any species of concern.

Revegetation. Studies since the publication of the FEIS show that the amount of material and effort needed to revegetate areas currently inundated by the reservoirs might be much higher than previously planned. For example, substantially more seeds and cuttings might be required, manual labor might be inadequate, and animal grazing of planted material might be a larger problem than initially anticipated. There would be a greater need for mechanized equipment and additional helicopters to collect cones and seeds; to carry large woody debris, duff, or litter from borrow sites; to fertilize or apply soil amendments; and to transport plants and/or crews. Increased use of mechanized equipment could require the development of staging areas and access roads, which could involve clearing and/or grading. Helicopter use could require additional landing pad(s) in addition to those analyzed in the FEIS, involving additional clearing and grading. Use of both types of equipment would result in ground disturbance, which has the potential for adverse impacts of unknown magnitude. Impacts are expected to be negligible to minor and site-specific in scope. Site-specific surveys would be conducted for any species of concern.

In addition, trees could be cut to obtain seeds or cones from certain species. Effects of this proposed action would be negligible.

Cumulative Impacts

Under this alternative restoring riparian, wetland, and upland communities after dam removal would result in major, cumulative benefits for vegetative communities in the park.

Conclusion

Floodproofing the existing DCWA well field could result in minor to moderate, long-term impacts to riparian vegetation, while the use of the alternative well field site would have moderate, permanent impacts to riparian vegetation; minor, permanent impacts to forested wetlands along an access road; and minor impacts to floodplain wetlands. Any of the five pipeline alignments for the alternative well field would have negligible to minor impacts on vegetation; this would also be true for an optional pipeline connecting the DCWA customers to the municipal system. Connecting the Dry Creek Water Association and the Elwha Heights subdivision could result in the loss or temporary sedimentation of six small wetlands, with minor impacts. Offsite mitigation or rerouting could reduce these impacts to negligible.

Loss of some riparian vegetation to remove the existing diversion and intake facility and to construct a new upstream control weir would occur, but the loss would likely be minor and temporary. Loss through inundation of riparian vegetation at the control weir could be compensated for by the recovery of riparian vegetation downstream where the existing diversion would be removed, with negligible impacts. Localized minor to moderate impacts from removing several cedars and other trees to build a temporary diversion channel to facilitate relocating the intake structure would also be possible. Two small, lower quality wetlands would also be lost when the existing diversion facility was removed and the new fish passage facility and control weir were built. Negligible to minor impacts to vegetation would result from their destruction.

Loss of mixed forest and understory would result in minor to moderate impacts, permanent impacts at the Elwha water treatment plant site, and temporary impacts at staging sites. Smaller wetlands on site might be lost when drainage was altered; since these are man-made, the loss would be considered negligible. Two larger wetlands could experience indirect, minor to moderate, temporary impacts during construction.

Impacts to vegetation from raising and widening the federal levee would generally be minor, as vegetation is generally disturbed or artificially maintained, although at the southern end impacts to a relatively undisturbed forest could be minor to moderate. Impacts to the forest east of the levee might be negligible to minor. Impacts from constructing the tribal fish hatchery or wastewater pump station on the Halberg property would be negligible to minor. Extending the levee south would result in moderate, permanent impacts to vegetation through the loss of trees and the division of a relatively pristine forested area.

Because the site the Port Angeles water treatment plant is already disturbed and limited in size, the impact of grading and removing forest and understory vegetation would be minor, adverse, and permanent.

Negligible to minor impacts to vegetation from installing culverts for bull trout, for clearing helicopter landing pads to outplant chinook, or to create chinook holding/rearing ponds (on Morse Creek) would occur.

Negligible to minor additional impacts beyond those in the FEIS could occur to vegetation from helicopter landing pads and the use of heavy equipment (staging and access roads) associated with revegetating the reservoirs.

Any impacts to riparian, upland, or wetland vegetation related to the construction of these mitigation facilities would be fully offset by the restoration of 5 linear miles of riverine habitat, including over 400 acres of floodplain riparian or wetland vegetation.

No impairment of park resources or values related to vegetation would occur.

Wildlife

Summary of Regulations and Policies

Relevant NPS *Management Policies* for biological resources, including wildlife, state that human impacts to native animals, populations, communities, and ecosystems, and the processes that sustain them, are to be minimized (NPS 2000, sec. 4.4.1). NPS managers are allowed to manage biological resources when intervention is needed to protect other park resources (sec. 4.1) or to accommodate necessary development in parks (sec. 4.4.2). Most of the development proposed in this SEIS is outside Olympic National Park boundaries, and NPS policies would not necessarily apply. In addition, wildlife management should minimize human impacts on natural wildlife population dynamics, while protecting native wildlife populations against harvest, removal, destruction, harassment, or harm through human action.

One of the purposes of the park, stated in a congressional report accompanying the park's 1938 enabling legislation, is to provide suitable winter range and permanent protection for herds of native Roosevelt elk and other native wildlife species (NPS 1989). The park's distinctive fauna has been identified as one of its primary resources.

Methodologies for Analyzing Impacts

The presence of wildlife and wildlife habitat at specific sites affected by the proposed actions of the SEIS was assessed through site visits conducted by agency contractors in February 2003 and by biologists from the Bureau of Reclamation in May and July 2003. In this SEIS, representative species are referred to specifically, and most other species are grouped according to broad classification categories. Wildlife with special status conferred by the Endangered Species Act or other laws are analyzed under "Species of Special Concern."

The following definitions of impact thresholds were applied:

Negligible — The impact would be at the lower levels of detection throughout the study area, or it would be slight, but detectable, over a small and localized area.

Minor — The impact would be slight, but detectable, throughout the study area, or it would be apparent over a small and localized area.

Moderate — The impact would be apparent throughout the study area, or it would be noticeable and quite adverse or beneficial over a small and localized area.

Major — The impact would be severe or highly beneficial throughout the study area

Impacts of noise to wildlife species were found in the literature. In particular, impacts of aircraft and helicopter overflights were examined, as these decibel levels are comparable to those associated with construction equipment used at most of the sites described in this SEIS.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

The primary impacts to wildlife have been the loss of habitat and anadromous fish populations that had occupied the river year-round before the dams were built. The reservoirs directly affected more than 700 acres of habitat. The dams would continue to have major adverse impacts on park wildlife in the Elwha River valley upstream of RM 4.9 by inundating habitat, blocking the passage of anadromous fish, and effectively removing the calories and nutrients that they otherwise contribute to the ecosystem. The 5.3 miles of river lost through inundation was optimal habitat for raccoons, muskrats, river otters, beavers, and mink.

Roosevelt elk, which require low-elevation, forested and riparian bottomlands for winter habitat and grazing, have suffered adverse impacts from the inundation of habitat. Deer, mink, beavers, Douglas squirrels, Cooper's hawks, pileated woodpeckers, and yellow warblers (which are used as representative species for the area) have been impacted by the loss of habitat.

In the upper and middle stretches of the Elwha, populations of fish-eating wildlife species may have decreased when salmon and trout were blocked by dam construction. At least 22 wildlife species that use salmon as food, including black bear, mink, mountain lion, bobcat, and river otter, could have been adversely affected by the dams (Cederholm et al. 1989).

Some species benefited from the dams and reservoirs. The common goldeneye, bufflehead, and lesser scaup are common winter residents on both reservoirs. Trumpeter swans also use Lake Aldwell as winter habitat.

As noted in the "Affected Environment," riparian vegetation lies along much of the area slated for water and flood mitigation measures. This wildlife habitat has been somewhat degraded, disturbed, or changed through development (such as the DCWA well field and the Elwha water treatment plant site) throughout much of the stretch between RM 3.7 and RM 2.8. However, north of RM 2.8 and the industrial supply channel and fish-rearing channel to about RM 2.3 and the Halberg property, the riparian forest is thick and relatively undisturbed, providing habitat that is likely used by a variety of wildlife species. Mammals that are likely to use this habitat include black-tailed deer, Roosevelt elk, weasels, bats, and mink.

Pileated woodpeckers (see "Species of Special Concern" section), Wilson's warblers, and more common species such as American robins and song sparrows are also found in these types of forests and were observed during surveys. Northern red-legged frogs or western toads may also inhabit riparian forests like these.

Continuing north to the river mouth, property on the east side of the levee has been developed or disturbed and does not generally provide more than minimal wildlife habitat. Notable wildlife species that were found in this part of the study area include deer feeding at the Halberg property orchard, a nesting red-tailed hawk, and a nest of California quail near the northern end of the levee. Some scattered wetlands and side channels (RM 3.7–3.5) and around the Elwha water treatment plant site (RM 3.0–2.8) provide habitat for fish, amphibians, and waterbirds, and the area at the far north end of the federal levee near the river mouth is populated by shorebirds and gulls. An unusual black oystercatcher was observed during one site visit near the northern end of the levee. In the side channel, river, and wetland habitat near the Elwha water treatment plant site, several ducks and waterbird species were noted. The eastern split of the river was particularly well used.

Surveys of upland habitat for roads, pipelines, and the Port Angeles water treatment plant site indicate most of these sites are somewhat disturbed, although deer were observed adjacent to the site, and cedar waxwings, yellow warblers, and more common species were found along some road alignments (The Rife Road alignment into the Elwha water treatment plant site and the Kaycee Road alignment). Songbirds and small mammals are the most numerous wildlife in the vicinity of the Morse Creek chinook pond development.

As noted in the "Affected Environment," trumpeter swans use the reservoirs and winter along the coast in the project area. The population here is stable or increasing slightly.

Cumulative Effects

Various wildlife species in the vicinity of the southern park boundary are being increasingly adversely affected by changes in land use related to human activities and development. This has the effect of isolating populations and minimizing diversity. Recreational use both inside and outside the park along the riparian corridor of the Elwha River also disturbs wildlife, sometimes to the point that individual animals abandon the area.

Conclusion

The dams would continue to have major adverse impacts on park wildlife in the Elwha River valley upstream of RM 4.9 by inundating habitat, blocking the passage of anadromous fish, and effectively removing the calories and nutrients that they otherwise contribute to the ecosystem. Conditions along the riverbank from RM 3.7 to about RM 2.8 are somewhat disturbed, and wildlife species have not been observed in abundance except at some side channel and river locations (near the Elwha water treatment plant site, for example). From RM 2.8 to the Halberg property, forest habitat is relatively intact, and riparian forest species are likely. The river from the Halberg property north to the end of the levee is also developed and disturbed, and few wildlife species have been observed, with shorebirds and gulls at the ocean end of the levee. Upland habitat at the Port Angeles water treatment plant site and along most roads and pipeline routes is also degraded. Habitat at the Morse Creek site is relatively undisturbed and occupied by common bird and small mammal species. Major, adverse impacts on some wildlife species upriver of the dams would continue with the dams in place, but because Elwha Valley wildlife are not specifically called out by the park's implementing legislation or management plan, no impairment would occur.

Impacts of the Proposed Action

Analysis

Wildlife and wildlife habitat could be affected by mitigation actions as a result of ground disturbance (trenching, clearing, grading, drilling) and filling activities, which would result in habitat loss and/or noise disturbance. In addition, helicopter overflights could disturb or temporarily displace wildlife. As noted in the "Noise" section, the kinds of equipment anticipated at some of the major construction sites can emit 75–90 decibels (dBA), and average construction noise at 50 feet ranges from 80 to 85 dBA. At a distance of 1,500 feet, this drops to 64 to 66 dBA. In the intervening area noise levels would range from 65 to 75 dBA, typical of a noisy street. Although some individual animals would habituate to nonthreatening, continuous, or frequently occurring noise levels below a certain threshold (usually 70 dBA), some apparently do not (Bowles 1995). Reactions to noise or human disturbance include flight or running, abandoning habitat or nesting sites, and avoiding feeding areas or stopping feeding. Running or flying increases an animal's metabolism twenty-fold over the resting rate (Mattfeld 1974). The loss of nutrients or increased energy expenditure can ultimately mean that reproduction or migration, or even survival, are compromised. If noise is very loud, animals can panic, and injury or separation between parents and their young can occur. Birds flushing nests can leave eggs or young vulnerable to cold or predation. Over 200 published and unpublished reports have identified direct, adverse reactions of wildlife to noise, although very few have conducted long-term follow-up studies to determine indirect effects (NPS 1994).

Noise levels during the construction of the Elwha and Port Angeles water treatment plants would be comparable to aircraft overflights for two years. Farther north, in what is the least disturbed and most pristine riparian forest habitat in the study area, noise levels would diminish to levels typical of busy streets. Panic and escape behavior is common at 80–85 dBA. Chronic noise at less intense levels, such as those that would be experienced at 0.3–0.5 mile from the construction sites, can cause stress in some species, making them more susceptible to disease (Gladwin et al. 1987), or in other species producing long-term deleterious effects on metabolism and hormone balances (Stemp 1983).

Helicopters have elicited a variety of responses in wildlife. At distances of 5,000 feet the heart rates of bighorn sheep accelerated; when a helicopter was between 500 and 600 feet, sheep and caribou panicked and ran (NPS 1994). Red-tailed hawks flushed their nests when a helicopter was 150 feet away, but glaucous gulls disrupted nesting activities when helicopters were as far as 500 to 1,000 feet away. Nestlings of one species (Lapland longspur) died when a helicopter approached within 50 feet (NPS 1994). In addition to energy loss, reproductive effects, or loss of habitat, animals running from loud noise can experience injury, or birds may accidentally break eggs or kick them or young from nests. These kinds of effects are likely at major construction sites inhabited by wildlife. Panic and escape responses are less likely even 1,500 feet away, although continuous noise at 65 to 70 dBA may result in eventual abandonment of territory.

Site-specific effects on wildlife and wildlife habitat are discussed below based on surveys conducted in 2003 (URS 2003b; BOR 2003a).

Dry Creek Water Association. Soil would need to be brought in to raise the present well field or the alternative well field site above the 100-year flood level. This would be several feet in either case. The alternative well field may not require raising if the buildings were located outside the 100-year flood area. Noise associated with the construction of the alternative well field, roads, and pipelines or of a connection to the city's water supply system would be loud for several months. As noted in the "Affected Environment," mammals in the vicinity include deer, elk, mink and several small mice, bats, and other species. Continuous loud noise in the vicinity could cause the effects described above, ranging from temporary disturbance for some species or individuals to permanent abandonment of a site by others. Bats in particular could be disturbed by noise or vibrations if they roosted or nested nearby. Since appropriate habitat is less common, impacts might be moderate. Other more mobile species would experience impacts ranging from negligible to moderate. No major impacts would occur because they would remain localized and would only affect individuals or small family groups.

Habitat for birds in the vicinity includes grassy roadside strips, forests, and side channel wetland habitat along the Elwha River and the Elwha River Road. Forest edges support several common songbird species, and this habitat may support less common species such as ruffed or blue grouse, great horned owls, western screech owls, band-tailed pigeons, and pileated and downy woodpeckers (however, none of these species was observed during the surveys). Wetland species in filled gravel pits on the west bank by the alternative well field site would likely include ducks, red-winged blackbirds, bald eagles, and other fish-eating species, as well as northern red-legged frogs, roughskin newts, and other amphibians. The habitat can support garter snakes and northern alligator lizards as well. Filling these pits to raise the level of the well field would remove relatively uncommon habitat for wildlife; however, only the northernmost pond is vegetated and complex enough to support wildlife. Impacts to wildlife would be minor to moderate and permanent. Two small wetlands on the access road for the new DCWA well field (the same as the roads described below for the surface water intake structure), as well as six small wetlands along the proposed route to connect the Dry Creek Water Association and the Elwha Heights subdivision offer minimal habitat for widlife. Only one of these, a small wetland in the clearcut field between the west end of Walker Ranch Road and the Elwha Heights subdivision, is definitely believed able to support wildlife. The loss of these wetlands, should it be required, would have negligible impacts on wildlife.

Construction noise would have immediate effects on birds and other wildlife at either well field location, or along a pipeline route or road access alignment. The noise would last for several months and could result in permanent relocation of some individual animals, a minor adverse effect.

Diversion and Intake Facility and the Elwha Water Treatment Plant. Habitat and wildlife in the area surrounding the existing diversion and intake structure and upstream 225 feet at the site of the new control weir and intake structure would be similar to that at the DCWA existing and alternative well field sites. Surveys in the spring and summer of 2003 and again in July of 2004 found this part of the riverbank and downstream to the end of the WDFW rearing channel to be heavily used and largely devoid of wildlife, although the 2004 survey did find some use of the scour pond and shoreline by a few birds, including a great blue heron, mergansers, and dippers. As noted above, in the forests away from the riverbank and in floodplain wetlands several bird and amphibian species or indicators of their presence were found. The presence of mammals was inferred by tracks, scat, and other evidence, although no individuals were observed during the surveys.

Construction noise to replace the diversion and intake facility could be quite loud at this location, and blasting noise would also be possible. Equipment would be required for in-water work, and as noted in the "Vegetation" section, riparian vegetation would be trampled and temporarily destroyed. It is likely that any mobile wildlife in the vicinity would abandon the area during construction. Wildlife as close as 1,500–2,000 feet could be temporarily affected, but would likely return to the area after construction equipment left at night or on weekends. Because habitat in the immediate vicinity of construction sites is already degraded, impacts would be minor to moderate. However, impacts would extend into the less disturbed forest area adjacent to the construction site, with moderate, temporary impacts on wildlife in this area.

As noted in the "Affected Environment," songbirds, waterbirds, waterfowl, river otters, and beaver have all been observed in the vicinity of the Elwha water treatment plant site. Signs of deer, elk, mammalian predators, and small mammals have also been noted in the forest east and north of the industrial supply channel. Amphibians, including western red-backed and northwestern salamanders, tailed frogs, and northern red-legged frogs either occupy adjacent wetlands or are considered likely to inhabit them. Several species of ducks, waterfowl, and a great blue heron were observed in the eastern split of the river running directly west of the Elwha water treatment plant construction area. These animals and any others in the immediate vicinity of the Elwha water treatment plant site would likely experience severe noise impacts (80–85 dBA, with louder noise during some periods) and the overwhelming presence of humans and equipment when construction began. Most or all mobile wildlife within a 1,500-foot or larger radius would likely panic and flee. Truck traffic would be nearly continuous throughout the construction period. Decibel levels would drop off with distance, but might still be loud enough (e.g., above 70 dBA) in the neighboring forests to the east and north to cause avoidance or stress-related diseases and reduced reproductive success in some species. Because impacts from construction would be temporary and would not threaten the continued existence of any species, impacts to wildlife at the Elwha water treatment plant site would be moderate and adverse.

To a lesser extent, any wildlife remaining in the four lower quality wetlands associated with the industrial intake channel would also experience impacts as the site was modified, and it is possible that these man-made wetlands would be lost. The same is true for the additional several small lower quality wetlands in the vicinity of the Elwha surface water intake or the existing access road to the current intake facility on the west side of the river. Species occupying the larger, high-quality natural wetlands to the east of the existing industrial channel would be adversely affected by construction noise as explained above, but they could also experience increases in air emissions and turbidity resulting from construction activities. As noted in the "Vegetation" section, a 200-foot buffer between any construction site and Class I wetlands is normally required, although this is sometimes averaged to facilitate construction. Any increases in turbidity or pollution in these wetlands would have an additional, negligible to moderate adverse impact on wildlife. In the long term after construction of the Elwha water treatment plant was complete, it is possible that the large wetlands east of the site would expand as drainage by the current channel would stop. If so, habitat for wildlife might be slightly improved over current conditions.

The Elwha water treatment plant would also have permanent or long-term impacts from the removal of about 2 acres of forest habitat to build clarifiers and other plant elements. This habitat is relatively common and not critical for any species; therefore, impacts would be minor, but permanent.

Subsequent to the implementation of the mitigation proposals, other closely related water supply / quality actions could be taken at a later time. These include the possible construction of three additional clarifiers. One of these clarifiers could be located at the treatment facility, but the site constraints mean that any additional clarifiers would need to be located elsewhere. Impacts to wildlife and wildlife habitat of unknown magnitude would be possible as a result.

Levees, Tribal Fish Hatchery, and Wastewater Treatment. Proposed mitigation actions in the northernmost stretch of the Elwha River floodplain include raising or strengthening the federal levee on the east bank and the private levee on the west bank (RM 0.1–1.6), extending the federal levee to the north and south, expanding the existing tribal fish hatchery or building a new one, and building pumping and pipeline facilities to transmit wastewater. As previously discussed, wildlife surveys were conducted for this entire corridor, as well as along the connecting piece between the Halberg property (RM 2.0–2.3), where the new tribal hatchery and wastewater pumping station could be built, and the northern edge of the WDFW fish-rearing channel and the Elwha water treatment plant site (RM 2.8).

The northern section of the levee would be raised and likely extended northward to provide current levels of flood protection for residents on the northern end of the Lower Elwha Klallam Reservation. Wildlife observed in this vicinity included turkey vultures and crows, as well as several coastal species such as gulls, cormorants, and a black oystercatcher. A brood of quail, which likely were nesting in riparian scrub habitat west of the levee, was also observed. Audubon migratory bird surveys from 1994 through 2001 show a variety of raptors, freshwater birds (ducks, grebes, loons), and shorebirds (gulls, cormorants), as well as smaller upland species that occupy habitat at the river mouth and along the shoreline. Because the area is already disturbed, raising the levee would likely have only negligible impacts on wildlife. Extending it northward could result in temporary, minor impacts during construction. The private levee across the river could be extended and raised, or the levee could be removed and the homes raised instead. Wildlife species were not surveyed in this area, but would likely consist of shorebirds and gulls. Removing the private levee would benefit estuarine wildlife because of reconnecting ocean and river water, which the levee now blocks.

In the middle third of the levee, songbirds were noted, and ravens were scavenging on fish from recently emptied tanks from the tribal hatchery. The presence of humans and daily activity at the hatchery appears to keep wildlife away now; therefore, altering or raising the levee in this location would have only negligible, temporary impacts.

As noted above for the no-action alternative, several songbirds were observed on the south end of the southern third of the levee near and on the Halberg property, as well as a red-tailed hawk (presumably nesting) and a ruffed grouse. Evidence of deer browsing in the orchard was also noted. Building the tribal fish hatchery or wastewater pumping station on this section of the property would result in the removal of the orchard trees, which were used as food by the many birds seen during the survey and presumably deer. The loss of this food resource would likely have no more than minor impacts to these species. Raising the levee in this area would have negligible to minor impacts on these same species.

Habitat from the south end of the levee southward to the vicinity of the WDFW fish-rearing channel is second- and third-growth forest and is much less disturbed than other areas. The habitat provided by this riparian forest is likely used by many of the species identified above for the forest east of the Elwha water treatment plant site, including deer, elk, cougar, mink, songbirds, grouse, and owls. Extending the levee through this forest would likely have moderate, temporary effects on wildlife from construction noise and the presence of humans. Minor, permanent effects from forest fragmentation in the levee footprint would also occur, which could alter movements by some ground-dwelling species.

Constructing a centralized wastewater collection facility, distribution pipelines, and access/maintenance roads could have additional minor impacts to wildlife, although the reservation is developed and human activity is already present. Following construction, wildlife impacts would return to their current conditions.

Port Angeles Water Treatment Plant. As noted in the “Affected Environment,” songbird species were observed in the area and a red-tailed hawk nest was located on the north edge of the Port Angeles water treatment plant site near the forest edge. Indirect evidence of large mammals was not observed, but four black-tailed deer were seen in the landfill area. Noise in the area is already high because of the adjacent landfill, airport property, and housing, but the presence of trucks and grading at the site would likely eliminate any wildlife during the construction period. Similar habitat is readily available elsewhere in the immediate vicinity, and impacts from construction would be no more than minor because of this and the already disturbed nature of the site. The proposed action would also result in minor adverse impacts on wildlife due to permanent loss of the regrowth forest.

Fish Restoration. The proposed aerial transport of adult fish to restore chinook salmon in the Elwha River could require the use of a helicopter, as well as landing pad(s) and possible access road(s). Wildlife could be adversely affected through ground disturbance and noise. As noted above, helicopter noise can be particularly frightening for wildlife and can cause various effects, from increased heart rate to nestling mortality or injury. Because fish outplanting would occur in wilderness, the number of flights allowed would be strictly regulated to minimize impacts to wildlife and to the wilderness experience of recreationists. Because of these restrictions, impacts from helicopter noise above Glines Canyon Dam, if outplanting was required, would be no more than moderate and temporary. Helicopter use in the vicinity of the reservoirs following dam removal could also have moderate, adverse effects on wildlife, although because the drained reservoirs would be large, unvegetated areas, wildlife would not be attracted to them and so would experience less severe effects than from outplanting fish.

The placement of culverts to provide clean water habitat for bull trout during dam removal would require a few days of construction, with associated temporary, negligible to minor, adverse impacts on wildlife in the vicinity. Efforts (electrofishing) to remove eastern brook trout from these tributaries prior to culvert removal would be needed to prevent hybridization with bull trout. Electrofishing activities would involve short-term, minor impacts from trampling of riparian vegetation.

Upland wildlife species in the vicinity of the proposed chinook holding/rearing ponds at Morse Creek would be disturbed by construction for up to six weeks. During this period, heavy equipment would be used to excavate the ponds and lay pipes. Wildlife could also be displaced by the occasional presence of humans operating the ponds during and following dam removal. Impacts would likely be no more than minor and temporary on wildlife in the vicinity.

Revegetation. Since the publication of the FEIS, studies show that the amount of material and effort needed to revegetate areas currently inundated by the reservoirs might be much greater than previously planned. For example, substantially more seeds and cuttings might be required, manual labor might be inadequate, and animal grazing of planted material could be a larger problem than initially thought. Mechanized equipment and additional helicopters might be needed to collect cones and seeds; to carry large woody debris, duff, or litter from borrow sites; to fertilize or apply soil amendments; and to transport plants and/or crews. Increased use of mechanized equipment could require staging areas and access roads, which would require clearing and/or grading. Animal control would be necessary since large herds of deer and other grazing animals would be attracted to the open area containing growing forbs and grasses planted by park staff. Fencing or other animal control mechanisms that do not involve animal destruction are preferred. Each of these activities would be temporary in nature, and as noted above, wildlife would not initially be attracted to the reservoirs, so impacts would be minimal. However, as grasses and forbs took root, the installation of fencing or other control measures might have a longer term, minor, adverse effect.

Trumpeter Swans. As noted in previous sections of this SEIS, mitigation for lost trumpeter swan habitat following dam removal and dewatering of the reservoirs had not yet been decided when the FEIS was released. To date, the agencies have agreed that protecting swan habitat is the most complete and effective means of mitigating impacts, and properties that support trumpeter swans during the winter are being identified, and the possible purchase of conservation easements is being investigated to keep that habitat from being used or developed in a way that would harm swans.

Cumulative Impacts

Removing the dams and restoring wildlife habitat in the currently inundated portions of the river, as well as returning anadromous fish to more than 70 miles of the mainstem of the Elwha River and its tributaries, would have major benefits for wildlife. Restoring riverbed gravels and sand, re-creating side channel and wetland habitat, and restoring pre-dam conditions to the estuary and marine environment at the river's mouth would provide additional major benefits to wildlife analyzed in the FEIS. The construction of mitigation facilities along the banks of the river could have a combined effect that would be more severe than the minor to moderate effects at each location. Wildlife along the entire lower Elwha river corridor (from RM 3.7 north to the mouth of the river) might experience up to two years of intensive construction activities and noise. If individual animals were not directly affected by construction at a particular site, they might nonetheless be adversely affected by noise up to 0.5 mile away. Cumulative impacts to wildlife along this corridor could approach major in intensity for several months when all construction was ongoing concurrently.

Conclusion

Negligible to moderate temporary impacts from construction noise to mobile wildlife at either DCWA well field site would occur; if bats abandoned roosting sites in the vicinity, the impact could be moderate and adverse. The loss of off-channel, water-filled gravel pits as a result of filling at the DCWA site would be a minor to moderate, adverse, permanent impact to wildlife. Construction noise would also disrupt and displace wildlife in the vicinity of the existing and proposed diversion and intake facilities; trampling of riparian vegetation would also occur. Because the riverbank has little wildlife, impacts here would be minor, although impacts to wildlife in the surrounding vegetation from noise would be moderate and temporary. The combined effect of constructing several mitigation facilities along the river could increase these effects to major for several months.

Wildlife in the vicinity of the Elwha water treatment plant would experience localized impacts, and are expected to panic, flee, and abandon the area within at least 1,500 feet of the site during construction, a moderate, adverse impact. Wetland habitat would be lost, or indirectly affected by air emissions or turbidity, a negligible to moderate, adverse impact. Minor impacts from the permanent loss of habitat would also occur.

Modifying the federal levee would generally have negligible or minor impacts on wildlife from construction noise, but little wildlife habitat exists along this corridor. At the Halberg property, minor impacts from building a tribal fish hatchery or wastewater pumping plant would be possible because wildlife use this area more. Extending the levee southward and/or placing the wastewater pipeline in dense riparian and upland mixed forest could have moderate temporary effects because of the relatively undisturbed nature of the forest.

Minor temporary impacts to wildlife from construction noise and permanent impacts from the presence of the Port Angeles water treatment plant facility would be likely. Additional minor impacts to upland wildlife would occur as a result of installing culverts and building fish-holding/rearing ponds at Morse Creek.

Helicopter noise to outplant fish above the Glines Canyon Dam could have localized, moderate adverse impacts to wildlife. Additional minor to moderate impacts from the use of heavy equipment, helicopters, and barriers such as fencing to revegetate the reservoir lands could occur.

No impairment of park wildlife would occur.

Species of Special Concern

Summary of Laws, Regulations, and Policies

The national mandate of the Endangered Species Act states that fish, wildlife, and plant species are of aesthetic, ecological, educational, historical, recreational, and scientific value to the nation and its people. The act's purpose is to conserve the ecosystems these species depend on and to generally increase populations and secure sufficient habitat to recover species to viable levels.

The act requires the National Park Service to determine whether and the degree to which a proposed action would affect federally listed threatened or endangered species. Consultation with the U.S. Fish and Wildlife Service or NOAA Fisheries is required if the action may affect such a species in order to ensure that it would not jeopardize the species' continued existence.

The Washington Department of Fish and Wildlife also maintains lists of threatened, endangered, and species of concern under the state's administrative code (WAC 232-12-297). These include species on the federal list, as well as species locally rare, unique, or in need of protection.

NPS *Management Policies* require the National Park Service to identify and promote the conservation of all federally listed threatened, endangered, or candidate species within park boundaries (NPS 2000, sec. 4.11). The National Park Service would also control access to critical habitats and conduct management programs that perpetuate the natural distribution and abundance of these species and the ecosystems on which they depend. The policies further require consideration of all state and locally listed species in planning activities. Management objectives specific to the park include the reestablishment of species that have been eliminated as a result of human activities (NPS 1989).

Methodologies for Analyzing Impacts

The focus of the SEIS is mitigation measures that have either changed or require site-specific analysis. In the case of fisheries, both the bull trout and Puget Sound chinook salmon are listed as threatened under the federal Endangered Species Act, and the coho is a candidate for listing. The impacts of mitigation facilities on each of these species is analyzed in this section. Additional information about chinook and bull trout, as well as additional mitigation during dam removal and efforts to quickly restore each of these species following dam removal, is now part of the plan and is analyzed in this SEIS.

Documents relevant to species of special concern were reviewed for baseline information; biological and life history requirements were completed, as well as numerous field surveys (see the "Affected Environment" and sections on individual species below).

Impact analyses are based on a number of factors: the known or likely occurrence of a species or its preferred habitat in the vicinity of the mitigation; direct physical loss of habitat or the effective loss of habitat (through avoidance or abandonment) due to construction activity or noise; and the species' sensitivity to human disturbance. The ability to predict impacts using these tools is limited to qualitative assessments by team biologists.

Vegetation and wildlife at specific sites affected by the proposed actions of the SEIS were examined through site visits in February, May, and July 2003. The sites were surveyed for the following plant species of concern: tall bugbane, spreading miner's lettuce, giant helleborine, false hedge-parsley, Dortmann's cardinalflower, pink sand-verbena, Cotton's milkvetch, long-stalked Draba, western yellow oxalis, looseflower bluegrass, royal Jacob's-ladder, floating bur-reed, and featherleaf kittentails. Animal species that are of concern include the Pacific fisher, four species of bats, the bald eagle, the northern spotted owl, the marbled murrelet, the harlequin duck, the northern goshawk, the pileated woodpecker, two species of frogs, the western toad, and 10 species of anadromous fish.

The following thresholds were applied to assess impacts:

Negligible — Impacts might occur but would be localized and at the lower level of detection.

Minor — There would be slight but detectable localized impacts to habitat, or temporary impacts at the lower level of detection to listed or monitored species. The impact would be comparable to "affect, but not likely to adversely affect" under the Endangered Species Act.

Moderate — Noticeable, localized impacts to habitat might occur, but the impact to habitat over the study area would be at the lower level of detection. Individuals of monitored or listed species might experience slight but detectable temporary effects. The impact would be comparable to "affect, but not likely to adversely affect" under the Endangered Species Act.

Major — Severe impacts to localized habitat might occur; the impact to habitat over the study area would be readily apparent. Individuals of monitored or listed species might be directly and noticeably adversely affected over the short term (comparable to an "adverse effect" under the Endangered Species Act), or many individuals or populations could be benefited.

A major adverse effect would result in formal consultation with the U.S. Fish and Wildlife Service for any species listed as threatened or endangered. As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would have a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

For a species to be impaired, a critical habitat for a listed species would have to be adversely affected on a large scale, or several individuals or a population of a listed species would experience very long-term or permanent adverse effects. This would be comparable to a "jeopardy opinion" under the Endangered Species Act.

Impacts of the No-Action Alternative

Analysis

Mammals. *Pacific Fisher* — As noted in the "Affected Environment," the Elwha River valley is considered possible fisher habitat, especially large diameter trees or snags typical of late-successional (mature or old-growth) mixed and coniferous forests. However, the last observation of a fisher in the Elwha River drainage in the study area was in 1975. The dams have degraded fisher habitat by removing salmonids as prey species and by inundating prime riparian habitat. It is considered highly unlikely that any fishers remain in the forests in and around the areas proposed for construction of water and flood mitigation facilities. The no-action alternative would likely continue current conditions, although Olympic National Park is considering a program to increase fisher numbers.

Bats — Four bat species of concern are known to occupy forests typical of those in the study area. Each of these four species (Townsend's big-eared bat, Keen's myotis, the long-eared myotis, and the long-legged myotis) occupy mid to late-seral forests. Townsend's big-eared bats require caves or mine shafts for hibernation and nursery colonies. Although habitat for these species appears to exist within the impact area, no bats were found in wildlife surveys conducted in 2003. It is therefore presumed that they do not exist directly at any of the construction sites, but would be likely to occupy less disturbed habitat within the range of construction noise. The no-action alternative would result in no additional impacts to bats over what they experience now from use of the area by recreationists and residents, or for existing water supply facilities.

Birds. *Bald Eagle* — Both wintering and nesting eagles were affected by the loss of salmonids as prey. On the middle and lower reaches of the river, the number of eagles feeding on spawning salmonids or carcasses probably decreased during the nine months when carcasses had traditionally been available (August through April). With fewer large riparian trees dying due to reduced river migration, the number of snags that eagles could use as nesting, foraging, and roosting sites has decreased. As a result of the dams and the loss of prey species upstream, bald eagles in the region tend to feed or nest along the coast. A few have been observed along the lower river at other times (see FEIS), but density decreases going upriver from the Elwha River delta, with very low numbers above the Glines Canyon Dam. No bald eagles were observed during any of the wildlife surveys conducted in spring and summer of the locations where mitigation facilities are proposed. The no-action alternative would likely continue current conditions. Eagles would be rarely sighted along the Elwha River, but would frequent more productive coastal waters in the area.

Northern Spotted Owl — A total of 514 potential acres of mature and old-growth forest habitat was inundated by the reservoirs, eliminating potential nesting, roosting, and foraging habitat for spotted owls above Elwha Dam. As noted in the "Affected Environment," this species requires unlogged old-growth forests, which is unavailable in any of the project area. While nesting locations vary year to year, spotted owls nonetheless have habitat requirements that are not true of any of the second-growth forest growing at or near potential construction sites. Surveys conducted to determine impacts of dam removal (see FEIS) found three active nests 1–2 miles from the dam sites. The no-action alternative would likely continue conditions favoring a few owls in the vicinity.

Marbled Murrelet — A total of 438 potential acres of old-growth conifer and mixed forest habitat was inundated by the reservoirs, eliminating potential nesting habitat for murrelets. As noted in the "Affected Environment," this species nests in old-growth or mature coastal forests. Although no evidence of nesting in the vicinity of the dams or proposed mitigation facilities was found during surveys in 1995 and 1996, the Elwha valley, including the study area, is used by murrelets as a flight corridor between the marine environment and upper reaches of the valley, where several pairs continue to breed.

Harlequin Duck — As noted in the "Affected Environment," several wintering harlequin ducks were found near the river mouth in surveys conducted in the mid 1990s. This species usually breeds in forests adjacent to swift-moving streams, and the Elwha River drainage is considered prime nesting habitat. No breeding or wintering harlequin ducks were found in any of the wildlife surveys conducted in 2003.

Northern Goshawk — This species breeds in the dense canopy of mature conifer or mixed conifer forests. Grouse are an important prey item. Although no goshawks were observed during any of the wildlife surveys conducted for this SEIS or the FEIS, habitat exists north of the WDFW fish-rearing channel and south of the Halberg property.

Pileated Woodpecker — A single woodpecker was observed in the forest south of the Halberg property, and there was evidence of another at the Elwha water treatment plant site. The pileated woodpecker requires individual large trees or snags for nesting and feeding. Under the no-action alternative these sites would be left relatively undisturbed.

Amphibians. *Northern Red-legged Frog* — Northern red-legged frogs were observed in more intense surveys at the larger wetland complex at the industrial intake channel and in side channel wetlands at the alternative DCWA well field location. As noted in the “Affected Environment,” this species is widely distributed along the Pacific coast, and it has no formal protected status, rather it is monitored by the U.S. Fish and Wildlife Service as a species of concern.

Tailed Frog — No tailed frogs were observed during any of the wildlife surveys. However, the cold, clear, mountain streams this species prefers exist in the study area, and this species is likely to be present. Like the red-legged frog, tailed frogs are widely distributed in the mountains of Pacific and western states. It is a federal species of concern.

Western Toad — Western toads were observed in the forested portions of the site proposed for the Elwha water treatment plant, and they are likely to occur more widely throughout the forests of the study area because they do not depend as much on open water as do frogs.

Fish. *Chinook Salmon* — Chinook salmon used to migrate as far as about RM 42, but migration has been limited to the lower 4.9 miles of river below Elwha Dam since about 1910. Habitat below the dam is degraded and does not provide the deep pools and the upper river areas needed for spring runs of Elwha River chinook. Chinook primarily use the mainstem of this section of river rather than tributaries for spawning. Because of elevated water temperatures and the resultant exacerbation of parasitic infestations in some low water years, adult chinook are sometimes removed from the river by WDFW personnel and held in the cooler, groundwater-fed, adult holding pond until artificially spawned. This means many of those attempting to spawn in the lower 4.9 miles of river are removed by gaffing or netting for propagation in the WDFW rearing channel.

The Elwha chinook salmon stock has been artificially propagated in the watershed since the early 1930s as a means to mitigate for the loss of juvenile and adult fish production resulting from dam construction. The fish-rearing channel was constructed in 1974. The major stock used in the hatchery program has been the Elwha River summer/fall chinook. NOAA Fisheries included the Elwha hatchery stock as part of the ESA-listed threatened Puget Sound chinook salmon evolutionarily significant unit in its 1999 listing because it was considered essential for recovery of the unit. From 1988 through 1996 the average number of chinook salmon juveniles released annually through the program was approximately 1.82 million fingerlings and 528,000 yearlings. The current hatchery program produces only subyearling chinook fingerlings, with an annual goal release number of 3.85 million fish.

The total number of chinook returning to the river averaged about 2,000 adult fish between 1990 and 2002, ranging from a low of 1,150 to a high of 3,361 fish during this period. This is lower than the goal of 2,900 returning chinook. A substantial proportion of the total number of adult chinook returning to the river die prior to spawning during years when river flows are low and water temperatures become high. Pre-spawning mortality has ranged up to 68% of the population, due largely to parasitic infestations described above. The average number of spawners over the last five years has been 2,079, which is somewhat higher than the average of 1,611 for the preceding five years (1993–1997). From 1986 through 2002, the total number of adult chinook salmon surviving to spawn naturally in the Elwha River has ranged from 163 fish (1994) to 5,228 fish (1988). During the same period, the number of adult fish collected as volunteers to the hatchery or removed from natural spawning areas for use as hatchery broodstock has ranged from 663 fish (1995) to 2,595 fish (1988).

A large portion of the natural spawners is taken for hatchery brood stock, and many of the hatchery returns stray and spawn in the river rather than the rearing channel (PNPTC et al. 1993). Because of this crossover, the Elwha chinook run is managed as a single unit, i.e., returns to the hatchery and naturally spawning fish are combined to represent the total chinook escapement. In years of high escapement, limited spawning habitat creates crowded conditions for the spawning adults, with much higher density of redds (spawning nests) per river mile than in other streams.

Under the no-action alternative natural chinook production would continue to decrease. Disease and genetic problems related to hatchery dependence would contribute to the loss of the naturally spawning stock. Fishing opportunities would likely become more restricted, potentially limiting all harvest of this stock. Water temperatures would remain elevated, contributing to disease and a significant number of pre-spawning adult mortalities.

Native Char (Dolly Varden and Bull Trout) — The lower and upper Elwha River subpopulations of bull trout represent 2 of the 34 subpopulations identified in the listing under the Endangered Species Act. The U.S. Fish and Wildlife Service rates the lower Elwha River subpopulation as "depressed," as noted in the "Affected Environment," based on extremely low numbers of char observed in recent years. The status of the upper Elwha River subpopulation is unknown, although fish have been found in low numbers in Lake Aldwell, in several tributaries in the middle reaches of the Elwha River between the dams, and in relatively high numbers above Lake Mills.

The lower river subpopulation is thought to be anadromous. Few fish are observed in the river, and no spawning population has been documented, although recent snorkel surveys identified three char fry in 2003, but only a handful of adults (10″–24″) since surveys began in 2000 (Pess, pers. comm. 2003). This population has likely been negatively impacted by the loss of access to the upper river, by habitat degradation (elevated water temperatures, lack of suitable spawning gravels), and potentially by harvest activities in the lower river. However, some bull trout from the middle or upper Elwha River may survive passage over the dams during periods of surface spill, thus contributing to the lower river population. Since some recruitment from above the dams could continue with the dams in place, the lower river subpopulation could possibly continue to persist in low numbers as a result of recruitment under the no-action alternative.

Construction of the dams isolated populations of bull trout in both the middle and upper Elwha River stretches. The creation of Lakes Aldwell and Mills also modified habitat features, resulting in the establishment of adfluvial populations (fish that live in lakes and migrate into streams to spawn) in these reservoirs. Fluvial populations (fish that live, feed, and mature in the mainstem and migrate to tributaries to spawn) are also present. It is believed that the upper river population, which appears to be in better shape than the lower river population, would continue to live in the river and reservoirs without dam removal.

A survey of one of the overflow channels at the industrial intake channel where the Elwha water treatment plant would be constructed found one bull trout.

Coho Salmon — Coho are limited to the lower 4.9 miles of the river. This habitat is degraded, with few gravel bars, side channels, woody debris, or other habitat needed for successful rearing. As noted in the "Affected Environment," a portion of the Elwha River coho run is raised in the tribal hatchery. Poor habitat conditions in the river would continue under the no-action alternative, and a viable population of coho in the Elwha would rely on artificial hatchery production. Dependence on hatchery propagation could degrade the quality of the stock because of increased potential for disease, inbreeding, and artificial selection pressures. Mechanical breakdowns and power outages at the hatchery facilities could further hamper survival.

Pacific and Brook Lampreys — Although both of these species have been observed in the Elwha River or its tributaries, their current status is unknown. None was found in any of the surveys conducted at the mitigation facility sites.

Plant Species of Special Concern. Tall bugbane, spreading miner's lettuce, giant helleborine, false hedge-parsley, hedge-parsley, helleborine, and bugbane may have been impacted in the past by road building and dam construction. Plant surveys in the project area were conducted in the spring of 2003, and no individuals of any protected plant species were found.

Cumulative Impacts

Species of concern are those species whose habitat has been removed through development, logging, and siltation; through deliberate filling, damming, or recreational use; or through other forces (such as commercial fishing) that have caused populations to dwindle to dangerous levels. Each species has been affected by some or many of these factors. Those species that are particularly sensitive to the presence of humans, such as the Pacific fisher or goshawk, might be indirectly affected through noise or human activity from more distant developments.

Harvests of the two salmon species of special concern, chinook and coho, can be intense. Coho are heavily harvested in the marine environment and to some degree in the Elwha River by the Lower Elwha Klallam Tribe and through sportfishing. Marine harvest rates of coho commonly exceed 65% of total harvest (U.S. Department of the Interior, Department of Commerce, and Lower Elwha S'Klallam Tribe 1994, p. 16). Reported in-river harvest of coho by the Lower Elwha Klallam Tribe from 1985 to 1994 has been as high as 9,000 fish, but is usually in the range of 500–2,000 (Northwest Indian Fisheries Commission [NWIFC] 1995). Annual sport harvest in the Elwha River has a daily limit of six fish per person. In 1992, the most recent year for which data are available, the Elwha sport catch was 368 fish (Zinicola 1994).

In recent years (1990–2000), an annual average of 47% (range 18% to 70%) of the sub-adult and adult chinook salmon population originating from the Elwha River to spawn are estimated to have been intercepted in ocean fisheries. Another substantial portion die in marine waters before returning to the river because of predation or other natural causes. Fishing pressure has been decreased on Elwha River chinook salmon in U.S.-managed marine and freshwater areas in response to the listing of the population under the Endangered Species Act. Harvest protection measures implemented by the state and the tribes are now designed to limit the proportion of the total Elwha River chinook return for a particular year to less than 6% in southern U.S. fisheries.

Spotted owls and marbled murrelets have been impacted primarily through the logging of old-growth and mature forest communities. The consequence of continued logging activity in their habitat is currently an issue of local, regional, and national debate (USFS and BLM 1994). Bald eagle populations recovered from their lowest levels in the 1970s and have been upgraded from endangered to threatened status. Restoration of the salmonid fisheries in the Elwha River would support this trend.

Conclusion

Most species of special concern have been and would continue to be adversely affected by the presence of the dams, either because habitat is inundated or occupied by the hydroelectric projects, or because salmon prey species are no longer available. Although little known habitat for threatened mammals or birds exists within the project area, some does occur for species that are of concern, with no formal listing. This includes wetlands where red-legged frogs, tailed frogs, and western toads live; forests where pileated woodpeckers were observed; and the river mouth where bald eagles and harlequin ducks feed. In addition, the Elwha River corridor is a flight path for marbled murrelets. Forests adjacent to the development sites may also be habitat for goshawks, bats, or plant species of concern. The river environment is home to the threatened chinook salmon and bull trout, and the candidate coho salmon, and it may provide limited habitat for the Pacific and brook lampreys. Under the no-action alternative the population of native (not hatchery raised) chinook and the lower river subpopulation of bull trout would die off. This would be a significant and adverse impact to fisheries in the Elwha River, but because these species and the Elwha River are only part of an extensive series of watersheds in the park, there would be no impairment.

Impacts of the Proposed Action

Analysis

Mammals. *Pacific Fisher* — It is unlikely that the proposed mitigation facilities would have any impact on the Pacific fisher, as no fishers have been observed in the area for nearly 30 years, and the species is presumed to be extirpated in the lower Elwha River valley.

Bats — It is possible that noise or vibration from construction equipment or blasting could adversely affect bats. Townsend's big-eared bats are known to be very sensitive to human disturbance. A single human entry into some colonies has caused the bats to abandon the roost. Noise and flashlights also disturb this species, forcing them to abandon caves or move to areas with less than optimal habitat (NPS 2003). Vibrations from blasting can also have adverse effects on this species, particularly if it takes place during the maternity cycle, when infant bats could fall to the floor of the cave and perish. Because Townsend's bats are a colonizing species, disturbance from noise, the presence of humans, or vibrations can have a widespread, adverse effect.

Townsend's and the other three species of bats known to inhabit forests in the project area are active at dawn or dusk and at night, so construction noise would not likely interfere with their ability to echolocate and find food. However, daytime noise could be annoying enough that individuals of other species, or colonies of Townsend's big-eared bats, would seek alternative habitat. If so, the impact to these federal species of concern would be moderate, adverse, and long term.

Birds. *Bald Eagle* — The "Biological Opinion" prepared in accordance with section 7 of the Endangered Species Act for the FEIS determined that dam removal "may affect but is not likely to adversely affect" the bald eagle (USFWS 1996). This decision is based on the lack of known nesting or wintering bald eagles along the shores of the river itself. However, the "Biological Opinion" notes that any impacts to eagles would be "disturbance related," such as those from construction noise. Nesting bald eagles are particularly sensitive to sound or disturbance by humans or human activity, such as from boats, cars, or hikers. The early phases of reproduction, including egg laying, incubation, and the early nestling period, are times when bald eagles are more likely to flush the nest when disturbed. Flushing can adversely affect adult eagles through energy loss, but can also more severely affect eaglets or eggs (Anthony et al. 1995; Grubb et al. 1992). If noise or activity is very frequent, some eagles may either abandon a nest or not return to it the following year (Knight and Cole 1995). If no eagles nest within hearing range of the construction sites along the river, this is not an issue. However, any eagles nesting near the mouth could by disturbed by construction to extend the federal levee northward, or the private levee on the western bank of the river. If a bald eagle did nest here or along the lower Elwha River, moderate impacts could result. If the eagle was simply wintering in this area, impacts from construction noise would be minor to moderate and temporary.

Northern Spotted Owl — The "Biological Opinion" issued for the FEIS indicated that the project "may affect, but is not likely to adversely affect" spotted owls (USFWS 1996). This is because surveys concluded that the closest of two known spotted owl territories was 0.9 mile from the dam site and 2,000 feet at its closest point to the access road to that dam. Disturbance to that owl as a result of blasting and road use would likely be minor because of the distance, topography, and temporary nature of the construction project. Noise from construction of the mitigation facilities would not be as loud as from dam removal, and it would take place for the most part in the disturbed mixed-conifer forest, where no spotted owl territories are known to exist. Therefore, no impacts from construction activities are expected to the northern spotted owl.

Helicopter use to outplant fish above the Glines Canyon Dam could have temporary, moderate effects on some individual spotted owls, but these would be very short term and only occasional. The "Biological Opinion" requires flight paths no closer than 0.25 mile from suitable marbled murrelet habitat, a minimum height of at least 100 feet, and a forward speed of at least 25 knots to prevent hovering. If these same standards were applied voluntarily for spotted owls, impacts would be reduced.

Marbled Murrelet — The "Biological Opinion" for the FEIS determined that the dam removal would be "likely to adversely affect" the marbled murrelet and imposed certain conditions and restrictions on the project to help minimize any impacts from construction and operation of the proposed mitigation facilities (USFWS 1996). In addition, the "Biological Opinion" indicates the USFWS guidelines for determining the impact area for both spotted owls and marbled murrelets is no closer than 1 mile to blasting noise and 0.25 mile to noise above ambient levels. Given that no habitat for murrelets lies within these distances for blasting or construction, impacts to nesting birds from noise are expected to be negligible or non-existent.

The "Biological Opinion" also indicates one form of impact to marbled murrelets expected from dam removal is the disturbance of birds as they fly between the coast to feed and their upriver nesting sites along the Elwha River. Demolition activities at the dam sites are expected to cause the birds to deviate from their accustomed routes. Floodproofing either DCWA well field site, constructing the Elwha water treatment plant, raising and extending the levees, replacing the diversion and intake structure, and constructing a tribal hatchery and/or wastewater pumping station, as well as constructing Morse Creek chinook holding ponds, would all occur within the river corridors used or suspected of being used by murrelets. Impacts from these activities on murrelets traveling through this area could be minor or collectively moderate for up to two years.

Harlequin Duck — Harlequins are highly sensitive to any kind of human disturbance and are unlikely to re-nest if disturbed (Washington Department of Wildlife [WDW] 1991). Studies in North Cascades National Park indicate that harlequins are even more disturbed by humans on foot than in rafts or kayaks (NPS 1990). Much of the riverbank in the area where construction would take place is already well used by recreationists, which may account for the lack of observations of harlequins during recent wildlife surveys. However, as noted in the "Affected Environment," several wintering harlequin ducks were observed in an earlier survey on the coast near the river mouth. The only proposed mitigation activities that might affect this species are likely to be raising, strengthening, and extending the federal levee northward and raising the private levee. If construction took place in the winter, it is possible that harlequin ducks would be disturbed enough to abandon the site for the season, a minor adverse impact.

Northern Goshawk — Only one pair of goshawks is known in the Elwha River valley corridor, and they traditionally nest along the Whiskey Bend trail. The nest site, however, is approximately 3 miles up the trail from the upstream end of Lake Mills, and no impacts are expected under the proposed action. It is possible, but not likely, that a goshawk could inhabit forest to the north or east of the Elwha water treatment plant site, but none was observed during surveys. Given the shy nature of this species and the proximity of this forest to development and human activity, the chances of goshawks inhabiting forest in the lower Elwha valley are considered remote.

Pileated Woodpecker — As noted above for the no-action alternative, two pileated woodpeckers were noted in the spring 2003 surveys. One was in the forest south and east of where the levee road would likely be raised, strengthened, and extended on the Halberg property. Tree removal would be required to complete these flood mitigation activities, with a direct impact on this species. Signs of a second pileated woodpecker were noted in the forest east of the Elwha water treatment plant site. Both these forests consist of older second-growth trees. Construction noise is expected to be quite loud at this location for a period of two years; the woodpecker is likely to abandon the site for at least this period of time. Other pileated woodpeckers were not specifically observed during the surveys but are very likely to inhabit similar conifer or mixed-conifer forests that are not subject to loud or annoying human activities. Construction noise or the removal of trees to facilitate construction would have a moderate, adverse impact on individuals in the study area.

Amphibians. *Northern Red-legged Frog* — As noted for the no-action alternative, red-legged frogs were observed in open wetlands near the DCWA well field and the Elwha water treatment plant sites. They are also likely in other emergent wetlands along the road to the DCWA well field or the road required to access pipelines, and possibly in riparian habitat in spots along the entire affected section of the river corridor from RM 3.7 to the mouth. Those frogs in the off-channel, water-filled gravel pits near the DCWA alternative well field site would likely be adversely affected from the filling needed to raise the well field, if this option was chosen. Frogs in smaller wetlands along the road could experience increases in construction noise and turbidity, which may cause them to leave. They might also acclimate to the noise and increased truck traffic. Impacts would be minor to moderate.

Tailed Frog — Tailed frogs were not observed during surveys, but may be present. This species is widely distributed throughout a large range, but tailed frogs are sensitive to stream warming. Increases in water temperatures of 4°C–8°C below the Elwha Dam may be enough to keep tailed frogs from occupying the Elwha River. Construction would have an unknown, but likely no more than minor, adverse impact on this species.

Western Toad — Western toads were observed in forested portions of the site east of the Elwha water treatment plant site, and they are likely to occur in mixed riparian forest in spots throughout the project area.. Construction would involve the use of heavy equipment, grading, tree removal, and vegetation trampling. All of these activities could kill toads or remove their habitat. Impacts could range from minor to moderate.

Fish. *Chinook Salmon* — Chinook salmon would experience impacts from the same construction and in-water activities as described for other species under "Native Anadromous and Resident Fisheries" (e.g., increased turbidity during construction, in-river work to replace the diversion and intake facility). To the extent possible, construction would occur in the two dry seasons before dam removal began to avoid impacts to fish. Best management practices would be applied during construction to minimize soil lost to the river and increases in turbidity; however, turbidity would inevitably increase when the river refilled during the fall and winter. If construction extended beyond the dry periods, turbidity, fuels, lubricants, and chemicals could threaten water quality and chinook for short periods, such as during high storm events. Because turbidity would already be higher than normal during these events, loose soil or other pollutants washed into the river or side channel might not be detectable. However, if there was an accidental release, a pulse of increased turbidity would be noticeable.

In addition to construction work on land near the river, some in-river work would be required to replace the diversion and intake facility, to install or replace some flood control measures, and possibly to lay pipelines. Sediment released as a result of these activities could be minimized during low-flow or dry seasons, or by constructing a cofferdam or other barrier, but eventually a pulse of sediment would be released downstream. Because river substrate below the dams is primarily embedded cobbles rather than fines, sediment release would be less than in a similar undammed river. The rock diversion structure also has accumulated gravels that would be released when the dam was removed. This would cause a loss of spawning sized gravel from behind the dam, a minor, adverse, short-term impact to chinook using this gravel for spawning. The gravels would be replaced following dam removal.

It is unlikely that chinook would experience turbidities during construction of more than 1,000 mg/L. This is a turbidity level already experienced during storm events in the Elwha River, with no known or apparent increases in morbidity or mortality among chinook. If upstream sediment was added to the river by a storm, turbidities could be higher in the vicinity of the mitigation facilities during construction, up to a maximum of about 2,000 mg/L. These turbidity levels can affect fish feeding and behavior if they occur over a longer period of time (more than six weeks). However, because they would not last more than a few hours or days, impacts are expected to be only negligible to minor and confined to the lower 3.7 miles of the main river stem. These same types of construction-related impacts would be possible on Morse Creek, where temporary chinook-rearing facilities are planned as a backup to production from the Elwha River.

The "Biological Assessment" for chinook, which will become the basis of a biological opinion by NOAA Fisheries on how best to protect chinook during dam removal, also has added a proposal for monitoring erosion and siltation and the success of any revegetation efforts along the river required as a result of constructing mitigation facilities. If, during the period of monitoring (five years following construction and revegetation), additional mitigation was needed to reduce impacts to chinook, these measures would be implemented (NPS 2002). The "Biological Assessment" also proposes the use of best management practices to minimize erosion, release of sediments, or the removal of trees, shrubs, and coarse or large woody debris. Road widening would be kept to the minimum needed to provide access by heavy equipment. Instead of further widening to maintain public access during the construction period, shuttle service through the road closure zone would be provided.

In addition to increases in turbidity, construction could remove riparian vegetation or prey used by chinook. In-stream work particularly would disrupt the riverbed and invertebrate prey. However, this impact is expected to be of short duration as aquatic invertebrates rapidly recolonize relatively small, depopulated areas (Somer and Hassler 1992). Overhanging vegetation would regrow following the completion of construction for the most part, although permanent loss of streamside habitat is likely at the diversion and intake site, as well as along the access road. Because the losses would be localized, they would likely only have minor adverse effects on fish species.

As noted in the "Native Anadromous and Resident Fisheries" impact section, extending the federal levee or lengthening or building other flood control structures could remove riparian vegetation and related fish habitat, including that used by chinook. It might also adversely affect woody debris recruitment and sediment transport in the localized area. Collectively, these impacts would be negligible or minor for chinook or other fish species. Placing large woody debris to act as cover and habitat in the vicinity of the federal levee and other larger-scale flood control structures would mitigate these impacts.

In addition to adverse effects of construction on chinook, this SEIS presents and analyzes the benefits of several new mitigation measures aimed at protecting chinook during dam removal and increasing the success and speed of restoration. Mitigation measures include additional clean water "windows" in the dam removal process, keeping the state's chinook-rearing channel in the Elwha open during dam removal, using Morse Creek for additional production, outplanting following dam removal, and using monitoring and best management practices to minimize the effects of flood control and water quality mitigation measures on chinook (and all fisheries stocks). Each of these measures is described in more detail below.

The FEIS stated that dam removal activities resulting in sedimentation downstream would be stopped during high spring runoff in April and May to help chinook (and steelhead) entering the river. The SEIS proposes extending this stoppage to June 30 to allow fish releases from the rearing channel and tribal fish hatchery to migrate out of the river. A second period of closure from August 1 to September 14 would be added for summer/fall chinook to return to the river, and in particular to the WDFW fish-rearing channel.

The FEIS proposed moving the WDFW rearing channel activities to the Solduc hatchery during dam removal to protect the chinook stock. This would mean that the chinook reared during these three years would return to the Solduc River and could mix with existing chinook stocks in that river. To keep the Elwha stock pure, and to keep production of the Elwha chinook high, the fishery co-managers have decided to keep the rearing channel in the Elwha open throughout dam removal. A clean water source (as described above under "Surface Water") would be required to keep the rearing channel open. To further ensure the stock was protected, some hatchery production during dam removal might be shifted to Morse Creek. Adults returning to Morse Creek would be captured and used to produce additional eggs and young fish for the restoration process.

In addition to outplanting eggs or subyearlings, adult fish could be transported by helicopter above Lake Mills during dam removal to increase the restoration stock of chinook in the Elwha River. The number of flights would be limited when spotted owls or marbled murrelets are nesting. This measure would be used if the hatchery and Morse Creek were filled to capacity and additional chinook in the Elwha needed a clean water environment.

Collectively, these measures would provide additional assurance against the loss of fish stock during dam removal, increasing chances of successful chinook restoration in the Elwha River. These would be potentially moderate to major beneficial impacts for chinook.

Coho Salmon — Like chinook, coho salmon would experience impacts from the same construction and in-water activities as described for other species under "Native Anadromous and Resident Fisheries" (e.g., increased turbidity during construction, in-river work to replace the diversion and intake facility). To the extent possible, construction would occur in the two dry seasons before dam removal began to avoid impacts to fish. Best management practices would be applied during construction to minimize soil lost to the river and increases in turbidity; however, turbidity would inevitably increase when the river refilled during the fall and winter. If construction extended beyond the dry periods, turbidity, fuels, lubricants, and chemicals could threaten water quality and chinook for short periods, such as during high storm events. Because turbidity would already be higher than normal during these events, the washing into the river or side channel of loose soil or other pollutants might not be a detectable change. However, if there was an accidental release, a pulse of increased turbidity would be noticeable. Because coho inhabit the lower Elwha River year round, they may be one of the species most sensitive to such an increase in turbidity.

In addition to construction work on land near the river, some in-river work would be required to replace the diversion and intake facility, to install or replace some flood control measures, and possibly to lay pipelines. Sediment release from these activities could be minimized during low-flow or dry seasons, or by constructing a cofferdam or other barrier, but eventually a pulse of sediment would be released downstream. Because river substrate below the dams is primarily embedded cobbles rather than fines, sediment release would be less than in a similar undammed river. The rock diversion structure also has accumulated gravels that would be released when the dam was removed. This would cause a loss of spawning sized gravel from behind the dam, a minor, adverse, short-term impact to chinook using this gravel for spawning. The gravels would be replaced following dam removal.

It is unlikely that coho would experience turbidities during construction of more than 1,000 mg/L. This is a turbidity level already experienced during storm events in the Elwha River, with no known or apparent increases in morbidity or mortality among coho. If upstream sediment was added to the river by a storm, turbidities could be higher in the vicinity of the mitigation facilities during construction, up to a maximum of about 2,000 mg/L. These turbidity levels can affect fish feeding and behavior if they occur over a longer period of time (more than six weeks). However, because they would not last more than a few hours or days, impacts are expected to be only negligible to minor and confined to the lower 3.7 miles of the main river stem. These same types of construction-related impacts to coho would be possible on Morse Creek, where temporary chinook-rearing facilities are planned as a backup to production from the Elwha River.

Bull Trout — Bull trout have more specific habitat requirements than other salmonids. In general, this species needs cold water, complex cover, stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. As noted in the "Affected Environment," the bull trout population in the lower river is "depressed" and has experienced severe declines. Water temperature, more than any other factor, is recognized by researchers as influencing bull trout distribution. An unknown number of bull trout exist in the lower river subpopulation, but they are known to exist in low numbers. Spawning has not been documented. Three groundwater-fed channels (side channel complexes with low gradient and favorable temperature characteristics) in the Elwha River below the Elwha Dam could be used by bull trout — Bosco, Boston, and Charley Creeks.

Because bull trout are especially sensitive to water quality, they, more than other species, might experience minor to moderate effects from increases in turbidity associated with the construction of mitigation facilities, as described above for chinook. However, turbidity is expected to be gone from the river within a few hours or days from the time it enters it (such as during a high storm event), so the effects would be temporary.

As noted in the "Affected Environment" and elsewhere, bull trout have also been listed as a threatened species since the FEIS was published. As a result, the U.S. Fish and Wildlife Service has written a set of terms and conditions that will function as additional means of protection for this species during dam removal. These are presented and analyzed below.

These measures fall into four categories: (1) preparing a rescue and removal plan for individual bull trout; (2) providing a temporary holding area for rescued bull trout; (3) improving accessibility to Elwha River tributaries during and following dam removal; and (4) monitoring effects of dam removal on bull trout habitat from the mouth of the river to the upstream end of Lake Mills.

Bull trout collected from the river between the Glines Canyon Dam and the Elwha Dam prior to dam removal would be transported to the Elwha River above Lake Mills. Bull trout collected from the river below the Elwha Dam would be genetically tested to determine their river of origin (i.e., the Elwha, Dungeness, or other stream). Fish originating in the Elwha would be transported above Lake Mills, while bull trout from other streams would be transported to either Dungeness Bay or Freshwater Bay.

The "Biological Opinion" by the U.S. Fish and Wildlife Service requires the National Park Service to replace or modify Hot Springs Road culverts that limit or block access to tributaries (identified above) that could be used by bull trout as a refuge during periods of high turbidity. Eastern brook trout would need to be removed (through electrofishing) from these tributaries prior to culvert removal in order to prevent hybridization with bull trout. The U.S. Fish and Wildlife Service has also required monitoring sediment levels before dam removal, following dam removal for 10 years or until pre-dam levels of sediment were restored, and periodic monitoring of suspended sediment and bedload levels after turbidity stabilized. If turbidity had not stabilized after 10 years, then sediment stabilization techniques such as replanting to reduce upstream erosion, must be implemented (USFWS 2000).

While the subpopulation above the Glines Canyon Dam would essentially be unaffected by dam removal, the lower Elwha subpopulation would largely be lost without these mitigation measures. Implementing mitigation measures would provide bull trout from the lower river with clean water refugia in tributaries and above the dam, helping them survive the impacts of dam removal, a major benefit to this species. Reconnecting the two subpopulations is one of the USFWS recovery goals for this species in the Elwha basin; it would also provide nutrients in the form of salmon carcasses for bull trout upstream of the dams and provide access to the marine environment. The Fish and Wildlife Service is hopeful that this open access would restore anadromy to the Elwha bull trout population (USFWS 2000).

Pacific and Brook Lampreys — In the Elwha River these species are thought to be at very low levels, possibly critically depressed, given that the conditions required by them to flourish and spawn are similar to salmonids. Impacts to individuals would be similar to those described above for chinook salmon, and they would experience minor adverse effects from increases in turbidity. The turbidity would be experienced as short-term pulses during major storm events. Dam removal and habitat restoration would have potentially major beneficial impacts for these fish.

Cumulative Impacts

In addition to the cumulative impacts described for the no-action alternative, species of special concern would also experience impacts related to dam removal. These are analyzed in the FEIS and include noise, blasting, road traffic, air emissions, and the release of sediments from behind the dams. They would also experience the major long-term benefits associated with restoration of the Elwha River ecosystem.

Conclusion

It is unlikely that proposed mitigation facilities would have any impact on the Pacific fisher, although moderate impacts to bat colonies would be possible. Minor to moderate temporary impacts on bald eagles wintering in the river construction area, or moderate impacts on nesting eagles at the river mouth from levee construction could occur. Minor to moderate, temporary impacts from helicopter use might occur on both northern spotted owls and marbled murrelets; additional minor to moderate impacts on murrelets traveling along the river corridor between upriver nesting sites and the coast would be possible during construction. Wintering harlequin ducks could experience minor effects from the construction of a levee extension northward. Construction noise and tree removal might have a minor to moderate impact on pileated woodpeckers. Impacts on small wetlands from filling, and indirect impacts on larger wetlands from construction, could result in minor to moderate impacts on northern red-legged frogs and tailed frogs. Grading or excavating could have minor to moderate impacts on western toads. Turbidity during construction could result in minor impacts on chinook salmon and Pacific and brook lampreys; however, turbidity could result in moderate temporary impacts for bull trout, as this species is more sensitive to water quality. Coho salmon, because they inhabit the river year-round, might also experience minor to moderate impacts from increased turbidity associated with construction of mitigation facilities. The extension of levees could have minor impacts on chinook, coho, or bull trout through the removal of riparian vegetation and other habitat. Additional mitigation measures designed to protect chinook and bull trout during dam removal, to prevent loss of the stock, and to increase the chance and pace of successful restoration would potentially have major benefits for both species. No impairment to park resources or values would occur.

Air Quality

Summary of Regulations and Policies

The Olympic Region Clean Air Agency (ORCAA) enforces federal, state, and local air pollution standards in Clallam County. Short-term construction activities are generally exempt from the agency's new source review permitting requirements (Regulation 1, Article 7 [d]). However, proposals are subject to regulations applicable to all air pollution-causing activities for which precautions to prevent reasonable fugitive dust and odors are required (Regulation 1 and WAC 173-400). Impacts to air quality are also regulated under the Clallam County conditional use permit process.

Methodologies for Analyzing Impacts

The air quality impact analysis is focused on dam rubble disposal activities and emissions from heavy construction and hauling equipment.

The follow assumptions about vehicle trips were made:

- Between 30 and 50 heavy-duty diesel vehicles per day would be required for construction of the Elwha water treatment plant. Trucks would enter and exit the site five days a week for 50 weeks annually for a two-year period. Materials, including cement, would be available within a 10-mile drive of the construction site.
- Between 3 and 10 heavy-duty diesel vehicles per day would be required for construction of the Port Angeles water treatment plant. Other assumptions would be the same as above.
- Between two and four light-duty diesel trucks per day for six months would be needed to elevate wellheads at the existing DCWA well field or to construct a new well field and pipelines. Soil to elevate the site would be brought from borrow pits no farther than 25 miles away.
- Between 10 and 20 light-duty diesel trucks per day for six months would be needed to raise and strengthen the federal and private levees. Soil would be brought from borrow pits no farther than 25 miles away.

Year 2000 emission information for vehicles is from the Bureau of Transportation Statistics (National Transportation Statistics, Table 4-38, 2000).

Standard threshold definitions were applied:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would be a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

Air quality is not affected by the dams, except indirectly as a result of providing 172 annual gigawatt hours of clean power.

Presently, Clallam County and the project site meet standards for all criteria pollutants. Silvicultural burns, pulp mill emissions, dust and other particulate matter generated from vehicles on unpaved roads, vehicle exhaust, and smoke from campfires, slash burning, and occasional forest fires affect air quality in the middle and lower Elwha valley areas and in Olympic National Park. The park is subject to episodes of smoke and particulate matter pollution from slash burning on adjacent lands and occasional forest fires; these short-term events affect visibility but have limited impact on other park resources. For those air quality indicators measured inside the park, all emissions are well below national standards (see Table 18).

Table 18. Air Quality Data and Standards for Olympic National Park (2002)

Pollutant and Averaging Time Period	National Ambient Air Quality Standards	Highest Measured in 2002
SO_2		
1-hour[a] (parts per billion or ppb)	--	16
3-hour (ppb)	549	11
24-hour (ppb)	144	3.2
O_3 (ozone)	124	46
1-hour (ppb)		
8-hour average exceedances (ppb)	84	none

Cumulative Impacts

As noted above, other sources of air emissions in the region include vehicles, smoke from wood stoves and campfires, silvicultural burns, and pulp mill emissions. Despite these emissions, air quality is considered high quality.

Conclusion

The hydroelectric projects do not adversely affect air quality, which is in attainment for all criteria pollutants in Clallam County. No impairment of park air quality would occur under the no-action alternative.

Impacts of Proposed Action

Analysis

Dam Rubble Disposal. The FEIS described the disposal of dam rubble in terms of site reclamation. In the previously proposed action approximately 210,000 cubic yards of concrete, rock, and earth fill (including 20,000 cubic yards of concrete from the Elwha Dam site and 15,000 cubic yards of concrete from the Glines Canyon Dam site) would have been trucked to one or more of several surface mines or open pit sites. Since that analysis, concrete has become more valuable, making the option of crushing the material for recycling a viable one. When compared to surface mine disposal, it is possible that removal of dam rubble in the proposed manner could occur more quickly and would be considered environmentally preferred.

Under this proposal dam rubble would be trucked to one or more sites for crushing. Several facilities permitted to conduct concrete crushing operations currently exist in both Clallam and Jefferson Counties. One or more of these could be selected for crushing operations. With the amount of rubble involved, crushing operations at this facility could be increased to accommodate the incoming materials, or the concrete could be stockpiled on the facility site for later crushing operations.

Issues related to air quality and the crushing of concrete are regulated under the air quality permit issued by the Olympic Region Clean Air Agency to such facilities. In addition, air quality is reviewed and regulated through the Clallam County conditional use permit process required for this action. Permit issues would include, among other things, emissions, times of operations, lighting, and noise.

While a facility has not yet been selected for concrete crushing, the contractor would ultimately be responsible for compliance with all air quality permitting requirements. Only facilities currently permitted to do such work would be asked to bid on the project.

Construction at each mitigation site proposed in this SEIS and along dirt roads into the sites would also result in dust and particulates. Best management practices would help minimize these effects, and impacts would remain localized and therefore minor or moderate for short periods of time.

Vehicular Emissions. Heavy-duty trucks, including semi tractor-trailer combinations and concrete delivery trucks, would be routinely used for the larger construction projects (e.g., the Elwha and Port Angeles water treatment plants). It is estimated that construction of the Elwha water treatment plant would require on the order of up to 50 trucks entering and leaving the site per day (URS 2003d). During operation of the facility (e.g., during dam removal), two to four trucks per day would enter and leave the site. Once the treatment plant was shut down for the most part, traffic would be similar to what it is now — light-duty trucks and private vehicles, with occasional use by heavy delivery and maintenance vehicles. No precise estimates of truck traffic at any other site have yet been made, although at least three heavy-duty vehicles (10-yard dump trucks or flatbed trailers) per day would be required to complete construction at the Port Angeles water treatment plant. Dump trucks to bring soil into the area would be needed at the federal levee and at the DCWA well field to raise them for flood protection purposes.

Assuming there would be between 30 and 50 trips per day at the Elwha water treatment plant, and that trips would be no longer than 10 miles from the construction site to a concrete or materials supply facility, total annual emissions are estimated to be between 0.25 and 0.5 ton of hydrocarbons, between 1.3 and 2.3 tons of carbon monoxide, and between 6 and 10 tons of nitrogen oxides. Emissions at the Port Angeles water treatment plant would be substantially less, amounting to about one-tenth of those at the Elwha water treatment plant.

Assuming between two and four dump trucks delivering soil for about six months at the DCWA well field location, total emissions from construction equipment are estimated at about 0.01–0.03 ton of hydrocarbons and about 0.02–0.05 ton of both carbon monoxide and nitrogen oxides. During the six-week construction period to strengthen and extend the federal levee, about 0.06–0.09 ton of hydrocarbons, 0.3–0.5 ton of carbon monoxide, and 1.2–2 tons of nitrogen oxides would be emitted (see Table 19). Major stationary sources of emissions are considered to be 100 tons/year (FEIS), and mobile sources are regulated by imposing standards on the emissions of each vehicle type. Compared to emissions from stationary sources, or to emissions associated with dam removal, emissions from construction vehicles would be negligible or minor. However, compared to existing air quality, impacts could be quite noticeable in the vicinity of construction sites, resulting in a moderate impact on construction personnel, staff at the rearing channel, or any residents in the vicinity. Currently, four residents live at RM 3.5 and DCWA members reside near RM 3.6.

Impacts from vehicles at the Port Angeles water treatment plant would be less intense than at the Elwha water treatment plant, but they could be noticed by construction personnel and landfill operators. There are no other neighboring landowners, so no additional impacts would be likely. Because landfill operators are already subject to dust, vehicle emissions, and odors, additional emissions from construction equipment might have only negligible effects.

As many as 10 trucks per day for up to six weeks could be involved in constructing the Morse Creek chinook-rearing ponds. Following construction, several fish truck trips would be needed to transfer fish into the ponds each year and to haul adult fish or gametes (eggs and milt) out.

Table 19. Total Approximate Air Emissions Related to Construction of Mitigation Facilities

	Hydrocarbons (including PM_{10})	Carbon Monoxide	Nitrogen Oxides
Elwha Water Treatment Plant	0.2–0.4 ton	1.3–2.3 tons	6–10 tons
Port Angeles Water Treatment Plant	0.03–0.08 ton	0.14–0.45 ton	0.6–2 tons
DCWA Well Field	0.01–0.03 ton	0.02–0.05 ton	0.02–0.05 ton
Federal Levee Raising / Strengthening	0.06–0.09 ton	0.3–0.5 ton	1.2–2 tons
Morse Creek	0.001–0.0015 ton	0.04–0.05 ton	0.12–0.17 ton

Cumulative Impacts

In addition to the proposed mitigation facilities, dam removal would result in air quality impacts. These would not be concurrent with the construction of mitigation facilities, but would follow immediately. To summarize conclusions about air quality impacts in the FEIS, Elwha dam demolition would be estimated to generate a total of 105.3 tons of PM_{10} during the two-year period. Most of these emissions (97.8 tons) would be from the use of haul roads, although wind-blown dust from the drained reservoirs could have moderate impacts on visibility as well. At 325 feet (100 meters) from the road where dust emissions would be highest, concentrations would be less than the standard (150 $\mu g/m^3$) but could have short-term, moderate impacts if unmitigated to residents living along a 0.5-mile unpaved section. Mitigation would reduce the magnitude of these impacts to minor. PM_{10} emissions for the Glines Canyon Dam are estimated at 25.2 tons. Demolition would have no long-term impact on local or regional air quality.

The City of Port Angeles will be closing its existing landfill, which is adjacent to the proposed Port Angeles water treatment plant. Soil from grading and excavating the plant site would be used to help close the landfill, and large amounts of dust and vehicle emissions are possible temporarily. Dust control in the form of spraying water is likely to reduce impacts to short term and minor. Port Angeles plans to construct a solid waste transfer station on property adjacent to the water treatment plan site as the first step in closure of the landfill. This activity and construction of the water treatment plant would overlap, and dust and emissions from heavy construction equipment might be moderate for short periods of time. Dust from any continued operation of the landfill would also potentially have an additive effect.

Table 20. Annual Emissions of Particulate Matter Less than 10 Micrometers (PM_{10})

Activity	Elwha Dam PM_{10} Emissions (Tons)			Glines Canyon Dam PM_{10} Emissions (Tons)		
	Year 1	Year 2	Total	Year 1	Year 2	Total
Haul Roads	1.2	96.6	97.8	6.9	6.9	13.8
Loading	0.00037	0.03	0.03	0.0011	0.0011	0.0022
Dumping	0.00037	0.03	0.03	0.0011	0.0011	0.0022
Bulldozing	-	-	0.16	-	-	0.0065
Wind Erosion	-	-	7.3	-	-	11.4
Total	**1.2**	**96.7**	**105.3**	**6.9**	**6.9**	**25.2**

Conclusion

All concrete crushing activities would be performed in compliance with air quality permitting state and county requirements. Temporary, negligible to minor impacts on air quality are expected as a result. Vehicular emissions from the use of a variety of heavy construction equipment are expected to have a negligible impact compared to stationary pollutant sources or to dam removal, but could have a minor or even moderate effect to some nearby residents, staff at the rearing channel, or construction personnel. Minor to moderate, short-term increases in particulates in the form of dust would occur during the construction of water supply and treatment facilities. Cumulative impacts from dust and vehicle emissions at the Port Angeles water treatment plant site from closure of the landfill and construction of the adjacent solid waste transfer facility would be likely. No impairment to park air quality would occur as a result of the mitigation activities described under proposed action.

Noise

Summary of Regulations and Policies

Noise produced by construction activities would vary depending on the specific equipment. Construction activities are excluded from Washington Department of Ecology noise ordinances (WAC 173-60-040). Before issuing the required conditional use permit, Clallam County would review and, if necessary, regulate a number of issues related to construction activities, including noise, lighting, and traffic. Construction work and water treatment plant operations are required to be in compliance with OSHA noise regulations and requirements for worker protection. However, nearby residents are not protected in a similar manner.

Activities causing excessive or unnecessary unnatural sounds in and adjacent to parks would be monitored in accordance with the NPS *Management Policies 2001,* which state that the Park Service will strive to preserve the natural soundscapes of parks (NPS 2000). If necessary, actions will be taken to minimize unnatural sounds that adversely affect park resources or values or visitors' enjoyment of them.

Methodologies for Analyzing Impacts

Noise impacts affecting humans can range from temporary, mild annoyances for local residents to noise-induced hearing loss resulting from a combination of high sound levels and an extended period of exposure to sounds above 80 to 85 dBA. The impact analysis for the proposed mitigation projects includes noise generated by construction equipment, as well as the long-term operation of the two water treatment plants. Heavy trucks and equipment (concrete trucks, excavating/earthmoving equipment, delivery trucks, utility trucks, etc.) would be used for many of the proposed projects throughout the two-year construction period.

Noise levels produced by construction equipment at a reference distance of 50 feet were obtained from scientific literature. These levels are presented in Table 21 for equipment that might be used for construction of water treatment plants or distribution pipelines, or road improvements.

Table 21. Construction Equipment Noise Levels (FEIS 1996)

EQUIPMENT	NOISE LEVEL AT 50 FEET (dBA)
Track Hoe (back hoe)	80
Dozer (Cat D-8)	80
Crane (Manitowac 4100)	83
Air-Track (rock drill)	93
Hoe-Ram (large jack hammer attached to a backhoe or similar equipment)	93
Front-end Loader	79
Heavy Truck	88
Air Compressor	81
Generator	78

Noise levels vary with distance from the source and with operation mode. For instance, at 10 feet away grading equipment produces 94 dBA, while at 70 feet the level falls to 82 dBA. Terrain, ambient weather conditions, and vegetation also influence noise levels at receptor sites.

Standard threshold definitions were applied:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

As previously discussed, an impact would be more likely to constitute an impairment to the extent that it would be a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of the No-Action Alternative

Analysis

The power generation equipment at the Elwha and Glines Canyon Dams is a minor source of noise; turbine whine, high voltage electrical transmission line hum, and intermittent water crashing through the spillways all contribute to unnatural sound levels. Noise levels are generally magnified on Lake Mills due to the very steep canyon in which it is situated, although the nearest residents and known nests of species of special concern (in this case, the northern spotted owl) are 1 mile away or farther, and so are unaffected by these sources. Recreational users may experience some temporary and minor impacts from these sources of noise if they are very close.

Cumulative Impacts

Noise in the project area is caused by vehicles traveling on Olympic Hot Springs and Whiskey Bend Roads, heavy traffic on U.S. 101 (including logging trucks and other heavy duty vehicles), occasional aircraft overflights, and motorboats on the lakes. None of these sources contributes more than minor impacts to noise levels in the area.

Conclusion

Noise from the hydroelectric projects has negligible impacts on residents in the area now. No impairment of the park natural soundscape would occur under the no-action alternative.

Impacts of the Proposed Action

Analysis

Construction Impacts. The noise impacts of dam removal are discussed in the FEIS. Noise impacts from activities proposed in this SEIS include those from construction, helicopter use, concrete crushing, and water treatment plant operations. Receptors include construction personnel, operations staff, residents, and wildlife. Noise impacts on wildlife are discussed in the “Wildlife” and “Species of Special Concern” sections.

As noted in other sections of this SEIS, construction sites occur along the east side of the Elwha River from RM 3.5 to RM 2.8 (where the diversion and intake would be replaced, the Elwha water treatment plant constructed, and the DCWA well field raised), from RM 1.5 to RM 0.1 (where the federal levee would be extended, the tribal fish hatchery relocated, and a tribal wastewater system provided), near the city’s landfill (Port Angeles water treatment plant) and at Morse Creek (chinook holding/rearing ponds). Equipment use at each of these sites would expose workers to noise in the 80–85 dBA range for up to several hours each day. For those workers in the vicinity of the loudest noise, restrictions on the time each was able to operate equipment and hearing protection or another means of preventing hearing damage in accordance with OSHA regulations would be required.

In the vicinity of these construction areas are four residences near RM 3.5 and DCWA homeowners slightly farther upstream, 15 tribal and private residences north of the north end of the federal levee, and 25 residents west of the private levee.

Table 22. Typical Sound Levels (Continuous Noise)

SOUND LEVEL (dBA)	LOCATION/SOURCE	SUBJECTIVE IMPRESSION
100	Chain saw @ 3 ft.	Very loud
90	Train @ 100 ft.	
80	Truck traffic @ 50 ft.	Moderately loud
70	Auto traffic @ 50 ft.	
60	Normal conversation	Typical
50	Typical office	
40	Household at night	Quiet
30	Soft whisper	
20	Sound test booth	Very quiet
10	Breathing	
0	Threshold of hearing	No sound

As noted in Table 23, construction noise drops off with distance. Staff operating the WDFW fish-rearing facility in the immediate vicinity of construction at the Elwha water treatment plant site could experience continuous noise levels higher than 64 dBA, but lower than 85 dBA. This is considered comparable to auto traffic at 50 feet on a busy street, a moderate but highly localized impact to these staff. Since construction of the Port Angeles water treatment plant would be farther away from where landfill operators are currently working, and since the operators would be using heavy equipment and hearing protection, noise impacts would be no more than minor.

Table 23. Estimated Decibels for Continuous Construction Noise at Reference Distances under Best and Worst Atmospheric Conditions

	SOUND LEVEL (dBA)				
	0.3 MILE	0.6 MILE	1.2 MILES	3 MILES	6 MILES
Under best conditions	64	54	40	8	0
Under worst conditions	66	58	49	31	10

Residents near RM 3.5 would be about 0.5 mile from the construction site for the Elwha water treatment plant and would experience noise levels in the 55–60 dBA range during weekdays for two years. These noise levels are considered the same as normal conversation or a typical office environment, with negligible effects on the closest residents. Replacing the diversion and surface water intake facility (near RM 3.5) would require the use of heavy equipment, and some blasting or other loud noises could occur, with effects similar to distant or moderate thunder. As noted in the FEIS, short “thumps” of sound like those from blasting are evaluated using flat-weighted sound pressure. Because the control weir and new intake would be located in an area where at least one side is a sheer cliff, sound would be further attenuated for residents. These blasts would occur only during the day and would have no more than minor effects on residents.

Farther downstream, raising and extending the federal and private levees would involve the use of dump trucks and other heavy equipment. As noted in the “Methodology” section, noise levels for this type of equipment would range from 80 to 85 dBA at 50 feet. One resident lives within about 200 feet of the northern extension of the levee and would experience noise on the order of 75–85 dBA during construction of this portion of the levee. As noted in Table 23, residents 0.3 mile from the construction site would experience no more than 64–66 dBA and probably less, comparable to normal conversation or living near a busy street. Impacts on residents at this distance would be minor; impacts on closer residents would be moderate or even major for short periods of time.

The chinook holding/rearing ponds would be constructed at RM 5.5 on Morse Creek. This area of the watershed is mountainous and rural, and the primary land use is cattle grazing. Any construction in the area would likely have only negligible to minor impacts, as residents would be 0.5 mile or farther away, and noise would not be greater than that experienced during normal conversation.

The location of the concrete crushing activities is not yet known; however, the facility would be permitted for such activity by Clallam County, and the conditional use permit would include requirements to mitigate noise, if necessary. It is likely that noise levels at the facility would not be greater than those currently experienced; however, the noise levels might be more continuous if the facility was supplied for two years with concrete blocks from the Glines Canyon Dam.

Transport Noise. Noise levels of trucks and equipment moving to and from construction sites would be comparable to background conditions in urban or industrial areas, with only minor, short-term (two years) impacts compared to existing noise levels. If travel through a residential area was required, trucks hauling rubble would sound similar to logging trucks.

Operations Impacts. Water treatment plant operators and staff would occasionally be subjected to noise levels that could damage human hearing. Such operations are subject to OSHA worker protection regulations. The use of mixers, clarifier mechanisms, slurry pumps, effluent pumps, air compressors, and an emergency generator at the water treatment plan was analyzed for potential noise impacts (URS 2003c). It was concluded that the pumps, air compressor, and generator would likely be major noise sources. If necessary, housing the pumps and the air compressor inside structures would help mitigate noise impacts. As the emergency generator is not expected to be in frequent operation, its impact to noise levels is not expected to be substantial (URS 2003c). As a result, noise impacts to operators of either the Elwha or the Port Angeles water treatment plant are expected to be negligible to minor, site-specific, and long term.

Helicopters would be used primarily to carry fish to clean-water locations above Glines Canyon Dam if needed during dam removal and for three to five years afterwards, to restore fish when water quality was stabilized, and possibly to help revegetate the reservoir areas. Up to 36 flights per year would be permitted annually from March to July to transport fish upstream. Helicopters would fly above tree top at a minimum height of 100 feet and forward speed of at least 25 knots. Helicopters would be equipped with a fire bucket filled with water and fish attached to a 150-foot cable. Once the drop location was reached, the pilot would place a fire bucket in the river water and release the fish by remotely opening the bottom of the bucket. At 150 feet helicopter noise would range from 92 to 95 dBA (California Public Utilities Commission 1999). No human receptors except for fisheries restoration or revegetation personnel would normally be in the path of the helicopters or anywhere near landing areas. Staff would experience a brief period of loud noise with negligible impacts to hearing.

Cumulative Impacts

In addition to cumulative impacts identified above for the no-action alternative, cumulative impacts from dam removal could occur from blasting, sawing, truck traffic, and other related activities. However, these impacts would occur immediately follow the completion of mitigation measures. Because receptors of dam removal impacts would be in a different location from those affected by the construction of mitigation measures, and because receptors for dam removal would be far enough away that noise would be negligible, no noticeable additive impacts from construction noise are likely.

Conclusion

Noise from trucks and equipment associated with general construction activities would result in minor, primarily site-specific impacts for a few residents. Residents in the vicinity of the northern end of the federal levee could experience moderate or even major impacts for short periods of time from raising, strengthening, and extending that levee northward. Impacts of concrete crushing would be within permitted limits. Operation of the Elwha and Port Angeles water treatment plants could have short-term, moderate to major impacts to staff, which would be mitigated to negligible or minor through the use of required OSHA protection measures. No park soundscapes would be affected as a result of the proposed action; therefore, no impairment would occur.

Cultural Resources

Summary of Laws, Regulations, and Policies

All federal actions affecting cultural resources are subject to the provisions of the National Historic Preservation Act of 1966 (as amended), the National Environmental Policy Act, the Native American Graves Protection and Repatriation Act, the American Indian Religious Freedom Act, "Protection of Historic Properties" (36 CFR 800), the "Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation" (NPS 1983), and "Federal Agency Responsibilities under Section 110 of the National Historic Preservation Act" (53 FR 4727–46).

NPS *Management Policies 2001* indicate that cultural resources are to be preserved and the appreciation of the resources should be fostered through appropriate programs of research, treatment, protection, and interpretation (NPS 2000). Other applicable legislation and regulations and specific management procedures are detailed in "NPS-28: Cultural Resources Management Guideline" (NPS 1997).

Section 106 of the National Historic Preservation Act requires a federal agency to take into account the effects of its undertakings on properties included on, or eligible for inclusion on, the National Register of Historic Places. This also applies to properties not formally determined eligible, but that meet eligibility criteria. Section 110 of the act requires that federal agencies establish a program to identify, evaluate, and nominate properties to the national register. It also requires agencies to act as necessary to minimize harm to historic properties adversely affected by a federal proposal, and it gives the Advisory Council on Historic Preservation a chance to comment. In summary, the section 106 process requires the identification of resources that would be affected by a federal proposal, their evaluation under national register criteria, an assessment of proposed impacts on those resources, and consideration of ways to avoid, reduce, or mitigate adverse impacts.

Methodologies for Analyzing Impacts

Please refer to the FEIS and Schalk et al. (1996) for a comprehensive review of the cultural history of the Elwha River valley and survey/testing results.

The process for the assessment of impacts to cultural resources is outlined in the revised regulations of the Advisory Council on Historic Preservation: (1) identify the area of potential effect of the proposed action; (2) compare that location with that of resources listed on or eligible for listing on the National Register of Historic Places; (3) identify the extent and type of impact of the proposed action on national register properties; and (4) assess those effects according to procedures established in the regulations (36 CFR 800). An effect on a historic property occurs if an undertaking has the potential of changing in any way the characteristics that qualify that property for inclusion on the national register. If the proposed action diminishes the integrity of such characteristics, it is considered to have an adverse effect.

In addition, a 1995 “Programmatic Agreement among the National Park Service, Lower Elwha S’Klallam Tribe, the Washington State Historic Preservation Office, and the Advisory Council on Historic Preservation Regarding Restoration of the Elwha River Ecosystem” further influences the assessment of impacts of this proposal to these resources (see FEIS, Appendix 5). This programmatic agreement establishes a process for the treatment of cultural resources within the project area. As stipulated in that agreement, the study area is to be surveyed before any construction activities. Where possible, areas where cultural resources eligible for the national register have been identified are to be avoided. Where avoidance is not possible, the National Park Service will develop treatment and mitigation in consultation with the tribe and the state historic preservation officer.

While the completion of a surface reconnaissance for the study area is important for resource protection, it is possible that buried cultural deposits will remain unidentified; these resources are also addressed in the programmatic agreement. Prior to any construction, a monitoring and avoidance plan will be prepared to address, among other things, when discoveries should stop construction, the required professional qualifications of monitoring personnel, and actions to be taken when previously unidentified buried cultural deposits are encountered.

For this analysis, impacts are described in terms of type (beneficial or adverse) and intensity. Generalized definitions related to intensity of impacts to historic properties are presented below.

Negligible — The impact would be barely perceptible and not measurable; it would be confined to small areas or a single contributing element of a larger national register district or archeological site(s) with low data potential.

Minor — The impact to the resource would be perceptible and measurable, but it would be localized and confined to a single contributing element of a national register district or archeological site(s) with low to moderate data potential.

Moderate — The impact would be clearly detectable and sufficient to cause a change in character-defining features of cultural resources that could have appreciable effects on the resource.

Major — The impact would have a substantial, highly noticeable influence on the historic property’s defining features.

If it is determined there is potential for impacts to cultural resources listed on or eligible for listing on the National Register of Historic Places, the National Park Service will coordinate with the State Historic Preservation Office to determine the level of effect to the property and any appropriate mitigation measures that need to be taken. An official determination of effect will be issued by the state officer that documents (1) the level of impact to the resource, including any potential for impairment to cultural resources, and (2) the course of action that the National Park Service will be required to perform to mitigate these effects.

In addition to analysis required in accordance with the National Environmental Policy Act, this SEIS complies with requirements of section 106 of the National Historic Preservation Act, which requires an assessment of the effect of implementing an action on cultural resources based on the criteria of effect and criteria of adverse effect found in the Advisory Council on Historic Preservation’s regulations (36 CFR Part 800). In this SEIS a section 106 summary is included at the end of the discussion of cultural resource impacts. In accordance with the advisory council’s regulations implementing section 106, impacts to cultural resources are identified and evaluated by:

(1) Determining the area of potential effect — The area of potential effect is defined as the area of development proposed in this SEIS and includes facilities proposed along or near the Elwha River, the Port Angeles water treatment plant, and all connecting pipelines and roads.

(2) Identifying cultural resources present in the area of potential effect — Resources are those that are either listed on or eligible to be listed on the National Register of Historic Places.

(3) Applying the criteria of adverse effect — Criteria apply to affected cultural resources that are either listed on or eligible to be listed on the national register.

(4) Considering ways to avoid, minimize or mitigate adverse effects.

An *adverse effect* occurs when an impact alters any characteristic of a cultural resource that qualifies it for inclusion on the National Register of Historic Places. Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5). A determination of *no adverse effect* means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion on the national register.

CEQ regulations and NPS Director's Order #12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (reducing impacts from major to moderate). Any reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only and does not suggest that the level of effect under section 106 would be similarly reduced. Cultural resources are non-renewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, while adverse effects under section 106 may be mitigated, the effect to the resource remains adverse.

Impacts of the No-Action Alternative

Analysis

Construction of the Glines Canyon and Elwha Dams in the early 20th century had major adverse consequences on tribal cultural resources. The river provided not only the resources for sustenance and lifeways of the Elwha Klallam, but was at the heart of their ceremonial, cultural, and spiritual existence. Dam construction and the subsequent loss of the Elwha as a free-flowing river decimated fish runs critical to the tribe's livelihood and flooded villages, fish camps, homesteads, medicinal plant, food gathering and preparation sites, and most likely burial sites. The harvestable shellfish have been altered by changing marine substrate and reducing the size of the estuary at the river mouth. (See "Living Marine Resources" and "Fluvial Processes and Sediment Transport" sections in the FEIS for more information.)

Some of the Lower Elwha Klallam Tribe's most spiritual sites were made inaccessible by the dams and/or reservoirs. The Elwha Klallam believe that the Creator made their ancestors in the lower canyon of the Elwha River. In the place where they were created, the Elwha Klallam went to receive spiritual guidance and information about their future life. The creation site was made inaccessible by the Elwha Dam and Lake Aldwell. It is unknown whether the fluctuating levels of the reservoirs have eroded archeological sites in the area, but it is possible as the areas nearest the river were most likely to have been occupied.

The hydroelectric projects themselves are now considered historically important early examples of dams and power plants and are listed on the National Register of Historic Places. Elwha Dam includes "a rare, early example of the multiple-buttress type" structure and Glines Canyon Dam is significant because of "its association with the evolution of power plant design and contribution to the development of the automation of hydroelectric installation."

The dams blocked the natural downstream transport of sediment, resulting in a lowered riverbed and lowered surface water elevation in some cases. This has reduced flooding in some spots and has stabilized flow in the river channel (i.e., reduced the frequency and distance of the river's meander). These decreases in erosion and flooding may have secondarily protected structures or cultural sites, particularly those built around 1910, when Elwha Dam construction began. These structures include the historic Elwha Ranger Station complex, former homesteads, railroad remains, and many other known (and unknown) archeological sites.

Cumulative Impacts

The no-action alternative would result in continuing and cumulative, major adverse impacts to cultural and tribal resources, including decimated fish runs and altered shellfish harvest; the loss of a free-flowing river important to tribal ceremonies, culture, and spirituality; flooded villages, camps, homesteads, plant gathering/preparation sites, and possibly burial sites.

Conclusion

Under the no-action alternative fisheries, including shellfish, which the Lower Elwha Klallam depend on for both cultural and sustenance reasons, would continue to decline as the result of impacts caused by the dams. Sites important to the cultural and spiritual lives of the Lower Elwha Klallam Tribe would remain inaccessible. The river would remain dammed and in an unnatural condition, a major, adverse, ongoing impact on tribal culture. The hydroelectric projects would continue as historically important early examples of dams and power plants. There would be no increased threat of the loss of structures, buildings, or archeological sites in or near the floodplain from erosion action of the river meander or flooding. Although the impacts to cultural resources from the dams have been severe, because the resources are largely outside the park and are not specifically named in the Olympic National Park enabling legislation or foundation documents, no impairment to park cultural values or resources would occur.

Impacts of the Proposed Action

Analysis

The proposed actions covered in this SEIS consist of new mitigation measures that have been developed since the FEIS was finalized in 1996. The proposed actions that could impact cultural resources include the following:

- water quality / water supply mitigation for industrial customers and fisheries, the Port Angeles municipal water supply, and the Dry Creek Water Association
- flood control measures
- Lower Elwha Klallam Tribe wastewater treatment
- fish restoration, including the tribal hatchery
- revegetation

Impacts associated with the proposed actions include vegetation clearing, soil grading / leveling, trenching, and possible filling, all of which could adversely impact cultural resources, primarily buried archeological sites, through the loss of cultural context for artifacts, features, etc. These impacts could occur at the actual construction site, as well as within staging and access areas where substantial ground disturbance could occur. In addition, major construction projects (i.e., the water treatment plants, roads) could adversely affect both visual and physical characteristics of cultural landscapes. With the implementation of the terms of the supplementary programmatic agreement, impacts would be mitigated and are expected to be negligible to minor and site-specific to local in scope. Potential local impacts mentioned here refer to the cultural landscape and would likely be short term.

Potential effects to cultural resources are discussed below in general terms with the understanding that, in accordance with the programmatic agreement, additional survey and impact assessments would take place once specific details and locations of actions were finalized. All of this would occur before construction. Cultural resources that are eligible for the national register will be managed according to the stipulations of the 1995 programmatic agreement. Resources considered ineligible are not subject to further management.

Water Quality / Water Supply. Two known historic resources exist in or near the Elwha water treatment plant site. The remains of a historic residence and orchard exist between the WDFW fish-rearing channel and the bank of the Elwha River. It is at least 200 feet from the proposed water treatment plant. The only structural remains of the second site, the Milwaukee Railroad grade, are trestle pilings visible in the current river channel. Monitoring of all drilling and trench excavation and the Elwha water treatment plant site for subsurface tests found no cultural resources (URS 2004b). No known impacts to subsurface resources would occur from constructing the water treatment plant; however, the provisions of the programmatic agreement would guide the National Park Service in protecting any resources discovered during construction.

Geotechnical drilling activities were undertaken by contractors to the Bureau of Reclamation to aid in the conceptual design of the proposed Elwha water treatment plant. Prior to drilling, a cultural resource survey was conducted; no cultural resources were identified within the surveyed area (URS 2003b). However, the area is within the territory of the Lower Elwha Klallam Tribe, who lived in villages along the river and nearby saltwater shoreline.

Nine 6-inch diameter borings, ranging in depth from 30 to 60 feet were drilled within the study area. All extracted materials were inspected for evidence of cultural resources, but none was identified. As a result of the drilling findings, the fact that the area lies within a floodplain and is periodically flooded, and the disturbed nature of the area due to past construction, it was concluded that there is a low probability of encountering cultural resources as a result of the proposed actions (URS 2003b). Road corridors for equipment access to the Elwha water treatment plant site have not yet been surveyed, but would either be surveyed prior to construction, or construction would follow the conditions of a monitoring and avoidance plan, as stipulated in the 1995 programmatic agreement.

Four geotechnical borings at the location of the proposed new intake facility were monitored for buried cultural resources, and a visual survey of a 5-acre parcel of land including these facilities was completed. Transects at 50- to 100-foot intervals were walked; visibility was excellent. The mid-channel island north of the intake structure was also investigated by NPS personnel. The area is full of side channels and was likely an active floodplain before the dams were built. It is also quite disturbed, with roads and evidence of high visitor use. The island also appears to be frequently flooded. The amount of disturbance caused by periodic flooding suggests that intact surface deposits are not likely, and no cultural resources were found.

Also, test pit trenches and the monitoring of geotechnical borings have found no evidence of archeological or other historic resources (URS 2004b) at the proposed Port Angeles water treatment plant site. The site where the water treatment plant would be located is adjacent to the city's landfill and is several miles from the nearest stream or river. It has also been severely disturbed in many places, as the city has used part of the site as a borrow pit to cover its landfill. Grading for the Actiflo filter building, clearwell building, and recycle storage pond would be required. Sludge would be dried in beds that might cover cultural resources. Although the likelihood of finding buried cultural resources is considered low at this location, the provisions of the programmatic agreement would be followed. As noted above, this includes preparation of a monitoring and avoidance plan, which would address, among other things, when discoveries should stop construction, the required professional qualifications of monitoring personnel, and actions to be taken when previously unidentified buried cultural deposits were encountered. The same type of impact and mitigation measures for access roads or staging areas would also occur.

Dry Creek Water Association. Possible impacts related to the proposed drilling of new well facilities for the Dry Creek Water Association include ground disturbance in the form of grading, clearing and filling for drilling, access, and staging. In a recent feasibility study both the existing and alternative well field locations were visited (URS 2002b). Cultural resource studies conducted at these sites, coupled with review of Schalk et al. (1996), resulted in the determination that no evidence of archeological materials or features was apparent at either site.

Developing the DCWA alternative well field site or connecting to the city water system would require the construction of a distribution pipeline. Associated impacts would include trenching, excavation, and grading. Additional impacts to cultural resources from construction of staging areas and access/maintenance roads would vary depending on location and would likely include grading/clearing and possible minor excavation and filling. Pipeline construction would vary in its potential to impact cultural resources, depending on the option. Alignments have not been investigated thoroughly, but given what is known of the general area, it is believed there is a very low potential for the discovery of archeological resources. Connecting the pipeline to the city's water system would require a limited amount of new pipeline within a developed area, where substantial grading and filling occurred previously.

Impacts associated with pipeline construction could include the loss or disturbance of archeological or ethnographic sites. In addition, road construction could adversely affect both the visual and physical characteristics of the cultural landscape. As the potential for additional historic or prehistoric resources is very low within the Elwha River floodplain study area, potential impacts to such resources are also considered low (URS 2002b). However, it is recommended that additional archeological inventory take place once the pipeline and road corridors are selected (URS 2002b). This suggestion is consistent with the 1995 programmatic agreement and would provide important site-specific impact data.

With the implementation of the terms of the programmatic agreement, the potential impacts to cultural resources by proposed actions related to the Dry Creek Water Association are expected to be negligible to minor and site-specific in scope.

Elwha Heights Subdivision. A visual surface survey was conducted over the entire 6,000-foot-long alignment of the proposed pipeline route connecting the Elwha Heights homeowners to the Dry Creek Water Association, and two test pits were excavated. Ground surface visibility was fair; no cultural resources were noted during the survey, and the probability of disturbing intact cultural deposits along the existing alignment is considered low given previous disturbance by road construction and utility work. The two test pits were dug in forested areas considered to have the highest likelihood of finding cultural resources; however, none was found.

Lower Elwha Federal Flood Control Levee. Grading or excavating could potentially disturb and uncover archeological resources in this area. Because the Lower Elwha Klallam Tribe historically occupied land along this stretch of river, the chances of finding buried resources may be higher. However, the area to the west of the federal levee is also in a floodplain, and most buried resources could have been scoured away during floods.

Much of the flood mitigation work for the tribe would involve filling to raise, strengthen, or extend the existing federal levee. In this case cultural resources would be buried under the fill rather than exposed through grading. However, substantial excavation would be likely with the construction of a buried toe to the river thalweg along the river side of the levee and the proposed extensions. To prevent impacts from this excavation, an archeologist might have to be present during belowgrade excavation activities. In addition, the provisions of the programmatic agreement, including preparing a monitoring and avoidance plan prior to construction, would be followed. These measures would prevent impacts from becoming more than negligible or minor.

Lower Elwha Klallam Tribe Wastewater Treatment. The major actions that could potentially jeopardize cultural resources under this option are the construction of a centralized collection facility, distribution pipelines, and associated access/maintenance roads. These actions would involve ground disturbance (clearing/grading, excavation, trenching, and filling), which could adversely impact cultural resources through the loss of cultural context of artifacts, features, etc. These effects would be possible at the construction site and any areas used for staging and access. In addition, construction projects like roads or pipelines could adversely affect both visual and physical characteristics of the cultural landscape. Depending on the location of these facilities, adverse impacts to cultural resources could be negligible to major in intensity. Cultural resource surveys would be necessary once specific details and locations of actions proposed for this piece of the project were finalized. In addition, an archeologist might be needed onsite during excavation in the Elwha valley if the risk of disturbing cultural resources was considered high. Implementing the terms of the programmatic agreement would likely keep the effects to no more than minor and site-specific and local in scope.

Fish Restoration. Since the publication of the FEIS, the bull trout and Puget Sound chinook salmon have been listed as threatened under the federal Endangered Species Act. As a result, additional mitigation measures for the fish are now required, some of which could affect cultural resources.

To ensure stock production of the chinook salmon, some hatchery operations could be shifted to Morse Creek during dam removal. As noted in the "Affected Environment," no archeological or historic sites were found in a 1984 survey (Daugherty and Welch 1984), and the Washington State Historic Preservation Office has indicated no adverse effects would occur from development of the site. Because the exact extent and nature of the 1984 survey is not clear, all or parts of the proposed project location might need to be re-surveyed once project boundaries are identified.

The proposed aerial transport of adult fish to increase the restoration of Elwha River chinook could require the use of a helicopter. Landing pad(s) and possible access road(s) could adversely affect cultural resources through ground disturbance. Implementation of the terms of the programmatic agreement would likely mitigate these effects to negligible or minor and site-specific in scope.

The measures that the U.S. Fish and Wildlife Service included in its "Biological Opinion" relating to bull trout require the replacement or modification of Hot Springs Road culverts that limit/block access to tributaries that could be used by the fish (USFWS 2000). These actions would likely involve ground disturbance (grading/clearing/excavation). Depending on the method of construction and location of these activities, the potential for adverse effects to cultural resources would vary. Implementation of the terms of the programmatic agreement would likely mitigate these effects to negligible or minor and site-specific in scope.

Operations at the existing tribal fish hatchery would either be expanded to support the protection and restoration of anadromous fish during and following dam removal, or they would be relocated to a new facility on the Halberg property. Grading, trenching, and other ground-disturbing activities could uncover or disturb archeological resources. Given the location of this property near the existing reservation, it might be more likely to yield Lower Elwha Klallam Tribal cultural artifacts than other construction sites. Therefore, it is more likely that a cultural resource survey would be completed once project boundaries are proposed, if these boundaries lie outside the area already surveyed. Additionally, depending on project design, archeological monitoring might be necessary during construction as per the treatment and monitoring plan and the programmatic agreement.

Revegetation. Since the publication of the FEIS, studies show that revegetation efforts could require additional work (i.e., manual labor may be inadequate). The proposal for greater use of mechanized equipment and additional helicopters could impact cultural resources because of additional ground disturbance. The use of heavy equipment and helicopters to apply soil amendments or to transport crews could require staging areas and access roads, with clearing and/or grading, which could impact buried cultural deposits. Implementing the terms of the programmatic agreement, including on-site monitoring of earth-disturbing activities where appropriate, would mitigate these effects to negligible or minor and site-specific in scope.

Cumulative Impacts

As documented in the FEIS, a number of cultural resources on the Olympic Peninsula have already been lost to human development and natural processes (erosion, flooding, etc.). Additional cultural resources are anticipated to be lost with the removal of the Elwha and Glines Canyon Dams (see FEIS), although some resources would also be restored. Because of the widespread loss of cultural resources on the Olympic Peninsula and the planned loss of historic properties such as the Glines Canyon and Elwha Dams, reasonable efforts would be made to protect remaining cultural resources within the project area.

Depending on the extent and location of roads, pipelines, staging areas, and other facilities, there could be cumulative, long-term impacts of unknown magnitude to the cultural landscape in the study area. For instance, vegetation clearing or new structures could substantially alter views and the historic character of an area.

Conclusion

The implementation of the proposed mitigation actions could affect cultural resources within the study area in a variety of ways. However, as described above, the 1995 programmatic agreement establishes a process for their treatment, including surveys, identification, evaluation, and if necessary, protection. Through the implementation of the programmatic agreement, major adverse impacts to cultural resources would be avoided, and only minor adverse impacts at most are expected. No actions proposed would result in impairment to cultural resources.

Section 106 Summary

This SEIS analyzes impacts to cultural resources of two alternatives (including the no-action alternative) associated with the mitigation of downstream impacts from dam removal, as well as changes unrelated to the project that have occurred since the 1996 FEIS was completed. Proposed mitigation actions include design changes for the Elwha water treatment plant, construction of a new surface water diversion and intake system, and installation of distribution facilities. All of these proposals involve ground-disturbing activities (trenching, clearing, grading, filling) and the potential to affect cultural resources, particularly those that are buried and, as yet, unidentified.

The no-action alternative would result in continuing and cumulative, major, adverse impacts to cultural and tribal resources, including decimated fish runs and altered shellfish harvest; the loss of a free-flowing river important to tribal ceremonies, culture and spirituality; flooded villages, camps, homesteads, plant gathering/preparation sites, and possibly burial sites. For purposes of section 106, this would result in an adverse effect to the cultural resources within the study area. The hydroelectric projects would continue as historically important early examples of dams and power plants (no adverse effect).

Under the proposed action water quality mitigation actions would have the potential to affect cultural resources (particularly archeological resources) within the study area in various ways, primarily by ground-disturbing and filling activities. Implementation of the 1995 programmatic agreement will aid significantly in avoiding major adverse impacts to cultural resources, with no greater than minor adverse impacts expected. For the purposes of section 106, this would result in no adverse effect to the cultural resources of the study area..

Pursuant to 36 CFR 800.5 concerning the criteria of effect and adverse effect, the National Park Service finds that the implementation of the proposed mitigation measures as outlined under the 1995 programmatic agreement would not result in any new adverse effects (no adverse effect) to cultural resources within the study area.

Socioeconomic Environment

Summary of Regulations and Policies

The National Environmental Policy Act requires an analysis of social and economic impacts resulting from proposed major federal actions. In addition, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires federal agencies to assess the impact of actions on minority and low-income communities. Because costs of the mitigation portion of the project have been updated for this SEIS, benefits were also updated.

Methodologies for Analyzing Impacts

This supplemental analysis revises the economic findings of prior EIS documents regarding the Elwha River restoration project. This analysis utilizes new information on economic variables, including the price of fish in commercial fisheries, expenditures for sportfishing, and expenditures by recreational visitors. All monetary figures have been updated for inflation by using the Consumer Price Index and are expressed in 2001 dollars. The analysis derived the net present value of future benefits assuming a 3% discount rate. The new information has been incorporated into the general framework and assumptions of the economic analysis in the prior EIS documents and Meyer et al. (1995).

Standard threshold definitions were applied:

Negligible — The impact would be at the lower levels of detection.

Minor — The impact would be slight, but detectable.

Moderate — The impact would be readily apparent.

Major — The impact would be severe or highly beneficial.

Impairment does not apply to socioeconomic resources; therefore no analysis or finding is required.

Impacts of the No-Action Alternative

Analysis

County Economic Base. Commercial and recreational fishing have traditionally been a cornerstone of the Clallam County economy. Construction of Elwha Dam starting in 1910 resulted in an immediate and significant decline in salmon and trout runs, and continued operation of the Elwha and Glines Canyon Dams has resulted in lower income and higher unemployment in related employment sectors. Recently, timber sector employment has also declined, exacerbating regional economic difficulties.

Infrastructure, Services, and Utilities. Repair and maintenance costs to keep Ediz Hook, a natural sand barrier than protects the Port Angeles Harbor from eroding, are approximately $100,000 per year. Erosion is exacerbated by the lack of sand and sediment supplied by the Elwha River, which would normally help replenish Ediz Hook.

As of the February 2000 purchase of the dams and reservoirs by the federal government, local property taxes to Clallam County ceased. This is a change from the no-action alternative described in the FEIS.

Under the no-action alternative, rapid demographic changes are not projected; however, the ongoing transition from extraction and harvest to tourism and service-based industries would be gradual.

Fish and Fish Processing. An estimated $840,000 in business benefits were generated to all fishing sectors in a recent average year.

Recreation and Tourism. Recreation and tourism play a major economic role for Clallam County and the Elwha River drainage. In 1993 annual jobs and annual payroll in the travel and tourism sector consisted of approximately 2,000 jobs that generated $21.3 million. Clallam County tax receipts from this sector were estimated at $1.4 million in 1993. These figures are expected to increase slowly over the long term. Travel and tourism expenditures in Clallam County in 1993 amounted to $116.9 million. Related payroll income was $18.8 million (Runyon 1994).

Dam Repair. Continuing to operate the dams would require repair and maintenance, which would amount to about $9 million.

Power Costs. The NPI mill pays an estimated $2.1 million per year for power from the dams on the Elwha River. This would continue or increase slightly over time if the dams remained in place.

Cumulative Impacts

Clallam County is in transition. The county is primarily rural, and residents have traditionally depended on the lumber and fishing industries. The county is now experiencing declines in its traditional resource-based activities, particularly in the U.S. 101 corridor from Port Angeles to Forks. In addition, the county is experiencing fairly rapid change due to increases in tourism, retirement settlement, and service-based jobs, notably from its eastern boundary at Sequim westward to the City of Port Angeles. The decline of the salmon fishery as a result of the Elwha River dams has added to the trend away from an economy based on a sustainable harvest of natural resources.

Conclusion

There would be no additional costs or benefits over existing conditions, except for the $9.0 million in required repair costs if the dams were not removed. The NPI mill would pay an estimated $2.1 million per year for power from the hydroelectric projects. Business benefits from fisheries would continue at $840,000 per year or could decline further. Recreation and tourism expenditures would increase slowly from 1993 levels of $117 million.

Impacts of the Proposed Action

Analysis

County Economic Base. Elwha River restoration activities would specifically affect the economy of Clallam County. Construction costs projected in 1996 and adjusted in real terms range from $127.7 million to $146.8 million. Over the 10-year construction period expenditures would generate between $67.7 million and $73.4 million in business activity in Clallam County and an additional $36.1 million to $38.4 million in personal income. An estimated 1,150–1,240 jobs total would also be generated during the construction period.

Infrastructure, Services, and Utilities. Removal of both dams would restore natural sediment processes in the river and marine area. It would increase natural sediment available to Ediz Hook, reducing maintenance costs by an estimated $31,605 per year. Over the 100 years after both dams were removed, the benefits of reduced maintenance costs for Ediz Hook would total $1.0 million in present value terms.

Fisheries and Fish Processing. Removing both dams would restore fish stocks over the following 20 to 30 years. The economic benefit to the commercial fishery business sector over 100 years would amount to $36.7 million expressed in present value terms. The corresponding economic benefit to the sportfishing business would be $10.3 million. The combined total benefit to the commercial fishing and sportfishing business equals $47 million over 100 years (discounted at 3%).

Recreation and Tourism. With the Elwha River restored, an estimated increase of 507,084 annual visitor trips are projected for Clallam County. The increased recreation and tourist activity would generate additional business expenditures by $57.1 million per year in Clallam County, and business profits of $11.4 million per year. Over the 100 years following dam removal, additional recreation and tourism benefits (discounted at 3%) would total $317.6 million, expressed in present value terms.

Present Value of Benefits from the Project. The present value of benefits from the project (the total present value for a 100-year period) measures the net change of benefits associated with removal of both dams compared to the no-action alternative, calculated over 100 years and discounted at 3%. Estimated business benefits are summed and displayed on this basis as single present dollar totals in Table 24. For the proposed action over the 100-year project life, benefits to commercial fisheries would amount to $36.7 million, benefits to sportfishing businesses would equal $10.3 million, benefits of maintaining Ediz Hook would be $1.0 million, and benefits of increased recreation and tourism would reach $317.6 million. The total benefits over the 100-year project life would be $355.3 million (excluding sportfishing business net revenue to avoid double counting). These benefits would be readily noticeable to the local economy, would be long term, and would be moderate to major in intensity.

Table 24. Summary of the Net Present Value of Elwha River Restoration Market Benefits over Project Life (3% Discount Rate)

Category	**Market Benefits of Removing Both Dams (million $2001)**
Commercial Fishing (tribal and non-tribal)	36.7
Sportfishing Business	10.3
Ediz Hook	1.0
Recreation / Tourism	317.6
Total	**355.3***

* Excludes sportfishing business net revenue to avoid double counting.

Lower Elwha Klallam Tribe. Because of the need to operate and maintain a community wastewater treatment facility, residents of the Lower Elwha Reservation would be required to pay monthly wastewater bills. The average annual income in 60% of the homes on the reservation is less than $20,000 per year, based on 2002 data from the Lower Elwha Housing Authority. The estimated $40 per month wastewater bill would have a serious financial impact in many tribal homes.

As noted in other locations in this SEIS, one of the alternatives for extending the federal levee south includes raising and lengthening the Corps of Engineers haul road through the Halberg property, which is reservation land that the tribe purchased for future housing development. If this route was selected as a preferred alternative for the southern extension, it could result in the loss of approximately 80 acres of reservation land that was intended for low-income tribal housing.

Project Costs. The need to modify mitigation for water quality, water supply, and flooding has increased the cost of dam removal and river restoration. The measures described in this SEIS would cost $69 million, whereas those in the FEIS were estimated at $27 million. Flood protection and cultural resource mitigation have also increased from $4.2 million to $17 million. Other factors, such as increased operation costs and inflation, have further added to the total cost, which now stands at an estimated $182.5 million compared to the $113 million reported in the 1996 FEIS.

Cumulative Impacts

Cumulative impacts would be the same as those described above for the no-action alternative.

Conclusion

Costs of the river restoration project have increased to $182.5 million, in large part because of additional and more complex mitigation for water quality, water supply, and flooding. Total benefits of dam removal over 100 years of project life, at 3% rate of discount, would total more than $355 million. This is a nearly 2:1 ratio of benefits to costs, and a moderate to major, long-term, beneficial impact for the local economy.

Public Health and Safety

While the 1996 FEIS document focused on earthquakes, dam failure, emergency notifications/alerts, and emergency action plans, the proposed action addressed in this SEIS focuses on mitigation measures as a result of dam removal. The no-action alternative discussed below reflects only those portions relevant to the discussion of impacts for the proposed action.

Summary of Regulations and Policies

Worker safety and hazardous materials are the focal point of the impact analysis in this SEIS, and the regulations and policies that apply to public health and safety in this SEIS differ from those provided in the 1996 FEIS. The topics of dam safety and earthquakes, which were discussed in the FEIS, are not considered in this discussion.

Worker Safety. Worker safety, including traffic safety, is primarily guided by regulations of the Occupational Safety and Health Administration, the Washington Department of Labor and Industries, the U.S. Department of Transportation, and the Washington Department of Transportation.

Hazardous Materials. NPS *Management Policies* state that "when lands are proposed for acquisition by the NPS, the Service will take steps to avoid or minimize its liability for the contamination of NPS property caused by other parties. The Service will include in the pre-acquisition environmental assessment process the identification of recognizable environmental conditions, such as those associated with prior or existing commercial facilities. . . . Any recognizable existing or potential environmental contamination of lands proposed for inclusion in a park will be brought to the attention of the regional director as soon as they are identified" (NPS 2001, sec 9.1.6.2). The same regulations presented in the 1996 FEIS for the handling of hazardous materials are provided in this SEIS, including:

- *Executive Order 12088, "Federal Compliance with Pollution Control Standards"* — requires necessary actions to be taken for the prevention, control, and abatement of environmental pollution.
- *The Resource Conservation and Recovery Act of 1976* — authorizes federal regulation of generation, transportation, treatment, storage, and disposal of current and future hazardous and solid wastes and underground storage tanks.
- *Washington Model Toxics Control Act (WAC Chapter 173-340)* — Washington State's toxic waste regulatory program.
- *Occupational Safety and Health Act, 1970* — requires safety measures for workers responsible for the cleanup of hazardous wastes (requires a safety and health work plan, emergency response program, record keeping, training, use of personal protective equipment, and medical surveillance).

Numerous health and safety regulations deal specifically with the operation of water treatment plants because the use and handling of hazardous materials at such facilities have the potential to impact individual workers as well as the larger community. In 1992 OSHA published standards in the *Federal Register* to require that hazardous chemicals be managed to ensure safe and healthful workplaces, which is to be documented in a process safety management report (29 CFR 1910.119). While risk management programs required under the Clean Air Act amendments reiterate many of the same requirements, the focus is on potential incidents that can cause environmental and health hazards outside the facility (40 CFR 68). Emphasis is on the reduction of accidental release of hazardous substances, coordination with and informing the local community regarding risks, emergency response planning, and risk management planning. Regulatory audits are required.

The Washington Department of Health has permitting authority over the operations of water treatment plants. In addition, several other Washington State agencies (e.g., Ecology, Labor, and Industries) require compliance with regulations specific to the handling and use of hazardous materials. A variety of federal, state, and local regulations govern the transport of hazardous materials.

Methodologies for Analyzing Impacts

The analysis of impacts to public health and safety are qualitative in nature. The intensity of potential impacts is described in the following terms:

Negligible — The impact would be barely perceptible.

Minor — The impact would be slight but perceptible.

Moderate — The impact would be readily apparent.

Major — The impact would be severe.

Impacts of the No-Action Alternative

Analysis

Worker Safety. No impacts to workers or risk to their safety would take place under the no-action alternative.

Hazardous Materials. A team of hazardous material experts from the Bureau of Reclamation and U.S. Fish and Wildlife Service conducted a reconnaissance level pre-acquisition environmental containment survey of both dams and accompanying facilities in February 1993. Since the dams were built in the early 1900s, the team particularly searched for asbestos and lead-based paint in the building materials and polychlorinated biphenyls (PCBs) in the transformers, capacitors, and other electrical components. The survey identified solid wastes at a quarry dump; household debris at private residences at the Elwha Resort; underground storage tanks at the Elwha Resort; chemicals such as fuel, paints, lubricants, and pesticides at various storage facilities and equipment repair areas at both dam sites; asbestos-covered wiring at both dams; oil-stained ground from leaking transformers at Glines Canyon Dam; pole- and pad-mounted transformers at both facilities; and banks of batteries at both powerhouses (USFWS 1993). Testing for lead-based paints was not done; although given the age of the structures, they are likely to be present.

Since recognized environmental conditions were found during the level 1 survey, a more detailed, level 2 survey was conducted by the U.S. Fish and Wildlife Service in 1995 (USFWS 1995b), and an even more detailed level 2/3 pre-acquisition environmental assessment was conducted in 1999 by Ecology and Environment, Inc. The 1999 survey provided information for the subsequent cleanup in 2001 and 2002 of the former Elwha Resort's asbestos-containing material and contaminated soil at both the resort and the transmission line pole yard storage area. Also in 1999, 16 surface and 26 subsurface samples were collected at the Glines Canyon switchyard. All of these samples, except the concrete samples, were tested for organochlorine pesticides, total PCBs, and total petroleum hydrocarbons. Only total petroleum hydrocarbons were found to be over the Washington State allowable limit of 200 ppm for cleanup. This area is to be cleaned up by removing concrete, transformers, and soils down to the deepest detected contamination, which in places are to bedrock, about 7 feet below ground level.

Capacitors and oil-filled electrical bushings have not been tested for the presence of PCBs. If testing indicates their presence, the bushings would be disposed of as hazardous materials. Hazardous waste disposal cost estimates for this project are based on the presumption that PCBs are present.

Inspection team members also found asbestos in the exterior siding of the Elwha Dam office, in the floor tile, interior wall plaster, and electrical wiring insulation of the Glines Canyon Dam residence, and electric cable insulation throughout both powerhouses during the level 2 survey (USFWS 1995b).

Since the FEIS was published, household debris, underground storage tanks, and contaminated soil under the former gas pump island have been removed from the former Elwha Resort, as well as many of the old residences. Contaminated soil at the former transmission line pole storage area at Elwha Dam has also been removed.

Cumulative Impacts

The Elwha River corridor is relatively pristine, with very few sources of hazardous materials. Some cars park near the river for recreational access to the shore, and small amounts of oil, grease, or other petroleum products may wash into the river. This is also true of road use in the study area.

Conclusion

Hazardous materials (asbestos, lead-based paints, and PCBs) found at the hydroelectric projects at both dam sites would remain under the no-action alternative. The aging transformers are leaking; these and other features would need to be maintained, replaced, or removed to prevent further contamination of the dam sites. Total petroleum hydrocarbons exceeding the state allowable limit would also need to be remediated.

Impacts of the Proposed Action

Analysis

Worker Safety. Proposed mitigation measures that could affect worker safety include

- constructing two water treatment plants and distribution lines, new hatchery structures, waste-water facilities, roads, and culverts
- removing and replacing existing diversion and surface water intake structures
- developing a well field
- conducting revegetation activities

Worker safety issues include potential impacts related to actual construction, including the use and transport of heavy equipment and materials. Catastrophic accidents as a result of worker inattentiveness or equipment malfunctioning and resulting in serious injury or death are always possible at construction sites; these are considered major impacts to public health and safety. However, careful adherence to standardized safety procedures (e.g., OSHA and Washington Department of Labor and Industries regulations and procedures) would make such catastrophic events unlikely. Such compliance would likely result in negligible to minor impacts to public health and safety during the two-year construction period.

Hazardous Materials. Proposed mitigation measures that influence public health and safety through the presence of hazardous materials include the use and maintenance of heavy equipment in construction-related activities, as well as the transport, storage, and use of chemicals at the new Elwha and Port Angeles water treatment plants.

Heavy-duty trucks or other equipment at construction sites could leak oil or require refueling, possibly resulting in minor spills of oil or diesel fuel, which could contaminate soil or water. Requiring the use of biofluids in place of petroleum products could eliminate a major source of possible pollution to the environment. In extreme cases, if all mitigation required by best management practices failed, downstream wells could also be affected. The timely use of appropriate and standardized containment and cleanup procedures would result in no greater than minor, site-specific to localized impacts to public health and safety. In addition, the operation of construction equipment would elevate workers' and the public's exposure to increased air emissions. However, these emissions would not exceed standards set by the Clean Water Act or the Clean Air Act and are believed to pose a negligible, short-term impact on public health and safety.

The use and handling of potentially toxic materials during construction and operation of the water treatment plants, including alum, polymers, and chorine products, could adversely impact both worker and public safety. Though unlikely, catastrophic accidents resulting in serious injury or death, or in significant chemical releases to the environment as a result of inappropriate storage/handling of hazardous materials are possible; this would result in a major, adverse impact to public health and safety. However, stringent compliance with health and safety regulations and standardized safety procedures for the handling of hazardous materials would likely result in negligible to minor impacts (refer to "Summary of Regulations and Policies" above).

Cumulative Impacts

In addition to cumulative effects identified under the no-action alternative, the proposed action would include impacts resulting from dam removal. Demolition of the dams could entail the removal of asbestos, wiring, or other potentially hazardous materials, but this deconstruction effort would not be simultaneous with the construction of mitigation facilities. Worker safety could also be a cumulative issue, as some of the crews completing mitigation facilities could work at the dam sites, with an increased risk of accident simply related to the length of time they are involved in the project. Again, OSHA regulations would keep workers from exposure to hazardous materials, noise, or other safety hazards to the maximum extent possible, but accidents or spills could nonetheless take place at the dam sites.

Conclusions

Impacts to workers or the public from exposure to fuel or chemicals during construction would be minimal; using best management practices would reduce the risk, resulting in a negligible to minor, adverse impact. The use of hazardous chemicals during water treatment plant operation would be monitored, and the use of standard containment and cleanup procedures would result in negligible to minor impacts. Workers continuing to work on the project during dam removal could add risk of accident, but OSHA regulations would minimize the risk.

Consultation and Coordination

History of Public Involvement

The planning history for the restoration of the Elwha River ecosystem dates back to the late 1980s when the Federal Energy Regulatory Commission began writing an EIS to consider issuing licenses for the Elwha and Glines Canyon Dams in August 1989; that document was distributed for public comment in February 1991. Prior to its finalization, Congress enacted the Elwha River Ecosystem and Fisheries Restoration Act in October 1992, which stayed the licensing process and directed the Department of the Interior to study how the native anadromous fisheries and the ecosystem of the Elwha River could be restored. Both the FEIS by the Federal Energy Regulatory Commission and the *Elwha Report,* prepared by the Department of the Interior, the Department of Commerce, and the Lower Elwha Klallam Tribe, were released to the public. An open house to discuss the *Elwha Report* was held in fall 1993, and the report was finalized and submitted to Congress in June 1994.

In August 1994, a public notice indicating the National Park Service's intent to prepare both a programmatic and implementation set of EISs was published in the *Federal Register*. The programmatic EIS would examine how to fully restore the ecosystem, and whether dam removal was required; the implementation EIS would examine the means to accomplish whichever alternative the programmatic EIS found preferable. Public comments were collected during the 30-day period following this notice.

The Programmatic EIS was distributed for a 60-day public comment period in October 1994. Public workshops to receive comments were held in Seattle and Port Angeles in November 1994. These workshops were also used to obtain scoping comments on the range of alternatives and issues the interagency team had decided were relevant to date for the Implementation EIS. Responses to comments on the Programmatic EIS were addressed in the Programmatic FEIS, released in June 1995. The removal of both dams was the selected alternative.

The Implementation DEIS was released for public comment in April 1996. Comments were received for 60 days, and workshops were held in Seattle and Port Angeles. The Implementation EIS was finalized in November 1996, and a "Record of Decision" was signed in December 1996.

As noted in the "Purpose and Need" chapter, the Implementation FEIS included mitigation measures for a variety of impacts that would result from dam removal. Since the release of the FEIS in 1996, new information has been developed, and environmental conditions have changed. To address changes in mitigation measures and the impacts of the measures themselves, this supplement to the FEIS (referred to as the SEIS) has been prepared. The draft SEIS will be available for a 60-day public review.

Public Scoping for this SEIS

Public scoping for the SEIS took place in September and October 2002, and nine comment letters were received. All scoping comments considered relevant to the analysis of the mitigation facilities are addressed in the "Purpose and Need" chapter of this SEIS. Below is a summary of comments and the agencies' response to them.

Comment	Response
In the NPS press release, it noted that sources of ground-water not hydraulically connected to the river were investigated as sources of supply during and following dam removal, but they do not exist in the quantities needed. This statement raises a question about the quantity of Elwha's water contemplated for future withdrawal, and the potential for affecting in-stream flows needed for fish habitat and migration in the Elwha River. Please address this in the SEIS.	Although this is outside the scope of what is being examined in this SEIS, the brief response to this comment is that the water use of the Elwha River before and after dam removal will remain the same; e.g. there is no additional impact to the quantity of water used from dam removal or restoration activities.
Address requirements to provide sufficient sediment transport to revive sediment deposits along the shore and banks of the Strait of Juan de Fuca and for Ediz Hook.	Again, this SEIS is prepared to address mitigation measures. Some information about the effect of dams blocking sediment and resulting impacts to Ediz Hook is available in the FEIS.
Include an assessment of the estuarine and nearshore water quality in the vicinity of the river mouth. What is the effect of dam removal on that environment? Wouldn't resources be adversely affected by sediment scouring, swift water currents, changes in salinity, and poor water quality at the time of dam removal?	The purpose of this SEIS is to address the impacts of mitigation measures for water quality and flooding impacts. Some information about the effects of dam removal on the nearshore environment is available in the FEIS (see "Living Marine Resources" sections).
I am in favor of a new diversion facility that will pass fish and sediment, but believe the SEIS should evaluate options for diverting surface water that do not entail construction of a structure spanning the entire floodplain. The design should not eliminate side channels and must pass all migrating smolts, including pink salmon, and old-growth size debris.	The weir and intake were designed to pass all migrating smolts, including pink salmon, as well as sediment, bedload, and large debris. However, the design team believed that the preferred option to obtain enough water was an intake that spanned the channel.
Consider a broad variety of restoration alternatives for chinook salmon, including captive brood. Risk of loss of this population must be avoided.	Rather than captive brood, the agencies believe rearing ponds on Morse Creek are the best protection against loss of the population.
Changes in fisheries management policy since the FEIS mean harvest of Elwha River salmon will be reduced and the rate of recovery increased.	This is addressed in cumulative impacts to fish in this SEIS to some degree. We agree that the rate of recovery may be slightly improved.
It may be unnecessary to alter the restoration plan for bull trout, even though bull trout have been listed as threatened.	The recovery plan for bull trout is explained in appendix B, the biological opinion from the USFWS.
Make sure the Port Angeles water treatment plant is compatible with FAA regulations, and does not include open air ponds that may attract birds.	The engineers designing the facility are aware of FAA regulations and will comply with them.
Carefully consider onsite recycling of cement as an alternative to upland disposal.	Crushing concrete at a privately owned offsite facility is the preferred method at this time. Upland disposal as analyzed in the FEIS remains an option, but is not preferred.
The current water system penalizes residents for maintaining a decent yard during dry conditions and is determined by the co-amount of sewage. The establishment of a system as you are contemplating will only further degrade this service by placing increased financial burden on local citizens.	Removing the dams will have no financial effect on the cost of water for residents.

Comment	Response
To continue utilizing undetermined methods for the physical aspect of dam removal, such as methods of disposing of debris, will surely create parallel dilemmas such as the water system problem (identified above).	Disposal of debris, whether in open pit mines (upland disposal) or by the recycling of crushed concrete, are well-founded, standard practices rather than “undetermined methods.”
What are the impacts to macroalgal and eelgrass beds in the vicinity of the Elwha River delta due to the release of a large volume of accumulated sediments?	The FEIS addressed these impacts in the section “Living Marine Resources.” Suspended solids are expected to have an adverse effect on macroalgae, which would subsequently affect fish, shellfish, crustaceans, and other marine animals it supports. These impacts would be lessened by periods of river clearing and by shifting of tidal currents, but short-term, major impacts and long-term, minor impacts on the marine ecosystem are expected.

Cooperating Agencies and Consultation

This SEIS has been prepared by the National Park Service, the Bureau of Reclamation, the U.S. Army Corps of Engineers, the Lower Elwha Klallam Tribe, and contractors to the agencies.

The National Park Service has consulted with the U.S. Fish and Wildlife Service on a protection and restoration plan for the bull trout, and with NOAA Fisheries on a similar plan for chinook salmon. The “Biological Opinions” for bull trout is attached as appendix B. The biological opinion for chinook salmon, and statements of findings for floodplains and wetlands, will be included in the final SEIS.

List of Preparers and Contributors

Preparers

Name	Title / Responsibility	Education	Experience
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Total Quality NEPA			
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Name	Title / Responsibility	Education	Experience
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Federal Agencies
Department of Agriculture
U.S. Forest Service, Olympic National Forest
Department of Defense
U.S. Army Corps of Engineers
Department of Commerce
National Oceanic and Atmospheric Administration, Olympic Coast National Marine Sanctuary
Department of the Interior
Bureau of Reclamation
National Park Service
Office of Public Affairs
Columbia Cascades Support Office
United States Fish and Wildlife Service

Indian Tribes and Organizations
Chehalis Tribal Business Council
Hoh Tribal Business Council
Jamestown S'Klallam Tribal Council
Olympic Peninsula Intertribal Cultural Advisory Committee
Point No Point Treaty Council
Port Gamble S'Klallam Tribe
Quileute Tribal Council
Quinault Indian Nation
Shoalwater Bay Tribal Council
Squaxin Island Tribal Council
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U.S. Congressional Delegation
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Representative Norm Dicks

Washington State Delegation
Senator Jim Hargrove

Representative Jim Buck
Representative Lynn Kessler
Representative Tim Sheldon

Washington State Agencies
Department of Ecology
Department of Fish and Wildlife
Department of Natural Resources
Department of Parks and Recreation
Office of Archaeology and Historic Preservation, State Historic Preservation Officer

Local Agencies
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Commissioners
Economic Development Council
Jefferson County Commissioners
Mason County Commissioners
Grays Harbor County Commissioners
Kitsap County Commissioners
City of Forks
City of Port Angeles
City of Sequim

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Institute for Policy Research
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National Audubon Society
North Olympic Peninsula VCB
Northwest Ecosystem Alliance
Olympic Park Associates
Olympic Peninsula Audubon Society
Port Angeles Chamber of Commerce
Protect the Peninsula's Future
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KONP
Peninsula Daily News
Peninsula News Network
Sequim Gazette

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Appendixes, Glossary, References Cited, Index

Appendix A: Best Management Practices

The following best management practices would be used to minimize impacts associated with increased sediment and turbidity levels:

1. To protect fisheries resources, construction activities for the mitigation facilities adjacent to or in waterways shall generally occur during the dry season from July through October.

2. If work is conducted in the active channel, water will be diverted around the project site. This measure is designed to minimize the mobilization and transport of fine and coarse sediments from the project site downstream, which may affect spawning gravels, substrate embeddedness, pool frequency / quality, and the development of large pools. Any instream diversion shall be in accordance with guidelines developed by the Washington Department of Fish and Wildlife and the National Marine Fisheries Service.

3. Excess material (spoils) shall be disposed of at least 300 feet from the active stream channels. This measure is designed to keep fine and coarse sediments from reaching flowing waters where they can be transported downstream and may affect spawning gravels, substrate embeddedness, pool frequency / quality, and the development of large pools.

4. Erosion control methods shall be used to prevent silt-laden water from entering the stream. These may include, but are not limited to, straw bales, silt fencing, filter fabric, temporary sediment ponds, check dams of pea gravel-filled burlap bags or other material, and/or immediate mulching of exposed areas. This measure is designed to keep fine and coarse sediments from reaching flowing waters where they can be transported downstream and may affect spawning gravels, substrate embeddedness, pool frequency / quality, and the development of large pools.

5. All disturbed ground will be reclaimed by planting or seeding with native vegetation, or, in the case of small treatment areas, allowing native vegetation to reclaim the area naturally.

6. If weather conditions during project operations generate and transport sediment to the stream channel, operations shall cease until weather conditions improve. The operation of ground-disturbing equipment during large precipitation events increases the potential for soil compaction and production of sediment that may be transported to flowing waters. This measure is designed to reduce the production of fine and coarse sediments; if these sediments reach the stream channel, they may affect spawning gravels, substrate embeddedness, pool frequency / quality, and the development of large pools.

7. Wastewater from project activities and water removed from within the work area will be routed to an area landward of the ordinary high waterline to allow for removal of fine sediment and other contaminants prior to being discharged to the stream. Sediment entering the stream channel may affect spawning gravels, substrate embeddedness, pool frequency / quality, and the development of large pools. Chemical contaminants may have a negative biological effect on many forms of aquatic life, including salmonids and macroinvertebrates.

8. All equipment shall be operated as far from the water's edge as possible.

9. All project leaders will contact a park fishery biologist prior to construction in areas where spawning fish may occur.

10. No construction staging areas will be allowed within 300 feet of any waterway.

11. Hazardous spill clean-up materials will be on site at all times. This measure is designed to avoid or minimize the introduction of chemical contaminants associated with machinery (fuel, oil, hydraulic fluid, etc.) used in project implementation. Chemicals may have a toxic effect on aquatic organisms, including salmonids.

12. Any machinery maintenance involving potential contaminants (fuel, oil, hydraulic fluid, etc.) will occur outside the riparian area, defined as the entire channel migration zone or a distance greater than 150 feet from the stream edge. This measure is designed to avoid or minimize the introduction of chemical contaminants associated with machinery used in project implementation. Chemicals may have a toxic effect on aquatic organisms, including salmonids.

13. Prior to starting work each day, all machinery will be inspected for leaks (fuel, oil, hydraulic fluid, etc.), and all necessary repairs will be made before the commencement of work. This measure is designed to avoid or minimize the introduction of chemical contaminants associated with machinery used in project implementation. Chemicals may have a toxic effect on aquatic organisms, including salmonids.

14. Spill kits will be present at all construction sites. The desired outcome is to control, absorb, or contain the spill for clean-up and disposal.

Appendix B: Final Biological Opinion — U. S. Fish and Wildlife Service

United States Department of the Interior

FILE COPY

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
Western Washington Office
510 Desmond Drive SE, Suite 102
Lacey, Washington 98503
(360) 753-9440 FAX: (360) 753-9008

FEB 24 2000

Memorandum

To: Superintendent, Olympic National Park, National Park Service, Port Angeles, Washington
(Attention: Dr. Brian Winter, Elwha River Restoration Coordinator)

From: Manager, U.S. Fish and Wildlife Service, Western Washington Office, North Pacific Coast Ecoregion, Lacey, Washington

Subject: Final Biological Opinion for the Elwha River Restoration Project (FWS Ref: 1-3-00-F-0606)

This document constitutes the U.S. Fish and Wildlife Service's (FWS) updated biological opinion for the proposed Elwha River Restoration Project located near Port Angeles in Clallam County, Washington. The Olympic National Park's (ONP) biological assessment amendment addresses the potential impact of the proposed action on bull trout (*Salvelinus confluentus*), which was listed as a threatened species on November 1, 1999. The biological assessment amendment (BAA) is dated January 2000, and was received in this office on February 2, 2000. Our revised biological opinion presents our conclusions on the effects of the proposed action on bull trout in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The bald eagle (*Haliaeetus leucocephalus*), marbled murrelet (*Brachyramphus marmoratus*), peregrine falcon (*Falco peregrinus*) and northern spotted owl (*Strix occidentalis caurina*) were addressed in an earlier biological assessment (FWS 1996a) and biological opinion (FWS 1996b).

The revised biological opinion is based on the following information: (1) the draft and final environmental impact statements for the Elwha River Ecosystem Restoration Project (ONP 1996a, ONP 1996b); (2) the FWS's biological assessment (BA) dated April 1996; (3) the ONP's BAA; (4) information obtained during formal consultation between staffs; and (5) field investigations, reports, and documents in our files. A complete administrative record is available at the letterhead address.

CONSULTATION HISTORY

The FWS prepared the 1996 BA for the ONP because the FWS was one of the cooperating agencies on the preparation of the National Environmental Policy Act documentation. The BA presented the determination that the proposed Elwha River Restoration Project is "likely to adversely affect" the marbled murrelet and "may affect but is not likely to adversely affect" the bald eagle, peregrine falcon and the northern spotted owl. We concurred with the effects determination in our biological opinion, dated August 5, 1996. Elwha River bull trout were a candidate species in 1996.

Project implementation has been suspended for four years because Congress did not appropriate the needed funds to begin the final design phase, now expected to be completed by the end of 2001. The November 1, 1999 listing of the Coastal/Puget Sound Population of bull trout and the Department of the Interior's (Department) anticipated acquisition of the two hydroelectric projects by February 29, 2000, as directed by Congress, led to the need to reinitiate consultation and update and amend both the biological assessment and the biological opinion at this time.

Refinements in project design since 1996 have not changed the magnitude of the project's effects to listed species. The available biological data and project details, including new information that has been developed or collected since 1996, still supports the effects determination contained in the 1996 BA for the bald eagle, marbled murrelet, and northern spotted owl, and the peregrine falcon, although the latter has since been delisted and no longer receives protection under the Act. Therefore, these species will not be addressed further in the amended biological opinion.

The ONP requested formal consultation on the bull trout on February 17, 2000. The ONP has determined that the proposed Elwha River Ecosystem Restoration Project is "likely to adversely affect" the bull trout. This determination is based on the known occurrence of bull trout in the Elwha River and tributaries between the two dams and within Lake Mills, their expected presence in the lower river, and the predicted release of turbidity and sediments during the project removal period at concentrations that are known to be injurious or lethal to fish, and which can adversely impact their prey resources, foraging efficiency, and spawning habitat. The FWS concurs with the ONP's effect determination for the bull trout.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Elwha River Ecosystem and Fisheries Restoration Act of 1992 (P.L. 102-495) authorizes the Secretary of the Interior to acquire and remove the Elwha and Glines Canyon Hydroelectric Projects to fully restore the Elwha River ecosystem and native anadromous fisheries. The proposed action consists of the Department's acquisition of the Elwha and Glines Canyon Hydroelectric Projects, the removal of both dams and related facilities, the operation of the hydroelectric facilities during the interim period prior to their removal, the restoration of anadromous fish runs, and the implementation of related flood control and water supply mitigation measures. A detailed description of the proposed action is presented in the project environmental impact statement (ONP 1996a, ONP 1996b) and in the FWS's earlier biological opinion.

Acquisition of the two hydroelectric projects from the Fort James Corporation includes two dams, two powerhouses, related facilities, and approximately 1,220 acres of land. The 160 acres that is located within the boundaries of Olympic National Park would be added to, and managed as part of the Park. The remaining 1,060 acres would be managed in accordance with the declared policy of section 1(b) of the Wild and Scenic Rivers Act to protect "... the Federal investment in restoration", as required by the Elwha River Restoration Act. Within this constraint, the Secretary of the Interior may decide on adding some or all of this property to ONP, hold the land in trust for the Lower Elwha S'Klallam Tribe, or let it be managed by the State of Washington, with their concurrence.

The project removal approach is described in detail in the project's environmental impact statement and its supporting documents, and in the BA and BAA. The removal of the two dams and related facilities would occur over a two year period to reduce the duration of sediment related impacts. The dams would each be removed in a series of stages to promote the transport and removal of the accumulated sediments by the erosive action of the river. Both controlled blasting and diamond wire saw cutting techniques would be used to break the concrete of the dams into smaller pieces to facilitate their removal.

The two hydroelectric projects will be operated for an estimated period of up to four years while the final design work is completed and sufficient funds for implementation are appropriated by Congress. The operation of the projects would be similar to the current mode except that it would not be optimized for power production. In addition, major repairs would not be undertaken, presenting the possibility that the entire flow of the river could be directed over the spillways instead of through the power tunnel.

The anadromous fish restoration plan will be collectively developed by the ONP, FWS, WDFW, and Lower Elwha S'Klallam Tribe. The draft restoration plan relies on a combination of natural recolonization, the outplanting of juvenile salmon in the upper basin, and the importing of donor stocks if the native stock has been extirpated. No outplanting of bull trout is proposed. Juvenile salmonid outplanting would be done for at least 10 years and would be at levels consistent with the carrying capacity of the receiving waters and expected redistribution of the planted fish. Monitoring would be used to verify recovery rates and to provide a basis for modifying the restoration plan, as needed.

The release of highly turbid water and large quantities of sediment from the reservoirs would adversely affect downstream water supplies, and public and private property. To address these issues, the following water supply and road improvements and flood protection measures have been included as project elements:

- raising the lower Elwha flood control levee by 2.5 feet;
- flood proofing 15 private residences near the north end of the flood control levee;
- raising the west side levee by 1.0 feet;
- flood proofing the City of Port Angeles' Ranney well collector;

- removing the water supply diversion dam at river mile 3.5;
- flood proofing the State of Washington's fish rearing facility and wells;
- raising the 2,500-foot-long access road to the City of Port Angeles' water supply intake by 3.0 feet;
- flood proofing several private residences located along the west bank at river mile 3.5;
- raising the Dry Creek Water Association wells and access road by 1.5 feet;
- raising about 2,000 feet of the Hot Springs Road and three residences at river mile 8.4 by 3.5 feet;
- raising a 300-foot-long dike at river mile 8.5 by three feet;
- flood proofing the residence at river mile 9.7 by raising the structure by 1.5 feet and adding rip rap to the bank;
- raising a 3,500-foot-long stretch of Hot Springs Road outside the Park by 2.5 feet;
- raising two sections of Olympic Hot Springs Road, totaling one mile in length, by 1.5 feet.

The above measures are described in greater detail in the environmental impact statement for the project, and in the BA and BAA.

Conservation Measures

Per the BAA, the conservation measures that would be incorporated into the dam removal approach include:

- Dam removal activities contributing to the release of sediments from the reservoirs will be suspended during the period from May 1 through June 30, to allow for the capture and potential salvage of bull trout and other fish.
- Fish access to Griff Creek is restricted during most stream flows because of blockage by a road culvert. This culvert would be replaced to provide unimpeded fish access to Griff Creek.
- Tributaries between and downstream of the dams would be monitored to determine if habitat conditions remain suitable during dam removal and whether the relocation of bull trout is appropriate.
- Best management practices would be employed to minimize erosion, the release of sediments, and the removal of trees, shrubs, coarse woody debris and large woody debris in connection

with flood control and water supply protection measures. Revegetation would occur with native species. Monitoring would occur for a period of five years to determine if additional measures are needed.

- The lower river (below RM 16.0) would be monitored to determine if recovery is occurring as predicted.

STATUS OF THE SPECIES (Rangewide)

The FWS listed the Columbia River and Klamath Basin Distinct Population Segments (DPSs) of bull trout as threatened under the Act on June 10, 1998 (USDI 1998a; 63 FR 31647). The Coastal/Puget Sound and St. Mary-Belly River DPSs of bull trout were listed as threatened under the Act on November 1, 1999 (USDI 1999; 64 FR 58910). This rule combined all DPSs of bull trout in the conterminous United States, and declared them all as threatened. Declining trends and associated habitat loss and fragmentation have been documented range wide and several local extirpations have been reported (Bond 1992; Thomas 1992; Rieman and McIntyre 1993; Donald and Alger 1993; Washington Department of Fish and Wildlife 1997a).

Bull trout are a member of the char family and are related to Dolly Varden trout (*Salvelinus malma*). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal/Puget Sound region of Washington State. Two distinct life history forms, migratory (fluvial or adfluvial) and resident, exist throughout the range of the bull trout (Rieman and McIntyre 1993). Bull trout are generally not anadromous (Meehan and Bjornn 1991), although anadromy may have been important in the past (Bond 1992) and is currently known to occur in Puget Sound and coastal rivers (Kraemer 1994; Mongillo 1993).

The historic range of the bull trout spanned seven states (Alaska, Montana, Idaho, Washington, Oregon, Nevada, and California) and two Canadian Provinces (British Columbia and Alberta) along the Rocky Mountain and Cascade Mountain ranges (Cavender 1978). In the United States, bull trout occur in rivers and tributaries throughout the Columbia Basin in Montana, Idaho, Washington, Oregon, and Nevada, as well as the Klamath Basin in Oregon, and several cross-boundary drainages in extreme southeast Alaska. In California, bull trout were historically found in only the McCloud River, which represented the southernmost extension of the species' range. Bull trout numbers steadily declined after completion of McCloud and Shasta Dams (Rode 1990). The last confirmed report of a bull trout in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990).

Bull trout distribution has been reduced by an estimated 40 to 60 percent since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors. The remaining distribution of bull trout is highly fragmented. Resident bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations have a low likelihood of persistence (Reiman and McIntyre 1993). Many populations and life history forms of bull trout have been extirpated entirely.

Highly migratory, fluvial populations have been eliminated from the largest, most productive river systems across the range. Stream habitat alterations restricting or eliminating bull trout include obstructions to migration, degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, and structural modification of stream habitat (such as channelization or removal of cover).

Resident populations are generally found in small headwater streams where they spend their entire lives, whereas migratory populations rear in tributary streams for several years before migrating downstream into a larger river or lake to mature (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1997).

Bull trout become sexually mature from 4 to 9 years old (Shepard *et al.* 1984). They spawn in the fall (August through October) (Shepard *et al.* 1984; Rieman and McIntyre 1996), typically in cold, low-gradient 1st- to 5th-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard *et al.* 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998). Spawning sites usually occur near cover (Brown 1992). Migratory bull trout frequently begin spawning migrations as early as May and have been known to move upstream as far as 259 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Bull trout spawn in consecutive or alternate years (Shepard *et al.* 1984; Pratt 1992) and may live more than 13 years. Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996).

Rieman and McIntyre (1993) state that bull trout appear to have more specific habitat requirements than other salmonids. In general, bull trout need habitat providing cold water, complex cover, stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre (1993)), they should not be expected to simultaneously occupy all available habitats (Rieman *et al.* 1997).

Rieman and McIntyre (1993) state that water temperature is consistently recognized by researchers more than any other factor as influencing bull trout distribution. Distribution is thought to be limited by temperatures above 15°C, while optimum incubation and juvenile rearing temperatures are thought to be much lower, 2 to 4°C and 4 to 8°C, respectively (Goetz 1989; Pratt 1992). Water temperature seems to be an important factor in determining survival in the early life history of juvenile bull trout, with cool water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992).

Sedimentation is shown to cause negative effects on bull trout, although no thresholds can be set as clear tolerance limits for population maintenance (Rieman and McIntyre 1993). Emergence success of fry appears to be affected by the proportion of sediment in the substrate (Pratt 1992). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard *et al.* 1984). Young bull trout are closely associated with the stream bed, this association appearing more important to bull trout than for other species (Pratt 1992; Rieman and McIntyre 1993). Due to this close connection to substrate, bed load movements and channel instability can also negatively influence the survival of young bull trout.

Bull trout distribution and abundance is positively correlated with complex forms of cover and with pools (Rieman and McIntyre 1993). Cover with which bull trout are usually associated consists of large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder). Studies conducted with closely related Dolly Varden showed that population density declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983; Dolloff 1986; Elliott 1986; Murphy *et al.* 1986).

The marine and estuarine residency period for bull trout is poorly understood. The lack of data requires using literature for other species, like Dolly Varden and cutthroat trout. Aitkin (1998) reviewed the estuarine habitat of anadromous salmon, including native char. His literature review found that Dolly Varden pass through estuaries while migrating, like steelhead, and inhabit coastal neritic waters, like cutthroat trout. Cutthroat trout that reside in estuaries are opportunistic and prey upon small fish like outmigrating salmonid fry. Kraemer (1994) found that the distribution of native char in marine waters was also closely timed to the distribution of bait fish, especially their spawning beaches. Char from Puget Sound have been found to prey on surf smelt, Pacific herring, Pacific sand lance, pink salmon smolts, chum salmon smolts, and a number of invertebrates (Kraemer 1994). The Quinault Nation (1995) documented smelt as a prey item for native char in the Queets River.

Coastal/Puget Sound DPS

The FWS has identified 34[1] subpopulations of native char (bull trout and/or Dolly Varden) within the Coastal/Puget Sound distinct population segment. These subpopulations were grouped into five analysis areas based on their geographic location: Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound, and Transboundary. These groupings were made in order to identify trends that may be specific to certain geographic areas. In subpopulations where it is not known if the native char that occur there are bull trout, Dolly Varden or both, they are addressed together as "native char" in this discussion. This does not imply that both exist within a subpopulation when the words "native char" are used, but merely that the subpopulation of char has not been positively identified as bull trout and/or Dolly Varden.

Genetic analysis has been conducted on nine of the 35 (see footnote #1) native char subpopulations. Samples from five of the nine subpopulations were determined to contain only bull trout (Green River, Queets River, Upper Elwha River, Cushman Reservoir and Lower Skagit River). Two were determined to contain only Dolly Varden (Canyon Creek and Upper Sol Duc River). The Upper Quinault River contained both bull trout and Dolly Varden. No samples had evidence of hybridization.

Within the Coastal/Puget Sound distinct population segment, 12 of the 35 (see footnote #1) native char subpopulations are known to contain bull trout based on either genetic or morphometric

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[1]In the proposed rule to list the bull trout (USDI 1998b; FR 63 31693), the FWS had delineated 35 subpopulations. Upon further review, they revised the total number to 34, when they concluded that the Puyallup River Basin had only two subpopulations as opposed to three. They made this revision in order to be consistent with the defined subpopulation criteria.

measurement data. In seven of these 12 subpopulations, Dolly Varden are also believed to be present. In three out of the remaining 23 subpopulations, only Dolly Varden are currently known to be present. It should be noted that in most cases, identification was based on a limited number of samples, so it is possible that bull trout may also occur in the three subpopulations that to date, have only yielded Dolly Varden. The FWS believes that the current identification trend of subpopulations within the Coastal/Puget Sound population segment indicates the high likelihood of bull trout being present in the majority of remaining subpopulations

The FWS rated a subpopulation as either "strong," "depressed," or "unknown," modified after Rieman *et al.* (1997). A "strong" subpopulation was defined as having all life history forms that once occurred, abundance that is stable or increasing, and at least 5,000 total fish or 500 adult fish present. A "depressed" subpopulation was defined as having either a major life history form eliminated, abundance that is declining or half of the historic abundance, or less than 5,000 total fish or 500 adults present. The FWS rated a subpopulation's status as "unknown" if insufficient information currently exists to determine whether the status of the subpopulation is either "strong" or "depressed." Within the Coastal/Puget Sound distinct population segment, the FWS rates one of the 35 (see footnote #1) delineated native char subpopulations as "strong", 9 as "depressed," and 25 as "unknown."

The Washington State Department of Fish and Wildlife (WDFW) also has a rating system for native char subpopulations. Within the Coastal/Puget Sound distinct population segment, 4 of the 35 (see footnote #1) delineated native char subpopulations are rated as "healthy" by WDFW, and the remaining 31 are of "unknown" status. The 1997 Washington Salmonid Stock Inventory for bull trout and Dolly Varden (WDFW 1997a) states, "The Healthy category covers a wide range of stock performance levels, from consistently robust production to those stocks that may be maintaining sustainable levels without providing any surplus production for directed harvests. In other words, the fact that a stock may be classified as Healthy in the inventory process does not necessarily mean that managers have no current concerns about its production status" (WDFW 1997a).

WDFW (1997a) defines a stock as "unknown," if sufficient trend information was not available or could not be used to assess stock status." WDFW further states that, "[s]tocks rated as Unknown may be rated as Healthy, Depressed, Critical, or Extinct once more information is available."

Native char subpopulations rated as "healthy" by WDFW are: 1) Queets River; 2) Upper Dungeness River; 3) Cushman Reservoir on the Skokomish River; and, 4) the Lower Skagit River. Currently, all but the Upper Dungeness River subpopulation have been determined to consist of bull trout. The FWS believes that the "healthy" status designation for the Queets River, Cushman Reservoir, and Upper Dungeness River subpopulations is not appropriate. Because of information indicating recent declines in the Cushman Reservoir subpopulation (WDFW 1997a) and the lack of recent information for the Queets River subpopulation (general decline indicated by fish/day seining data between 1977 and 1991, and no trend information for 1991 to 1997) (WDFW 1997a), an "unknown" rating better describes their status. The Upper Dungeness River subpopulation status is "tentatively considered healthy" by WDFW based on a single distributional and abundance survey conducted in 1996 (WDFW 1997a). Although the calculated linear densities for the areas sampled on the Upper Dungeness River appear to indicate that char are relatively numerous, the FWS believes this one year of distributional and abundance information is insufficient to conclude a "healthy" or "strong" status in this subpopulation. The FWS believes that the Upper Dungeness River subpopulation should be rated "unknown" at this time. The FWS believes the Lower Skagit River subpopulation meets the criteria described above for a status rating of "strong."

Coastal and Strait of Juan de Fuca Analysis Areas

Very limited efforts have been made, so far, to determine identity and current abundance of native char subpopulations in coastal areas of Washington. Based on the FWS's assessment, the FWS believes that 3 of 15 subpopulations of native char in the Coastal and Strait of Juan de Fuca analysis area are "depressed" (Hoh River, Lower Elwha River, and Lower Dungeness River/Gray Wolf River). The remaining 12 subpopulations of native char are of "unknown" status.

The WDFW rated the status of 13 out of 15 coastal and Strait of Juan de Fuca subpopulations of native char as "unknown" (WDFW 1997a). The Queets River and Upper Dungeness River subpopulations are the sole exceptions, and have been rated "healthy" by WDFW. As mentioned above, the FWS questions whether the Queets River subpopulation is indeed healthy, due to the type of data used to make this determination and the lack of additional data for the past 5 years (Quinault Indian Nation (QIN), in lit. 1995; WDFW 1997b).

The identity of native char (bull trout or Dolly Varden) has been determined for 3 of 10 coastal subpopulations, and 3 of 5 Strait of Juan de Fuca subpopulations. Bull trout are known to occur in two coastal subpopulations (Upper Quinault River and Queets River), and two Strait of Juan de Fuca subpopulations (Upper Elwha River and Dungeness River/Gray Wolf River) (Leary and Allendorf 1997; WDFW 1997b). Only Dolly Varden have been identified in the Upper Sol Duc River and the Upper Dungeness River subpopulations (Cavender 1978; Cavender 1984; WDFW 1997b).

The subpopulations of native char on the southwest Washington coast appear to be in low abundance based on anecdotal information. This is thought to be the southern end of the range for coastal bull trout and Dolly Varden in this DPS, and abundance may be naturally low in systems like the Chehalis, Moclips, and Copalis rivers. These basins are relatively low gradient which is not ideal for bull trout and Dolly Varden (WDFW 1997a). There is scant historical and current information to compare, although there have been adverse impacts from past habitat degradation to other salmonid species in these systems (Phinney and Bucknell 1975; Hiss and Knudsen 1993), and these same impacts have likely affected native char (WDFW 1997a). Although status information for the Lower Quinault River is limited, native char in this system are said to be at low levels of abundance or in a depressed state (Meyer and Averill 1994). The majority of the lower Quinault River basin lies outside of Olympic National Park and has been severely degraded as a result of past forest practices (Phinney and Bucknell 1975; WDFW 1997a). The Upper Quinault River subpopulation of bull trout is likely in much better condition since it occurs completely within Olympic National Park.

Northwest Washington coast and Strait of Juan de Fuca subpopulations appear to be relatively more abundant compared to southwest Washington based on limited data. Most of these subpopulations lie partially within the Olympic National Park and benefit from the excellent habitat conditions that exist within Park boundaries. However, large portions of the Queets River, Hoh River, and Dungeness River basins also lie outside of the Olympic National Park, and have been severely degraded as a result of past forest practices (Phinney and Bucknell 1975; Williams *et al.* 1975; WDFW 1997a). Non-native brook trout are also present in some Park waters, and pose an ongoing threat to bull trout populations from competition and hybridization. The Lower and Upper Elwha River subpopulations have been fragmented by dams. The FWS believes the Lower Elwha River subpopulation is depressed based on the extremely low number of char observed in this system in recent years. It is generally believed that the Hoh River may have the largest subpopulation of native char on the Washington coast, even though it is thought to have been greatly reduced since 1982 (Washington Department of Wildlife (WDW) 1992; WDFW 1997a). Although the reasons for this decline are unknown, some believe over-fishing contributed to the decline (WDFW 1997a). It has been noted that native char were historically very common and widespread throughout the lower Dungeness and Gray Wolf rivers. They are still widespread, but "greatly reduced in numbers" (WDW 1992; WDFW 1997a). The FWS concludes that the Hoh River and the Lower Dungeness River/Gray Wolf River subpopulations are "depressed."

Habitat Conservation Plans (rangewide)

The range-wide status of the bull trout has been affected by a few recent Habitat Conservation Plans (HCPs) that were prepared in conjunction with incidental take permit applications to the FWS pursuant to section 10(a)(1)(B) of the Act. The Plum Creek Timber Company and the WDNR HCP Amendments are the only ones that specifically address bull trout, but a number of others address other aquatic species.

The WDNR's HCP amendment (USDI 1998c) to include bull trout allowed for incidental take of bull trout associated with habitat degradation/loss due to 29 miles of road construction and maintenance per year, and 158 acres of selective and thinning harvest per year. This amendment added only the Coastal/Puget Sound DPS of bull trout to the WDNR's HCP.

The Plum Creek Timber Company's HCP amendment (USDI 1998d) added the Columbia River DPS of bull trout to their HCP. The amendment allowed for the take of bull trout associated with habitat degradation/loss due to 150 acres of selective and thinning/restoration-oriented silvicultural harvest per year, 2 miles of stream restoration per year, and 20.2 miles of road construction, maintenance, and removal per year. The term of the Plum Creek HCP and permit is 50 to 100 years.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR §402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

<u>Status of the Species</u> (in the action area)

For the purposes of this consultation, the FWS has determined the action area to be the Elwha River between its mouth and River Mile 16, Lake Mills, Lake Aldwell, and the nearshore marine waters near the mouth of the Elwha River. The Lower and Upper Elwha River subpopulations are two of

34 subpopulations identified in the final listing rule (USDI 1999; 64 FR 58910) that would be affected by the proposed action.

Elwha River Basin

The Elwha River flows in a northerly direction, entering the Strait of Juan de Fuca west of the City of Port Angeles. The river is about 45 miles long, has more than 100 miles of tributaries, and drains 321 square miles. About 83 percent of the drainage lies within Olympic National Park and is protected from intensive development.

Information on the status and abundance of native char within the Elwha River basin is limited, but the presence of two subpopulations of bull trout is considered likely because of the restricted access caused by the two dams. The construction of Elwha Dam at river mile 5 in 1913 blocked all upstream migration and created the lower Elwha River subpopulation. This subpopulation is likely anadromous, although a remnant of the fluvial life history form may still be present. The construction of Glines Canyon Dam in 1926 resulted in further isolation of the native char populations. The upper Elwha River subpopulation exists in the mainstem and tributaries both between and upstream of two dams, and likely retains its fluvial and resident life forms, in addition to developing an adfluvial form. Its anadromous life form may be lost, but the capture of juvenile bull trout below Glines Canyon Dam during the normal outmigration period for the anadromous life form suggests that latent anadromy may still exist.

Within the Elwha River Basin, there are approximately 190,000 acres (92 percent) in Federal ownership (Forest Service and National Park Service); 6,400 acres (3 percent) in state ownership; 9,100 acres (4 percent) in private ownership (includes City and County lands); and 400 acres (<1 percent) in tribal ownership (USGS 1996).

Hatchery releases of chinook and coho salmon and steelhead occur in the lower Elwha River. Interaction between native char and these hatchery origin fish has not been examined (WDFW 1997a). Although bull trout evolved with and continue to coexist with anadromous salmonids (Ratliff and Howell 1992), hatchery releases of certain anadromous salmonids may impose predation and competition pressures on bull trout that are above natural levels.

Brook trout *(S. fontinalis)* have been planted in ONP, and are known to occur in tributaries both upstream and downstream of Glines Canyon Dam.

The Lower Elwha River outside of Olympic National Park is closed to fishing for native char (WDFW 1997a). The park has catch-and-release regulations for native char in all ONP waters. There may be some mortality from incidental hook and release of bull trout in fisheries targeting other species.

Lower Elwha River Subpopulation

Only limited information exists on the abundance and use of the Elwha River mainstem and tributaries located downstream from Elwha Dam by native char. It is presently unknown if the native char are bull trout, Dolly Varden, or both. A few native char are incidentally captured in the tribal test fishery or observed in the State rearing channel or at the tribal hatchery holding pond each year in the fall (WDFW 1997a, Crain 1999). Native char seen at the tribal facility have been about one to two pounds in weight (Crain 1999). Char observed in the WDFW rearing channel have been about 300 to 380 millimeters (12 to 15 inches) in length (WDFW 1997a). No native char spawning has been documented for the lower river. In general, native char are present in the river below Elwha Dam in low numbers (USDI 1994). WDFW has assigned this subpopulation an unknown status (WDFW 1997a). The FWS believes the subpopulation has a depressed status.

Available habitat for this subpopulation includes the 5 miles of the Elwha River mainstem downstream from Elwha Dam, and three small low gradient tributaries (Bosco, Boston and Charley Creeks). Suitable spawning habitat in the mainstem is extremely limited because of the predominance of large substrate (mostly cobbles and boulders) and high water temperatures. The three tributaries that enter the lower river are unlikely to provide suitable spawning conditions for bull trout because of their low gradient and expected higher than favorable temperatures. The location of spawning habitat used by the lower river subpopulation is unknown.

Water temperatures are elevated by the solar warming that occurs in the two reservoirs. Water temperature data collected by the Lower Elwha S'Klallam Tribe show about a 7 degree F. increase between the Elwha River upstream of Lake Mills and the lower river below Elwha Dam (Orsborn and Orsborn1999). Temperatures in the lower river exceed 65 degrees F for several weeks during the summer low flow period.

Upper Elwha River Subpopulation

Native char upstream of Elwha Dam (lower dam) have been identified as bull trout using genetic and morphometric techniques. No data are available, but the FWS believes the bull trout occurring between the two dams are more likely to have the genetic makeup of the upper river subpopulation. This assumption is based on the significant numbers (23) and similar size (most between 100 and 120 millimeters) of bull trout that were caught in a scoop trap downstream of Glines Canyon Dam between late April and early June (Hiss and Wunderlich1994, FWS 1998). Genetic testing, however, has not yet been done to verify this assumption.

Bull trout have been reported to occur in low numbers between the two dams, in Lake Aldwell, and in three tributaries (Griff Creek, Hughes Creek and the Little River) within this reach (Hiss and Wunderlich1994, FWS 1998, Morrill and McHenry1996). No bull trout were found in the tributaries or in the mainstem during the snorkel surveys of this area by the U.S. Geological Survey in 1995 (Reisenbichler 1999). In contrast, nearly 200 bull trout were observed upstream of Lake Mills.

Habitat between the dams is impacted by the interception and trapping of nutrients, gravels, and large woody debris by Lake Mills, and the solar warming that occurs because of the longer retention time and the large surface area (415 acres) of the reservoir. The reduction of nutrients from upstream sources as well as the elimination of anadromous fish from this reach has likely resulted in a decrease in production of benthic invertebrates. Munn (1999) concluded that the Elwha River and its tributaries are presently oligotrophic and that restoring salmon runs will affect the ecosystem profoundly, increasing both primary and secondary productivity. Li (1990) found fewer taxa of benthic invertebrates downstream of the dams than he found upstream of Lake Mills. Substrate below Glines Canyon Dam now consists mainly of large cobbles and boulders, and is generally too large to be considered suitable spawning habitat. Water temperatures can exceed 15 degrees C. (daily average) for several weeks during the summer low flow period (Crain 2000). These factors are likely responsible for the low numbers of bull trout that have been observed between the dams.

Bull trout utilize Lake Mills as foraging habitat. Hiss and Wunderlich (1994) captured 7 bull trout (118 mm to 404 mm), with a relatively low level of sampling effort. Sixty rainbow trout and numerous crayfish were also caught during this sampling effort, indicating that a forage base exists in the reservoir for bull trout.

The habitat upstream of Lake Mills (more than 50 miles of mainstem and tributary habitat) exhibits the conditions (clear and cold water, substrate with few fines, substantial amounts of large woody debris) that are typical of good bull trout habitat. Bull trout have been observed in the Elwha River mainstem between river miles 16 and 42, and in a number of the tributaries (Cat, Godkin and Delabarre Creeks and the Hayes River), in the upper basin (Reisenbichler 1999). Reisenbichler (1999) observed 160 and 39 bull trout in the mainstem and tributaries, respectively. (In contrast, no bull trout were observed by Reisenbichler in the Elwha River mainstem and tributaries between the two dams). Based on this survey data, Reisenbichler estimated the bull trout standing crop at 559 $\pm$ 316 and 483 $\pm$ 416 in the mainstem and tributaries upstream of Lake Mills, respectively. Since these estimates are uncorrected for sampling efficiency, and did not include areas that were to hazardous or deep to snorkel, these values should be considered a lower estimate of standing crop. Good habitat occurs above Lake Mills, but the actual locations used by bull trout for spawning is unknown.

Although the USFWS does not consider there to be sufficient information to establish the status of the upper river subpopulation at this time, the greater numbers of bull trout observed and the availability of suitable habitat upstream from Lake Mills indicates that this subpopulation is in much better condition than the lower river subpopulation.

For the purpose of this BO, the FWS assumes spawning occurs in the Elwha River mainstem and in tributaries that enter the Elwha River between the two dams. The two reservoirs are probably used mainly for foraging. The Elwha River likely supports anadromous, fluvial, resident, and adfluvial life forms, and provides habitat for foraging, migration, and overwintering.

EFFECTS OF THE ACTION

The proposed project is expected to adversely impact bull trout in the short and near term, but significantly benefit bull trout in the long term. Bull trout are likely to be adversely affected by both physical and biological changes to the condition of their habitat and by the direct and immediate effect of sediment releases and dissolved gases on the health and survival of individual fish. There will be some minor releases of turbidity and sediments in the year preceding dam removal as a result of mitigative measures to protect water supplies, roads, and private property. The effect of these measures on bull trout are expected to be minor in comparison to the impact from the release of reservoir sediments. Up to 2.6 million cubic yards of coarse and 5.6 million cubic yards of fine sediment are predicted to erode from the two reservoirs (ONP 1996b). In the short-term (2-6 years) due to high turbidity and bedload, the project will have moderate to severe impacts on individual fish that reside in Lake Mills and in the Elwha River downstream from Glines Canyon Dam (ONP 1996b).

The introduction of sediment in excess of natural amounts can have multiple adverse effects on channel conditions and processes resulting in effects on bull trout survival, the food web, and water quality conditions, such as water temperature and dissolved oxygen (Rhodes *et al.* 1994). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985) but may also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995). Emergence success of bull trout has been shown to be approximately 80 percent when no fine materials are present, and approximately 30 percent when 35 percent fine materials are present (Weaver and White 1985 in Montana Bull Trout Scientific Group 1998). Bull trout at all life stages occupy deep pools and few bull trout are found in streams where pools are lacking (Dambacher *et al.* 1992; Buckman *et al.* 1992 and Goetz 1989 in MBTSG 1998). Shifts in sediment loads set off a complex of channel responses including changes in pool volumes, depth and frequency, and changes channel morphology (including slope, sinuosity, shape, velocity, flooding regime, and sediment transport) (Rhodes *et al.* 1994; Castro and Reckendorf 1995).

The occurrence of dissolved gas levels could increase if the frequency and magnitude of spill events increase as a result of project operation. Per the BAA, major repairs to the hydroelectric projects will not likely be undertaken which could lead to an increase in the frequency and magnitude of flow over the spillways. Dissolved gas measurements taken below each of the dams were typically 108 percent of saturation, or less, but ranged as high as 113.3 percent (James River II 1988). Within 0.8 miles of the location of highest measurement, saturation levels dropped to less than 108 percent. Fish mortalities from gas bubble disease generally occur when saturation levels exceed 110 to 115 percent (EPA 1986). The FWS did not observe evidence of gas bubble disease from any of the chinook and coho salmon, steelhead trout or bull trout examined during the Elwha River smolt outmigration and dam passage studies of the 1980's (Wunderlich 2000). Captured fish, however, were not specifically examined for the purpose of evaluating gas bubble disease, nor were smolts collected over the full range of spill events. Still, no obvious injury related to gas bubble disease was noted. For these reasons, the risk of injury or mortality from gas super saturation is considered low.

Although significant adverse impacts to bull trout and their habitat within the immediate influence of the project will occur during the removal of the two dams, and for several years afterwards as silt, clay and sand is transported from the two reservoirs downstream to the estuary, the benefits will be highly significant over the longer term. With the removal of the two dams, the barriers separating the two subpopulations will be eliminated, and access to former spawning, foraging and rearing habitats will be restored. In addition, the lower river habitat will be improved with the replenishment of spawning gravel, nutrients, large woody debris and cold water. The restoration of the Elwha River's salmon and steelhead stocks will benefit bull trout foraging throughout the basin. The acquisition and management of 1220 acres for the primary purpose of ecosystem restoration will eliminate the potential for incompatible land use practices that could adversely impact bull trout habitat.

Nearshore Marine Environment

The release of large quantities of silt and clay, presently trapped in the two reservoirs, can be expected to reduce the forage fish availability for bull trout that use the nearshore marine environment near the mouth of the Elwha River during the two year period that most of the fine sediments would be washed out. The potential adverse impact would be moderated by a number of factors, including the presence of strong tidal currents, and the retention of the fine sediments in the freshwater surface layer, which will reduce the level of turbidity that would otherwise occur along the bottom and nearshore. Bull trout and their prey (e.g., mysids, herring, sand lance, smelt and other fishes) are likely to avoid localized areas of high turbidity. Given the strong tidal currents, the containment of most of the turbidity in the freshwater surface plume, the turbidity events occurring in pulses, and the mobility of bull trout and their prey, the project's impact on foraging is expected to be very localized in the nearshore marine environment. Following the two year project, turbidity pulses would generally occur only during high flow events, most of which occur in the November through February time period (USGS 2000).

Over the longer term, as the Elwha estuary is replenished with sand, gravels, and nutrients, the increased diversity and productivity will benefit bull trout. Rebuilding of the beach areas should begin within 3 years (ONP 1996b). The beach area near the mouth of the Elwha River is presently steep and consists mainly of boulders and cobbles. The return of a more natural beach (i.e., gradual slope, sand and gravel dominated) will benefit sand lance, surf smelt, herring and salmon by improving their spawning and/or rearing habitat. Bull trout should benefit from the improved forage base.

Elwha River Downstream of Elwha Dam

The dam removal approach is designed to expedite the erosion and transport of sediments from the two reservoirs to reduce the impact to bull trout and other fish from chronic sediment releases. The lower river subpopulation will be adversely affected by the loss of spawning, rearing, and foraging opportunities in the five mile long reach of the Elwha River below Elwha Dam for probably six years while eroded silt, clay and sand from the two reservoirs pass downstream to the Strait of Juan de Fuca. The erosion process could be shorter or longer depending on the magnitude and frequency of high flow events that occur following the two year project removal period. The lower river subpopulation, however, will have access to spawning habitat in the upper basin after the second year. High turbidity levels would begin in July with the drawdown of the Lake Mills water level to provide additional flow control for the downstream construction work at Elwha Dam. During the first two years, when most of the silt and clay would pass downstream, conditions within the main channel would be inhospitable for bull trout during periods of high turbidity (BAA). Periods of high turbidity would occur each time a layer of the dam is removed and a new area of the lakebed is exposed to the action of the river. Glines Canyon Dam would be removed in a sequence of about 25 layers, while Elwha Dam would be removed in just two stages because of the large amount of fill on the upstream side of Elwha Dam and the specialized demolition approach that would be used to address this factor. Generally, turbidity levels would increase to high levels (greater than 10,000 parts per million) with the removal of each layer, then clear substantially (but would still be higher than background levels), until the next layer of the dam is removed, two or more weeks later. The turbidity levels will vary greatly during this two year project period because of the uneven distribution of fine sediments within the reservoirs and the reduced dilution potential of the reservoirs due to their decreasing volume. During peak turbidity events, suspended solid levels are expected to be between 28,000 to 51,000 parts per million (BAA, ONP 1996b). Peak concentrations, however, would generally be of short duration, about 1-3 days. Injury or mortality could occur at these levels, and foraging efficiency could be impacted at much lower levels. High turbidity levels can injure or kill fish by abrading or clogging their gills, and can smother fry and eggs in the gravel. The prey base (fish, crayfish and benthic invertebrates) would also suffer high mortality. Some bull trout and some of their prey base may be able to find refuge in the three tributaries to the lower river, but the amount of tributary habitat is small and may not provide adequate conditions throughout the year for large numbers of fish. Some bull trout would likely migrate to the nearshore marine environment, or if already present in marine waters may remain there and not enter the river during high turbidity. Bull trout are unlikely to find suitable spawning or rearing habitat within the lower river during the two year project removal period because of the reoccurring high turbidity pulses and the large amounts of sand that would be eroded from the lakebeds.

Following the two year project removal period, another 1-4 years is estimated for the vast majority of reservoir sands to pass through the lower river. While this occurs, the substrate would probably be too unstable to support a healthy benthic community, allow for the recovery of the bull trout prey base (rainbow and cutthroat trout, sculpins, and crayfish), or provide good rearing habitat for bull trout. Significant recovery of the lower river, however, is expected to occur within 6-10 years of dam removal. Access to good habitat in the upper river would occur by the end of the second year, since subsequent high turbidity pulses would occur concurrent with high flow events and would be of relatively short duration.

Elwha River Between Elwha and Glines Canyon Dams

Bull trout between the two dams are likely to be exposed to the same turbidity and bedload impacts faced by the lower river subpopulation. Most of the accumulated clay, silt, sand and gravel is trapped in the upper reservoir (3.9 million and 13.8 million cubic yards in Lake Aldwell and Lake Mills, respectively), and little of this sediment is expected to settle out between the two dams (ONP 1996b). Therefore, the impacts to bull trout from this reach are expected to be similar to those in the lower river. Larger tributaries (Griff, Hughes, and Indian Creeks, Little River) entering this reach should provide better refuge for bull trout than those of the lower river because of their larger size, higher gradient and cooler water. The documented presence of bull trout (though at very low levels) in the Little River and in Hughes and Griff Creeks suggest that suitable conditions occur for at least some period of the year (Morrill and McHenry1995).

Lake Aldwell

Lake Aldwell probably provides limited foraging opportunities for bull trout, based on the very narrow littoral zone, the expected limited prey base (given the low level of fishing pressure for rainbow trout despite the accessibility of Lake Aldwell) and the very few bull trout reported. Foraging opportunities will be eliminated or greatly limited by the reoccurring high turbidity pulses. Bull trout and their prey (e.g., rainbow and cutthroat trout) may seek refuge in Indian Creek or the Little River which enter the Elwha River slightly upstream. Turbidity levels in Lake Aldwell would be high enough to cause injury and mortality.

Lake Mills

The removal of the Glines Canyon Dam will eliminate Lake Mills and the foraging opportunities it presently provides. Lake Mills appears to be better bull trout foraging habitat than Lake Aldwell, though data on which to base this conclusion is limited. During the two-year dam removal period, Lake Mills will likely have very limited or no value to bull trout. Even though the reservoir will go through reoccurring periods of high turbidity and clearing, the more productive littoral zone will be dewatered with the first level of reservoir drawdown using the power intake. Bull trout prey species (rainbow and cutthroat trout) are expected to leave the turbid waters of the reservoir for clearer water (e.g., Boulder Creek and the Elwha River upstream of Lake Mills). The high turbidity levels are also likely to severely limit the foraging efficiency of bull trout in the unlikely event that their prey resources remain in Lake Mills. Bull trout are also likely to exit Lake Mills when turbidity levels increase to unfavorable levels. The risk of injury or mortality from the high clay and silt concentrations is considered low because the high levels will not occur immediately or persist, and the attraction of clearer water flowing into the reservoir should hasten their departure before the turbidity levels reach injurious or lethal concentrations.

Significant recovery of the Elwha River within its former lakebed should occur within five years, and probably sooner because much of the accumulated sand will be transported away within the first two years and a large portion of the remaining amount will be confined on terraces and beyond the zone of the river's erosive influence. Therefore, the project's adverse impact on bull trout foraging is expected to occur for 3-5 years, with significant long term benefits beginning as the 3-mile long channel recovers and provides other foraging opportunities, e.g., salmon and steelhead fry, resident trout, and benthic invertebrates.

Elwha River above Lake Mills

Although the habitat above Lake Mills would not be directly impacted by the project, the restoration of anadromous fish runs and the increase in habitat for resident fish species will have a very significant beneficial effect on the upper basin ecosystem. The Elwha River upstream of Lake Mills is oligotrophic (Munn et *al.* 1999). The restoration of salmon runs to the upper basin will increase both primary and secondary productivity and benefit bull trout by improving their prey base. In addition, the Upper Elwha River subpopulation will again have access to the foraging habitat in the marine environment, which should lead to the recovery of the anadromous life form. Finally, the two Elwha River subpopulations would be reconnected, satisfying one of the FWS's recovery goals for this Elwha basin.

Long-Term Ecosystem Response

Dam removal and natural erosion of the accumulated sediments would allow for the full restoration of native Elwha River fishes, including bull trout. Transport of sediment would be reestablished along the entire river, increasing the quality and quantity of spawning and rearing habitat. The estuary and nearshore beaches in the Strait of Juan de Fuca would recovered from their sediment depleted condition, increasing important smolt habitat and prey base. Water temperatures would be reduced in the middle and lower river to pre-dam levels, the middle and lower reaches would be fully supplied with woody debris, and nutrient flow to the upper reach via salmon carcasses would be restored.

Temperatures would be near levels considered optimum to the well being of trout, salmon, and char. The nutrients would support the invertebrates on which most species of trout and salmon feed. Woody debris would influence important river habitat characteristics such as riffle/pool complexes, substrate type and location, and cover.

Bull trout would again have access to all of their former habitats (spawning, rearing, foraging, over-wintering) within the Elwha River basin and the marine environment. The flow of genetic material between the two subpopulations would be restored, and the anadromous life form would have the opportunity to recover.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Since about 83 percent of the Elwha River watershed lies within Olympic National Park, the level of cumulative effects would be relatively minor. Still, non-Federal forest lands in the basin will continue to be cut as they reach harvestable size. Some additional roads may be constructed to access the timber, and could increase runoff and sediments entering the river. Some residential and commercial development is also likely to occur in the future and could degrade bull trout habitat by removing riparian vegetation, increasing surface runoff, and reducing water quality. On the other hand, the proposed project and the future restoration of anadromous fish runs may result in other habitat improvement efforts being undertaken along the Little River and Indian Creek.

CONCLUSION

After reviewing the current status of the bull trout, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the FWS's biological opinion that the Elwha River Ecosystem Restoration Project, as proposed, is not likely to jeopardize the continued existence of the bull trout in the short term and is likely to significantly benefit Elwha River bull trout by restoring connectivity between the two subpopulations and access to their former range. No critical habitat has been proposed for the bull trout, therefore, none will be affected.

The FWS does not believe that the proposed project would result in jeopardy to the bull trout for the following reasons:

1. Harm, harassment and mortality of bull trout would likely occur from the Elwha River estuary, and from the mouth of the Elwha River at River Mile (RM) 0.0 to the upstream end of Lake Mills at RM 16. Although the affected area represents about 20 percent of the available habitat within the basin, the optimal habitat lies upstream of the project and would not be adversely impacted.

2. The potential for harm/harassment is unquantifiable in terms of the number of fish potentially affected. However, the existing survey data indicates that far greater numbers of bull trout occur

upstream of the project.

3. The project will significantly benefit bull trout over the long term by re-establishing the connectivity between the two Elwha River subpopulations and access to their former habitats, and by restoring the natural transport of nutrients, spawning gravels, large woody debris, and cool water to the lower river and estuary.

4. The Lower and Upper Elwha River subpopulations are two of 34 (5.9 percent) subpopulations within the Coastal/Puget Sound DPS identified in the final listing rule (USDI 1999; 64 FR 58910).

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulations issued pursuant to section 4(d) of the Act, prohibit take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the FWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the lead agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The ONP has a continuing duty to regulate the activity covered by this incidental take statement. If the ONP (1) fails to assume and implement the terms and conditions or (2) fails to require the contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract, the protective coverage of section 7(o)(2) may lapse.

<u>Amount or Extent of Take</u>

The FWS anticipates that the proposed project has the potential to result in the incidental take of bull trout in the form of harm, harassment or mortality to incubating eggs, juveniles, and adults due to potential detrimental effects on parameters such as substrate quality, food supply, spawning success, successful incubation, and suspended sediment and dissolved gas levels which may cause direct injury or mortality. Such detrimental effects are due to impacts associated mainly with the removal of the two Elwha River dams, but also include the construction of related flood control, road improvement and water supply measures, and the interim operation of the hydroelectric projects prior to project removal.

The FWS anticipates incidental take of individual bull trout will be difficult to detect or quantify for

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the following reasons: (1) low likelihood of finding dead or injured eggs, juveniles or adults given the low density of bull trout and the high turbidity levels that would make recovery of injured or dead eggs or fish difficult; (2) rapid rate of fish decomposition; and, (3) high probability of scavenging by predators, especially gulls. Using post project habitat conditions as a surrogate indicator of take, the FWS anticipates that the following forms of take could occur as a result of the activities associated with the project.

1. Take of resident and migratory bull trout in the form of harm, harassment, and mortality associated with impacts from food supply reduction and degraded water quality, is predicted to last up to 10 years as suspended solids and bedload levels in the lower river return to pre-dam levels.

2. Take of migratory bull trout in the form of harm, harass, and mortality associated with degradation of instream habitat (i.e., substrate composition, pool depth, and channel stability) is predicted to last up to 10 years, as suspended solids and bedload inputs to the lower river return to pre-dam levels.

The following location, life form, and life stages will be affected by the forms of take listed above:

1. Individual bull trout in the Elwha River, from the upstream end of Lake Mills to the mouth of the Elwha River (including 11 miles of the Elwha River, Lake Mills and Lake Aldwell) and a one half mile long by a one quarter mile wide band of the nearshore marine zone adjacent to the Elwha River mouth.

2. The life forms expected to be harmed, harassed or killed are resident and migratory bull trout.

3. All life stages are expected to be harmed, harassed or killed.

Effect of Take

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the bull trout.

Reasonable and Prudent Measures

The FWS believes the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize impact of incidental take of bull trout.

1. Rescue and remove bull trout from the Elwha River (including tributaries between and below the dams, if appropriate), to reduce the level of take from the release of reservoir sediments.

2. Determine the appropriate location(s) to hold or relocate bull trout that are rescued and removed from the lower river during the two-year long dam removal period.

3. Improve accessibility to Elwha River tributaries to increase the availability of refuge habitat for bull trout during periods of high turbidity and bedload levels.

4. Monitor effects of the proposed action on instream habitat from the mouth of the Elwha River to the upstream end of Lake Mills.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the ONP must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

RPM 1. Develop and implement a bull trout rescue/removal plan that is acceptable to the FWS.

RPM 2. Determine the origin of bull trout utilizing the Lower Elwha River through a genetic analysis (micro-satellite DNA) of these fish, e.g., from the tribal test fishery, tribal hatchery and State rearing channel.

RPM 2. Determine by genetic analysis if bull trout from the lower Elwha River are distinct from the Upper Elwha River or Lower Dungeness River/Gray Wolf River subpopulations.

RPM 2. Determine the genetic signature of the Lower Dungeness River/Gray Wolf River subpopulation. This information is presently unavailable and is necessary to properly relocate bull trout rescued and removed from the lower Elwha River. Potentially, bull trout from the Lower Dungeness River/Gray Wolf River subpopulation may use the lower Elwha River. Their placement above Lake Mills must be avoided.

RPM 3. Replace or modify Hot Springs Road culverts that limit or block access to tributaries that could be used by bull trout as a refuge habitat when the high sediment load and turbidity levels occur in the Elwha River. Any culvert should be sized for the 100-year event and installed to safely and effectively pass both juvenile and adult bull trout.

RPM 4. Using an appropriate, FWS-approved methodology(ies), monitor sediment levels pre- and post-project, both above and below the project area for a period of ten years, or less if pre-dam sediment levels in the affected areas occur sooner. Periodically monitor the condition of the Elwha River and determine if suspended solids and bedload levels have returned to pre-dam levels. If by the end of the 10 year monitoring period, sediment levels have not returned to pre-dam levels, implement additional measures, e.g., grading, seeding, replanting, etc., to reduce the input and transport of sediment from the project area.

In order to monitor the effectiveness and impacts of implementation of the reasonable and prudent measures, the ONP shall prepare a report describing the progress of the proposed Elwha River Ecosystem Restoration Project, including implementation of the associated terms and conditions, and impacts to bull trout (50 CFR §402.14(i)(3)). The report shall be submitted to the Western Washington Office annually through the completion time for the proposed action, and shall be submitted no later than April 1 for the preceding 12-month period ending December 31. The report shall list and describe:

a. adverse effects to bull trout resulting from the implementation of the proposed Elwha River Ecosystem Restoration Project;

b. when and if the level of anticipated incidental take is approached;

c. when and if the level of anticipated incidental take is exceeded; and,

d. the effectiveness of the terms and conditions.

The FWS is to be notified within three (3) working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact our Law Enforcement Office at (425) 883-8122 or our Western Washington Office at (360)753-9440.

The FWS believes that all bull trout associated with the degradation of habitat in approximately 11 miles of the Elwha River, the two reservoirs, and the nearshore marine waters near the mouth of the Elwha River will be incidentally taken as a result of the proposed Elwha River Ecosystem Restoration Project. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The ONP must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, help implement recovery plans, or develop information.

The FWS recommends the following additional actions to promote the recovery of Federally listed species and their habitats:

1. Minimize the removal of trees and shrubs and other impacts to sensitive areas.

2. Utilize only native plant species when reseeding disturbed or unstable areas.

3. Conduct night snorkeling surveys to determine local bull trout distribution and seasonal use within the Elwha River mainstem and its tributaries.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation of the proposed Elwha River Ecosystem Restoration Project as outlined in your February 17, 2000, request for consultation. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or, (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions regarding this biological opinion, please contact Gwill Ging (360) 753-6041) or Jim Michaels (360-753-7767) of my staff at the letterhead address.

Gerry A. Jackson

GG/jk
SE/NP/1-3-00-F-0606/Clallam County

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Glossary

A

adfluvial population — Refers to fish that live in lakes and migrate into streams to spawn.

affected environment — Existing biological, physical, social, and economic conditions of an area that are subject to change, both directly and indirectly as a result of a proposed human action.

agglomeration site — The surface (such as a lamella plate) where suspended particles can efficiently collect and form a larger particle. During processes such as water treatment, these larger particles (called floccules) settle out of solution more rapidly than individual particles would.

aggradation — Process of raising the level of a streambed, floodplain or sandbar by deposition of sediment.

alluvium — Sediments that are transported and deposited by streams and rivers such as clay, silt, sand, gravel, cobbles, and boulders.

anadromous fish — Species of fish such as salmon, which hatch in freshwater, spend a large part of their lives in the ocean, and return to freshwater to reproduce.

armoring — Progressive removal of finer grained sediments from a streambed leaving a layer of coarser sediment that is less easily eroded.

artificial constant head — Hydraulic head maintained by artificial means.

attenuate — To weaken or reduce the force of something such as flood waters.

B

bedload — Coarse sediment (sand, gravel, cobble or rock fragments) transported along the bottom of a stream and frequently in contact with it.

blinding — Infilling of the upper layer of riverbed materials with fine sediment to such a degree that the surface may be “sealed” and unable to pass water in the quantities needed.

butterfly valve — A mechanical device used to control the flow of water in a pipeline. This valve contains a circular leaf which is located in the center of the pipe and rotates 90 degrees to regulated the flow of water in the pipeline.

C

caisson — A watertight structure in which underwater structures are housed.

capacitor — An electric circuit element used to temporarily store an electrical charge.

cfs — Cubic feet per second. A cubic foot of water passing a reference point in 1 second of time.

channel storage — Sediment or water that is temporarily stored in between the banks of a river channel.

cofferdam —– A temporary dam allowing dewatering of a portion of a river or lake for construction purposes.

constant head — The force or pressure acting on a system that does not vary. This force or pressure is applied from a constant water level.

D

discount rate — The rate at which future benefits and costs are discounted because of positive time preference, or because of the existence of a positive real rate of power (i.e., placing higher value on current consumption or income than accruing it in the future).

E

ecosystem — A community of living organisms interacting with one another and with their physical environment, such as a forest, pond or estuary.

Eicher screens – Experimental technology to minimize fish injuries that places a screen within a penstock and uses water velocity to carry juvenile salmonids past the screen and into a bypass pipe, thus avoiding turbines.

EIS — Environmental Impact Statement. The National Environmental Policy Act of 1969 requires that an environmental impact statement be prepared to evaluate the potential environmental affects of major federal actions. An EIS identifies and analyzes activities that might affect the human and natural environment.

epicenter — Location on the surface of the earth above where an earthquake originates.

escapement — Adult fish that escape fishing gear to migrate upstream to spawning grounds.

F

fine-grained sediments — Clay and silt sized particles that are smaller than 0.0030 inches (0.075 mm) in size.

fingerling — Small fish ranging in size from 1 to 3 inches.

fish ladder — An ascending structure of intervening pools of water that is built to allow fish to migrate upstream.

flocculants — Chemicals that cause small particles suspended in a solution to form clumps or masses precipitated from a solution.

floodplain — Land adjacent to a river that is periodically subject to flooding.

fluvial population — Refers to fish that live, feed, and mature in the mainstem of a river and that migrate to tributaries to spawn.

forebay — Impoundment immediately above a dam or hydroelectric plant intake structure.

freeboard — The height of a structure above the recorded high-water mark.

fry — Early swimming stage of young fishes, between the egg and fingerling stages.

G

gaging station — Specific location on a stream where systematic observations of hydrologic data are obtained through mechanical or electrical means.

gunite — Mixture of cement, sand, and water applied as a sealing agent to prevent weathering of things such as mine timbers and roadways.

H

hydraulic gradient — The slope of the surface of open or underground water.

I

infiltration gallery — One or more horizontally laid screens placed in permeable alluvial materials, either adjacent to a water body or beneath its bed. Usually installed to supply water from aquifers where the hydraulic conductivity is large but the transmissivity is severely limited because the deposits are thin.

in-line filtration — A water treatment filter (mechanical screening device) installed on the main water supply line.

L

lamella plates — A water clarification system that uses a series of closely spaced flat plates inclined at an angle of 45° to 60°. As water with sediment flows over the plates, heavy solids with a specific gravity higher than the surrounding water settle onto the top surface of the plates and slide down the inclined surface to be collected and removed.

levee — A dike or embankment of earth or concrete that is used to prevent water from overflowing the river channel during times of flooding.

M

maximum probable flood — The most severe flood that is considered reasonably possible at a site as a result of hydrologic and meteorological conditions.

mitigation — Activities that will avoid, reduce the severity of, or eliminate an adverse environmental impact.

N

native anadromous fisheries — The populations of anadromous fish that historically inhabited a river.

NEPA — National Environmental Policy Act, a 1969 federal law that requires the consideration of environmental effects of proposed federal actions.

nonpoint — Refers to the source of sediment or pollution (such as runoff from a field) that cannot be linked to a discrete, identifiable source.

NTU — Nephelometric turbidity unit is a measurement of how much light is scattered by particles in the water.

O

oligotrophic — Body of water with low biological productivity.

outmigration — The movement of juvenile fish from freshwater to the sea.

outplanting — Distributing of fish to suitable habitat.

outwash — Accumulation of material such as sand and gravel removed from a glacier by meltwater streams and deposited in front of the margin of an active glacier.

P

palustrine — Nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens, or nonvegetated wetlands less than 20 acres in size.

penstock — An intake pipe from a water source to a hydroelectric turbine or powerhouse.

polychlorinated biphenyls (PCBs) — Hazardous chemical compound that may be present in electrical power transformers.

post tension anchors — A method of providing stability by holding components of a structure together using steel cables or tendons.

R

Ranney well — A method of collecting groundwater through buried perforated pipes, often placed under riverbeds.

real costs — Costs that do not account for inflation.

residualism — Typically refers to anadromous trout or salmon juveniles that remain in fresh water instead of migrating to the ocean.

riffle — A shallow extending across a streambed and causing broken water.

riparian — Typically refers to vegetation found along waterways and shorelines that is adapted to moist growing conditions and occasional flooding.

riprap — Large angular stones that are used to build or strengthen riverbanks, and structures such as dikes, levees and spits.

roughness coefficient — Is an indicator used in modeling of the resistance to flow created by the channel bed and banks.

run-of-the-river — Natural conditions in a river where the flow of water (discharge) has not been altered by structures such as dams.

river stage — The elevation of a water surface above or below an established reference level, such as sea level, same as water surface elevation.

S

salmonid — Fish within the family Salmonidae, e.g. salmon and trout.

setback levee — A levee that is located away from a stream or river, typically to minimize impacts to the floodplain.

sluiceway — An outlet facility in a dam usually located low in the reservoir to allow for the flushing of sediments through the reservoir.

spawning gravels — Gravel of suitable size and shape in a stream where salmonids lay their eggs.

spillway — Overflow channel of a dam.

subduction — Long narrow zone, usually along a continental margin (such as the Pacific coast) where a crustal plate on the Earth's surface descends beneath another plate.

substrate — Surface upon which plants or animals live or grow.

surge tank — A storage tank on a pipeline which has a free water surface which prevents damaging pressures during operation of the pipeline.

suspended sediments — Materials such as clay, silt, and sand that are carried in suspension by moving water, free from contact with the stream bed.

T

tailrace — The region of high velocity water flow below the turbine discharge in a hydroelectric facility.

thalweg — Line connecting the deepest points along a riverbed.

thrust block — A large mass of concrete that serves as the foundation for a concrete arch dam and is designed to accept loads transferred from the arch dam.

till — Unlayered glacial deposit composed of clay, sand, rocks, and gravel.

trashrack — A grille-like structure on the inlet to a pipeline which prevents debris from entering the pipeline.

turbidity — The clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter. Increasing the turbidity of the water decreases the amount of light that can penetrate.

W

watershed — The area drained by a river system.

wetland — Lowland area such as a swamp or marsh that is periodically saturated with water and supports vegetation adapted to wet areas.

References Cited

Bibliographic abbreviations used in the text:

BOR	Bureau of Reclamation
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
NPS	National Park Service, U.S. Department of the Interior
NWIFC	Northwest Indian Fisheries Commission
PNPTC	Point-No-Point Treaty Council
PSMFC	Pacific States Marine Fisheries Council
SCS	Soil Conservation Service, U.S. Department of Agriculture
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife
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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-377 (November 2004)