# COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION

FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE ROCKY REACH HYDROELECTRIC PROJECT
Docket No. P-2145-060

Section 3
Environmental Analysis
Pages 29 through 210
FEIS

## 3.0 ENVIRONMENTAL ANALYSIS

The project is located in north central Washington approximately 7 miles north of the city of Wenatchee on the Columbia River in Chelan County. The dam is 215 river miles south of the Canadian border and 474 river miles above the mouth of the Columbia at Astoria, Oregon. The project reservoir extends upriver 43 miles and has a surface area of approximately 8,235 acres.

The project's drainage area at the dam is about 87,800 square miles. The watershed lies east of the Cascade Mountains and west of the Rocky Mountains, in parts of Washington, Idaho, Montana, and British Columbia. The normal maximum headwater elevation is 707 feet, and the average tailwater is at elevation 617.6 feet.

The Columbia River System is primarily fed by snowmelt and upstream storage projects. The river at the project location is essentially a gorge interrupted by confluences with a number of tributary valleys. The two most significant tributaries within the project area are the Entiat and Chelan rivers, which enter the Columbia River at approximately RMs 483 and 503, respectively.

The project lies between two significantly different physiographic areas. It is located in a valley that is north-south trending, with the North Cascades Mountains to the west and the Columbia plateau to the east. The rugged peaks in the Cascades average about 5,000 feet and reach elevations of over 10,000 feet.

The climate in the vicinity of the project is semi-arid, which is typical of eastern Washington. The seasonal range of temperatures in the area is from a winter average of about 25ºF (degrees Fahrenheit) to a summer average of about 75ºF. Spring and fall temperatures average 50ºF. Extreme temperatures can approach –30ºF in winter and 110ºF in summer. Precipitation is generally low, with an annual average of approximately 10 inches, the bulk of which falls between October and March. There are usually no more than 8 to 15 inches of snow on the ground.

Vegetative cover adjacent to the project reflects the low level of precipitation in the area and the definitive shoreline edge of the reservoir. Riparian vegetation occurs intermittently along the margins of the reservoir. Riparian grasses/forbs, riparian shrubs, and riparian deciduous trees are representative of vegetation within this typically narrow zone. Riparian vegetative types represent about 40 percent of the shoreline. Grassland, shrub steppe, and open conifer/shrub vegetation occur along the upland margins of the shoreline. Exposed rock of both fluvial and glacial origin is often mixed into the landscape. Narrow wetlands occur intermittently within the shoreline margins of the reservoir and are also found where depressions occur beside the highways that parallel much of both sides of the river.

## 3.1 Cumulative Effects

According to the Council on Environmental Quality regulations for implementing NEPA 40 CFR 1508.7, cumulative effects are defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Within the project, we have identified water quality, anadromous salmonids, Pacific lamprey, and white sturgeon as having the potential to be cumulatively affected by this project in combination with other hydroelectric project operations and other activities on the Columbia River.

### 3.1.1 Geographic Scope

The geographic scope of the cumulative effects analysis defines the physical limits or boundaries of the proposed action's effects on the identified cumulatively affected resources. Analysis of the cumulative effects at the project is limited to the Columbia River watershed, as bounded by the project from the tailrace of the upstream Wells Hydroelectric Project (FERC No. 2149) downstream to the beginning of the Rock Island Hydroelectric Project (FERC No. 943) reservoir.

### 3.1.2 Temporal Scope

The temporal scope of analysis includes a consideration of past, present, and future actions and their effects on cumulatively affected resources. Based on the likely term of a new license, we projected 30 to 50 years into the future, concentrating on the effects on the resources from reasonably foreseeable future actions. The historical discussion is limited, by necessity, to the amount of information available for each resource. We identify the current resource conditions based on the license application, comprehensive plans, and scoping comments received from various agencies and other stakeholders.

## 3.2 GEOLOGICAL AND SOIL RESOURCES

### 3.2.1 Affected Environment

Columbia Plateau lava flows and repeated failure of glacial ice dams during the continental glaciation of the Pleistocene epoch influenced the position of the Columbia River at the project site. Repeated uplifts have caused the river to be entrenched into its position at the edge of the lava flows. Glacial activity also has greatly enlarged the river

valley and shifted the river channel in some locations. The resulting glacial dam failures and floods were often catastrophic, resulting in a large flow of ice- and dirt-filled water that would rush down the Columbia River drainage scouring the canyon in some areas and depositing sediment in others. Steep, rocky upper slopes currently characterize both sides of this part of the river valley. In a few places, bedrock slopes extend to the reservoir level. In most areas, bedrock on the lower slopes is covered by talus or other soil deposits.

The valley is geologically young, and the Columbia River was still actively down-cutting at the time of project development. The river in the project area is commonly incised into alluvial fans, terrace deposits, eolian[13] deposits, and some deposits of lacustrine[14] sediments, many of which are remnants of glacial processes in the area. Where the river passes through terraces, eolian deposits, or lacustrine deposits, the shoreline is characterized by steep banks typical of youthful river valleys. These banks are the remaining erosion faces from downcutting by the river and have relatively flat slopes above them. Alluvial fans more commonly exhibit moderate to gentle slopes that extend to, or nearly to, the water surface. Both terrace and alluvial deposits are composed of sandy gravel with varying percentages of cobbles. The eolian and lacustrine deposits are typically composed mostly of sand-sized and finer materials.

Based upon a flow of 220,000 cfs, a 1999 study conducted by Duke Engineering Services (DES) for Chelan PUD (DES, 2001a) found that silt was the most abundant substrate type in the river itself (25.6 percent), followed by large cobbles (17.7 percent) and sand (17.4 percent).

#### 3.2.1.1 Existing Geologic Hazards

There are no seismic hazards related to the project, and no geologic hazards of significance have been identified. The project is periodically assessed for seismic and other geologic hazards through the required Part 12 inspections under the Commission's authority.

#### 3.2.1.2 Sediment Supply, Transport, and Storage in Reservoir

The project is a run-of-river project with a generally narrow reservoir and a noticeable current flowing through the reservoir. Storage projects farther upriver, including the Wells Project immediately above the Rocky Reach Project, have reduced the sediment supply to the project reservoir.

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[13] Eolian deposits are sediments transported by the wind.

[14] Lacustrine deposits are sediments associated with deposition in or directly adjacent to a lake.

The reservoir created by the Rocky Reach dam (known as Lake Entiat) is essentially a backwater effect. As such, it slows river velocities in the reservoir and raises the water level. Since the first generating units were placed in operation in November 1961, the project has regulated the water level in the reservoir to maintain water levels at the dam between 703 feet and 707 feet msl. The water level at the dam is generally between 706 and 707 feet msl, with a 20-year average of 706.53 feet. During flood flows in the river, the reservoir can be raised as high as 710 feet at the direction of the Corps to minimize the downstream flooding effects.

The water surface elevation is not constant throughout the reservoir, instead increasing measurably from the project dam to the upstream Wells Project dam and varying with the volume of flow. For example, with a headwater elevation at the Rocky Reach dam of 707 feet and a flow of 100,000 cfs, the reservoir water surface elevation at Wells dam is approximately 4 feet higher, or 711 feet msl.

Generally, depths increase in the reservoir from upstream to downstream. The shallowest, most riverine portion of the reservoir is found near the Wells Project tailrace, with depths increasing downstream to the Rocky Reach forebay.

As a result of project development, the typical range of flows and water levels experienced by the shoreline has changed. The annual range of flows has decreased as a result of water storage at upstream projects. These upstream projects store water when natural flows are high and release water during times of lower natural river flows, thus moderating the extremes of flow volume during the water year. Despite this tempering of seasonal variation, the daily range of changes in flow and water level may have increased as a result of regulation of the river. This effect results from the operation of projects upstream of the project and the project's need to pass incoming flows.

Water depths are relatively unchanged from that of the pre-project river in the upper part of the reservoir (i.e., immediately downstream of Wells dam). Immediately upstream of Rocky Reach dam, water depths exceed 100 feet, substantially more than prior to construction of the project. In short, the amount that the average shoreline water elevations have increased because of the project increases with distance downstream.

Lake Entiat also produces a backwater effect on tributary rivers, the extent of which varies with river flow and lake elevation (Chelan PUD, 2001a). At lake elevations at or below 707 feet msl (normal maximum lake level at the confluence of the Entiat and Columbia rivers) and for river flows up to and including the 25-year flood flow, the backwater effect is within the project boundary. Easements purchased for the project extend beyond the project boundary and encompass the entire backwatered area at the 25-year flood flow on the Entiat River. Chelan PUD has stated that the project's backwater effects are covered by these easements.

The backwater effect created by the reservoir at the mouth of the Entiat River results in the deposition of sediment near the river's mouth. In its December 27, 2004, letter, Chelan PUD indicates that prior to project development, it appears that essentially all of the Entiat River's sediment that reached the Columbia River was transported downstream in the river and on the river floodplain. Currently, the sediment deposit is roughly 1,000 feet long and extends from the mouth of the river (the location of which changes with the elevation of Lake Entiat) out into Lake Entiat (Chelan PUD, 2001a). Also in its December 27, 2004, letter, Chelan PUD reports that analysis of aerial photographs shows that mid-channel bars have formed on the Entiat River upstream of the Highway 97 bridge, and by 1998, these bars were heavily vegetated. The Entiat River still maintains a channel through this delta deposit, meeting the fluctuating reservoir water surface at Lake Entiat. Stream currents present in Lake Entiat may be capable of transporting some of the finer sediment from the toe of this delta, but much of the sediment forming the delta deposit remains.

Similarly, the backwater effect at the Chelan River mouth has deposited gravel carried down the Chelan River during flood flows. Gravel deposition in the area of the river mouth and the Chelan Project tailrace channel has created a successful salmonid spawning area (Chelan PUD, 2001a). As with the Entiat River, the Chelan River flow maintains a channel through the deposited gravel, providing access to the area by fish.

#### 3.2.1.3 Shoreline Erosion

Erosion is occurring along the shoreline of Lake Entiat. Inventory fieldwork was done in the spring and summer of 2000. The approach to documenting and inventorying erosion sites included site location using hand-held Global Positioning System equipment. Sites were photographed and each site was described based on visual observations made at the site. Written observations include site characteristics such as material type and slope angle at various levels, apparent degree of erosion activity (or inactivity), height of slope, soil type, limitations on erosion at the site, freshness of exposed soils, and exposure of the site to waves. This inventory identified and mapped 48 erosion sites around the lake. Sites inventoried along the lakeshore have a combined length of approximately 7.3 miles, or about 8.5 percent of the shoreline.

Because shoreline erosion around Lake Entiat was not the subject of organized monitoring efforts prior to the work in 2000, no baseline data are available to estimate the average rate of recession at erosion sites. In the early 1980s, a reconnaissance-level review of erosion was done, with erosion sites marked on topographic maps. More precise data were not recorded, but in general the sites appear no more active or, in some cases, less active in 2000 than was noted in the 1980s. The only available photographs that might prove useful for comparison with current conditions are oblique aerial slides taken in 1991. The appearance of the shoreline has changed little since that time.

The majority of the existing erosion repair or protection work around the reservoir, as surveyed in 2000, takes the form of riprap placed in areas where the railroad or highway are adjacent to the reservoir. Some private property owners have done erosion control work, but most have not. Erosion control work on private property has taken a variety of forms, including riprap, individual large rocks, logs or other large woody debris, and vegetation. Few bulkhead walls were noted around the lake.

When the project was developed, Chelan PUD purchased flowage easements, or damage waivers, around the reservoir, except on sites federally owned at the time. The easements were intended to cover damage in perpetuity to land within the project boundary and to adjoining lands, by "seepage, erosion or similar causes…" as a result of raising the reservoir water level or water table. The easements are not contingent on land use or current ownership, and specifically cover any damage to "improvements, appurtenances and personal property." The damage waivers are reflected in deeds with reservation of easement rights and flowage easements.

Most of the erosion along the project reservoir is occurring in alluvial fans or terrace deposits. The alluvial fans generally display relatively gentle slopes to, or nearly to, the water's edge and are the most common setting for residential development. Terrace deposits, sometimes topped with eolian soils, are generally relatively level areas above the water level, with steep slopes down to the water. They also are commonly developed, with agricultural development more common than residential.

### 3.2.2 Environmental Effects

#### 3.2.2.1 Shoreline Erosion

Shoreline erosion is occurring around the project reservoir and in some instances may be influenced by operation of the project. Important factors influencing shoreline erosion on Lake Entiat include waves caused by wind and boat wakes, stream currents, recreational and other land uses, and higher water levels on the shoreline as a result of project impoundment of the Columbia River. Surface water, including drainage from roads or irrigation, also appears to be a significant factor in some locations, as shown by gullies in banks of exposed soil.

Chelan PUD indicates that wave action is thought to be the most significant factor in erosion at most locations around Lake Entiat (Chelan PUD, 2004a). Waves on Lake Entiat commonly reach 3 to 4 feet in height, with larger waves occurring occasionally. Winds that produce the waves are predominantly up or down the valley. Reservoir levels expose parts of the shoreline that have not been inundated since the most-recent geologic disturbance, glaciation. These highly erodable soils increase the potential for shoreline erosion. Flow velocity is thought to play a larger part in shoreline erosion at some locations around Lake Entiat than is typical of most reservoirs. At these locations, there

is a discernable current at or near the shore. Recreational use and some other land uses also aggravate bank erosion. Foot traffic at parks and docks has killed some vegetation, compacted soil, and caused the displacement of sediment at some sites. Similarly, at some sites along the lake, construction activity has caused substantial disturbance that is unrelated to project operations.

An inventory of shoreline erosion (Chelan PUD, 2001b) noted 48 erosion sites around the reservoir, ranging in length from 30 feet to 5,350 feet, with an average length of 819 feet. These were photographed and described in the inventory report, referenced above. The total shoreline length of the erosion sites was 7.3 miles, which is about 8.5 percent of the roughly 86-mile-long shoreline. No substantial active erosion was noted downstream of the project dam. Most of the erosion along the project reservoir is occurring in alluvial fans or terrace deposits.

The available data do not support a quantitative estimate of the average rate of recession at the erosion sites; however, based on the presence of plants and other site features, the inventory suggests that recession is progressing relatively slowly at most sites. Of the erosion sites inventoried, two are on land managed by the BLM, while the remaining 46 sites are located on lands for which Chelan PUD holds erosion easements.[15] Of the two BLM sites, one is within the project boundary for the Wells Hydroelectric Project. The second BLM site is a small area within the Rocky Reach Project boundary that was identified by the Cultural Resources Working Group as having cultural significance [Chelan PUD, 2001c]).

The Columbia River Valley is essentially an erosional feature and the landscape includes many features that are remnants of erosion that occurred or was in progress prior to project development. In many locations, particularly those where erosion is taking place in terrace or eolian deposits, steep erosion faces were created by the river's downcutting and lateral migration. These steep faces are the most prominent erosional features along the reservoir. Erosion of these faces continues with the higher water level of the reservoir. Factors influencing erosion at these sites vary in their ability to erode the shoreline: a decrease in flow velocities in the reservoir has likely resulted in decreased erosion from this source; however, areas of the river/reservoir formerly not subjected to wind- and boat-generated waves (i.e., steep erosion faces on terrace or eolian deposits that are now inundated by the higher reservoir water levels) likely have higher amounts of erosion. Despite these complicating factors, the study indicates that shoreline erosion appears to be progressing slowly at most sites. In the absence of significant changes in project operations or other relevant factors, the study suggests that erosion is expected to continue in a manner similar to what is currently taking place (Chelan PUD, 2001b).

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[15] As noted in section 3.2.1, Chelan PUD indicates that flowage easements, or damage waivers, were purchased around the reservoir, except on sites federally owned at the time of project development.

The erosion inventory (Chelan PUD, 2001b) indicates that erosion along the toe of alluvial fans at many of these locations is attributable to factors such as land use and irrigation. For example, where erosion is occurring along the edges of alluvial fans, native vegetation has been replaced by grass lawns that are being undercut very close to the water's edge. This is particularly noticeable since, in many cases, adjacent areas with native vegetation are not eroding, though they are similar in all other ways. Vegetation type and cover appear to be the key differences in these locations.

The upper surfaces of terrace deposits are often from several to many tens of feet above the water level. Downcutting and lateral migration of the river through the terraces have formed steep faces of soil standing at its angle of repose. Active erosion of many of these faces has continued under current conditions, with gravel and cobble accumulating at the toe of the slope/edge of the reservoir. In some instances, this harder material can act as revetment to some degree, protecting the toe of the slope. It is likely that similar erosion would have continued in the absence of project development, but at different elevations because of the change in the river/reservoir inundation level.

Eolian or lacustrine deposits found at some locations along the reservoir consist of sandy soil without significant gravel or cobble fractions. They are similar to the terrace deposits, but typically are not accumulating cobbles at their toes, so do not gain protection in that way. The fine sand and silt found in these deposits typically erode relatively easily.

In the Settlement Agreement, Chelan PUD proposes to perform erosion repair work at four sites selected by Chelan PUD to demonstrate appropriate erosion control techniques and educate the public about such techniques. In addition, Chelan PUD would make information about erosion control methods available to local governments and individuals with land along the reservoir shoreline, and monitor shoreline erosion during the new license term. Chelan PUD would conduct erosion control work at the BLM-managed cultural site; treatment of the site is included in the Cultural Plan (see section 3.7.2, *Cultural Resource, Environmental Effects*).

With regard to demonstrating erosion control techniques, Chelan PUD during the first 20 years of the license term would select four sites at which to perform erosion control work with the intent of demonstrating a variety of appropriate, permissible techniques to the public. Chelan PUD would select and perform erosion control work at the rate of one or more sites per 5-year period, after the effective date of the new license, although it could elect to conduct the work sooner. These sites would be repaired using current bio-engineering techniques and native plants resistant to erosion, and interpretive signs would be erected to explain the techniques. Chelan PUD would provide an opportunity for WDFW to provide input on the designs and sign content. An effort would be made to include, as one of the demonstration projects, a site at which riprap would be modified to improve its value as habitat. The intent of this effort and of the distribution of information to landowners is to enhance the public's understanding of

state-of-the-art erosion control techniques applicable to conditions found along the project reservoir and to encourage their use.

Chelan PUD proposes to distribute information to assist the public in efforts to control shoreline erosion. The information could include technical information on suggested repair methods and/or reference and contact information that would allow landowners to readily find suitable technical information. Distribution could take place through county offices responsible for building or shoreline development permits, and/or through the Chelan PUD staff responsible for arranging electrical service to sites along the reservoir. Information could also be distributed directly to owners of erosion sites continuing to have erosion problems. Chelan PUD would update the information no less than every 5 years of the first 20 years of the new license, or commensurate with the completion of one of the aforementioned demonstration projects.

Chelan PUD also proposes to complete and carry out a plan for monitoring the progress of shoreline erosion for changes in condition or trends and for monitoring the effectiveness of repairs in years 20 and 40 of any new license. Under this Shoreline Erosion Monitoring Plan, Chelan PUD would inventory erosion sites in the reservoir by boat, using techniques similar to the 2000 inventory of shoreline erosion (Chelan PUD, 2001b). In addition, to establish a baseline and examine erosion rates, Chelan PUD would select four to six representative erosion sites for more-frequent monitoring. These sites would not include any sites selected as erosion control demonstration sites. Chelan PUD proposes to monument or otherwise equip these sites to monitor the rate of erosion at 5-year intervals.

In addition to the planned shoreline erosion monitoring described above, Chelan PUD also proposes to inspect the reservoir shoreline for new erosion sites or substantial changes to existing sites after exceptionally high flows (e.g., 100-year level flood flows) through the reservoir or other events that could lead to unusual shoreline erosion, as determined by Chelan PUD. Shoreline monitoring under such special circumstances would be conducted similar to the year 20 and year 40 shoreline erosion inventories.

*Our Analysis*

There are 48 inventoried erosion sites greater than 30 feet long on the shores of Lake Entiat, with most of this erosion in alluvial fans or terrace deposits. Many of these features were eroding prior to the creation of the project. A substantial amount of effort has been devoted by various landowners to control erosion around the reservoir. This work has employed a variety of techniques, including riprap, rock walls, and anchored logs. These efforts have typically been successful where they have protected the toe of the slope (around the high water level) from waves. In those cases, the higher parts of the slope appear to have made progress toward stabilization. At other sites, where soil at the toe is not protected either artificially or by rock left behind by erosion, the shoreline has

not made as much progress toward stabilization. Plants along the toe have been of some benefit, but it is unclear whether plants alone are effective in stabilizing the toe.

Chelan PUD proposes to implement erosion control projects at five sites around the reservoir (four demonstration sites plus the one BLM-managed cultural site, as described in the Cultural Plan), educate the public regarding erosion control, and provide for long-term monitoring. All of these measures would bring increased stability to affected portions of the Lake Entiat shoreline, could help reduce the adverse effects of shoreline erosion, and could improve the state of knowledge regarding erosion control techniques for the land owners/managers surrounding the reservoir.

#### 3.2.2.2 Sedimentation and Backwater Effects

The reservoir created by the Rocky Reach dam is essentially a backwater effect. As such, it slows the flow of the river through the reservoir and raises the water level. As noted by the participants in the ALP, these phenomena affect both the Columbia River itself and its tributary streams—notably the Entiat River.

In the reservoir, the slower flow is expected to contribute to greater sedimentation from the waters of the Columbia River because the slower current has a decreased capacity to transport sediment, allowing more sediment to be deposited. While this phenomenon is likely occurring, it does not appear to be producing substantial deposition because several large storage reservoirs upstream of the project remove sediment from the water that would otherwise pass downstream to the project.

The lower Entiat River contains a significant sediment accumulation at its confluence with the Columbia River. The accretion of sediment was likely encouraged by backwater effects from Lake Entiat, in conjunction with high sediment loads in the river resulting primarily from forest fire-induced erosion. Adjoining landowners have expressed concern about increased inundation of adjacent orchard land potentially resulting from the backwater effect.

A computer model of the lower Entiat River and its confluence with the Columbia River was developed to evaluate effects of the project reservoir water surface elevations and other factors on the Entiat River water surface profile (Chelan PUD, 2001a). The model was used to simulate the effects of various reservoir levels and Entiat River flows up to the level of a 25-year flood. The model results show that the backwater effect from the reservoir end within the project boundary and within the area covered by project flowage easements. Although the sediment accumulation is significant in terms of volume, its influence on backwater is limited. The hydraulic model was manipulated to analyze the effects the sediment may have on backwater profiles. As indicated in the backwater curve plots, removal (in the model) of the sediment accumulation downstream of the existing highway bridge (near RM 0.0) and upstream of the bridge for a distance of

approximately 1,600 feet resulted in negligible effects on the backwater profile of the river.

In its December 27, 2004, AIR response letter, Chelan PUD reports that aerial photographs of the mouth of the Entiat River prior to project development depict a small delta near the mouth. In the years subsequent to project development, this delta has reformed downstream of the Highway 97 bridge, and projects out into Lake Entiat. Sediment has also deposited upstream of the Highway 97 bridge, forming mid-channel bars. Also in its December 27, 2004, letter, Chelan PUD indicates that these bars have become heavily vegetated, forming valuable riparian habitat. Similarly, the backwater effect at the Chelan River mouth has resulted in the deposition of gravel carried down the Chelan River during flood flows. Deposition of the gravel in the area of the Chelan River mouth and tailrace channel has resulted in creation of a successful salmonid spawning area (Chelan PUD, 2001c). As with the Entiat River, the Chelan River flow maintains a channel that provides access to the area by fish and other aquatic resources.

After studying the backwater effect issues (Chelan PUD, 2001a), the Erosion Working Group concluded that no action was needed to address sedimentation or potential flooding. Chelan PUD's proposal does not include specific measures to address sedimentation.

*Our Analysis*

Water clarity in the project reservoir is well within the Washington State Class A water quality standards for clarity and turbidity. No problems or negative effects have been identified in connection with sedimentation at the mouth of the Entiat River. The project's potential influence on water levels during flood flows (up to the 25-year recurrence flow) in the Entiat River is contained within the limits of the project boundary and easements. At the mouth of the Chelan River, the backwater effect and sedimentation is, on the whole, beneficial because it has resulted in creation of salmonid spawning area. The backwater effect in the Columbia River caused by the project reservoir has a diminished influence on sediment transport because upstream reservoirs decrease the available sediment supply. For these reasons, we conclude that no action is needed to address backwater effects and sedimentation.

### 3.2.3 Unavoidable Adverse Impacts

Shoreline stabilization measures, placement of informative signage, and the construction and/or improvement of fisheries facilities, trails, campsites, boat ramps, and access areas, all elements of Chelan PUD's proposal, have the potential to result in minor, unavoidable, short-term, localized increases in the potential for erosion.

## 3.3 WATER RESOURCES

### 3.3.1 Affected Environment

#### 3.3.1.1 Columbia River and Rocky Reach Project Hydrology

The project impounds 43 miles of the Columbia River from the project dam at RM 473.7 to Douglas PUD's Wells dam (FERC No. 2149) at RM 515.5. The drainage area of the Columbia River Basin upstream of the project dam is approximately 87,800 square miles. Annual average flow through the reservoir from 1960 to 2001 was 115,400 cfs (U.S. Geological Survey [USGS], 2002). However, since completion of Canadian flood control storage with construction of Mica dam (in 1973), the annual average flow has been 113,200 cfs (1973 to 2001). The maximum and minimum daily average flows for this same period were 358,000 cfs (June 12, 1997) and 25,100 cfs (November 11, 1973), respectively.

The Columbia River System is primarily fed by snowmelt. Numerous dams and reservoirs developed for hydropower and flood control alter the natural flow in the basin. Water is withdrawn from the Columbia River and its tributaries at various locations for agricultural, domestic, municipal and industrial supply. The annual flow regime is primarily controlled by flow releases from upstream storage projects regulated by the Federal Columbia River Power System (FCRPS). Upstream storage is managed under the terms of the NMFS 2000 Biological Opinion for Operation of the FCRPS (NMFS, 2000) and the FWS 2000 Biological Opinion on Effects to Listed Species from Operations of the FCRPS (FWS, 2000). The 2000 biological opinion sets conditions on the fill and drafting of upstream storage reservoirs to meet the multiple needs of flood control, passage conditions for anadromous fish, resident fish species, recreation, and power production. These storage projects operating conditions determine the daily flows that pass the project, with some additional flow contributed from tributaries (Okanogan, Methow, Chelan, and Entiat rivers) downstream of the storage projects. Management of the upstream storage releases accounts for these tributary contributions in the management of Columbia River flows.

The two major tributaries in the project area are the Chelan and Entiat rivers. The Entiat River enters the Columbia River at approximately RM 483, approximately 9 miles upstream of the Rocky Reach dam. Flow records from two Entiat River gaging stations provide information about inflows to the project. Long-term flow records are available for a gaging station located approximately 18 miles upstream of the Entiat River's confluence with the Columbia River (USGS gage no. 12452800, Entiat River near Ardenvoir, Washington), which has a drainage area that comprises about half of the entire basin. For water years 1957 to 1995, average monthly flow at this Entiat River gage station ranged from 112 cfs in September to 1,417 cfs in June. A maximum recorded flow of 6,430 cfs occurred on June 10, 1972. Since March 15, 1996, flow

measurements from the entire Entiat River Basin have been available from a gage near the confluence of the Entiat and Columbia rivers (USGS gage no. 12452990, Entiat River near Entiat, Washington). The minimum flow recorded at this gage, 58 cfs, was recorded on November 1 and 2, 2002, although lower flows may have occurred due to ice on December 12 and 13, 2000. For the period of March 1996 through September 2004, average monthly flows at the lower Entiat River gaging station ranged from 151 cfs in September to 1,711 cfs in June, while the measured flows at the upper Entiat River gage station ranged from 97 cfs in February to 1,477 cfs in June. Based on paired comparison of daily flows, flow at the upper gage accounted for an average of 85 to 92 percent of the total flow during the months of June through August, but only 55 to 65 percent of the total flow from December through April. In their comments on the draft EIS, the Forest Service and City of Entiat noted that the Entiat River is one of the few rivers in the world that commonly experiences anchor ice, which may cause infrequent flooding. In shallow turbulent sections of rivers that have minimal protection from riparian vegetation, ice crystals can form in the water column (frazil ice) and then these crystals can attach to the stream bottom (anchor ice) due to super cooling of the river bottom. This ice can create ice dams that restrict the flow of water and cause backwaters to flood upstream areas.

The Chelan River enters the Columbia River at approximately RM 503. The minimum, mean, and maximum recorded flows for the Chelan River are 0 cfs, 2,060 cfs, and 18,400 cfs, respectively. From 1903 to 2001, the mean annual flow recorded at USGS gage no. 12452500 (Chelan River at Chelan, Washington) ranged from 1,119 cfs to 3,158 cfs. The recorded flows include powerhouse releases as well as spill from the Chelan PUD's Lake Chelan Project (FERC Project No. 637) dam, which is located approximately 4 miles upstream on the Chelan River at the outlet of Lake Chelan. It is connected to the Lake Chelan Project powerhouse, which is a few hundred yards upstream of the Chelan River/Columbia River confluence.

The Rocky Reach project is primarily operated as a run-of-river project; however, there are some project-induced fluctuations in reservoir level and discharges to the tailrace. These can result, at least in part, from coordination of project operations with other hydroelectric projects in the mid-Columbia River. The operators of the five non-federal hydroelectric projects (Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids) cooperate with each other and with the operators of the federal projects immediately upstream (Grand Coulee and Chief Joseph) to efficiently manage the flow releases from Grand Coulee to meet the daily demands of power load peaking while maintaining reservoir levels as stable and full as possible. This cooperation is managed under the terms of the Hourly Coordination Agreement. Hourly coordination has also been used to manage flows and reservoir levels for protection of fisheries resources, in particular the spawning and incubation of Chinook salmon in the Hanford Reach of the

Columbia River, which is affected by flow releases from the Priest Rapids Project (Vernita Bar Agreement).[16]

The Hourly Coordination Agreement allows Chelan PUD to maintain the reservoir water surface elevation within 1 foot of the normal operating maximum of 707 feet approximately 73 percent of the time. Although the license allows the reservoir to be drawn down to an elevation of 703 feet, the forebay elevation is rarely below 705 feet. The water surface elevation, and therefore the volume of water impounded, varies upstream from the dam as a function of the headwater elevation and as a function of river flow.

At a flow of 20,000 cfs, the volume of the impoundment would be 346,900 acre-feet at elevation 703 feet and 383,800 acre-feet at a headwater elevation of 707 feet. At a flow of 220,000 cfs, the volumes would be 363,700 acre-feet and 398,200 acre-feet at the 703-foot and 707-foot elevations, respectively. The surface area of the impoundment varies similarly, with a typical value of approximately 8,235 acres at a headwater elevation of 707 feet and flow of 100,000 cfs. Under flood conditions, the headwater elevation may be drawn down to 703 feet and the reservoir used to store floodwaters to an elevation of 710 feet to reduce downstream flood flows, as directed by the Corps in accordance with the current Rocky Reach License Article 34. This operation occurs infrequently and has not been implemented in the past 20 years.

#### 3.3.1.2 Water Use and Quantity

**Project Water Rights**

WDOE has jurisdiction over water use in the mid-Columbia River. Chelan PUD currently holds several water rights for various uses. It holds two surface water rights of 185,300 cfs and 24,700 cfs for power purposes and a reservoir permit for the project that allows 390,000 acre-feet of water to be impounded. WDOE's Water Right Application Tracking (WRAT) database (e-mail from B.A. Bealba, Technical Assistance Specialist, WDOE, Yakima, WA, to B. Mattax, Senior Aquatic Scientist, The Louis Berger Group, Bellevue, WA, November 30, 2005) indicates that Chelan PUD has four additional surface water rights for a total of 25.6 cfs for fish propagation and irrigation, and shares with Washington State University a 350-gallon-per-minute right (approximately 0.8 cfs per minute) for irrigation.[17] WDOE's WRAT database indicates that Chelan PUD holds 12 groundwater withdrawal permits and has applied for two additional permits. The maximum total allowable withdrawal from these wells is 37,240 gallons per minute

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[16] See Public Utility District No. 2 of Grant County, Order Approving the Settlement Agreement, 45 FERC ¶61, 401, December 9, 1988.

[17] This right was originally issued as a ground water right, but has been revised to authorize direct diversion from the Columbia River.

(gpm) (83.0 cfs) used for fish propagation, irrigation, domestic water, and heat exchange. Several of the wells are used on a seasonal basis, while others operate year-round.

*Consumptive Uses of Project Waters*

*Irrigation*—Orchards with apple, cherry, peach, apricot, and other fruit trees represent the primary agricultural activity in the Columbia River Valley and its tributary valleys throughout north central Washington. All orchards throughout the area rely on a source of irrigation water for their existence. Within the project area, irrigation withdrawals from the river constitute the largest segment of allocated water rights for consumptive water use. Annual irrigation water rights provide for the withdrawal of up to 313 cfs from the project reservoir. The allocated water rights represent the maximum withdrawals; hence it is reasonable to assume that actual withdrawals are frequently less than the established water rights. In their comments on the draft EIS, the Forest Service and City of Entiat note that a high percentage (up to 85 percent) of the water used for irrigation is not consumed but instead is lost in transmitting the water and that these losses return to the river.

The narrowness of the Columbia River Valley through the project area restricts space available for substantial additions to orchards or other irrigated agricultural activities. Current trends indicate an ongoing reduction in lands used for irrigated orchards as they are being replaced with residential development, resulting in a lowering of consumptive withdrawals from project waters. The majority of consumptive water use within the project area is non-project related; project-related consumptive use is primarily associated with irrigation of parks.

*Domestic*—Domestic water withdrawals of project surface waters are limited. Some withdrawals for use in irrigating yards and gardens may occur. Water withdrawals for drinking water are primarily from groundwater sources, although one municipal domestic water right has been issued. According to WDOE, domestic water rights for groundwater within the project area are 64 cfs (Chelan PUD, 1991). These domestic water rights are allocated to non-project related entities. No significant change in the use of project waters for domestic water supply is anticipated.

*Commercial and Industrial*—Commercial and industrial uses account for only 10.5 cfs, and stock watering use is at 3 cfs (Chelan PUD, 1991). The majority of this volume is allocated to non-project related entities.

*Non-consumptive Uses of Project Waters*

*Fisheries and Natural Resources*—Chelan PUD holds four water rights for fish propagation, which consist of one surface water right for 8 cfs and three groundwater rights for a total of 25,140 gpm, equivalent to 40,539 acre-feet/year (WDOE, 1999).

*Power Production*—As described above, Chelan PUD holds two surface water rights for project power production. These water rights are for 185,300 cfs and 24,700 cfs, entitling Chelan PUD to a total of 210,000 cfs for power production (WDOE, 1999). Chelan PUD also holds a reservoir permit that allows impoundment of up to 390,000 acre-feet of water in the project reservoir.

#### 3.3.1.3 Water Quality

**Applicable Water Quality Standards**

Under current Washington water quality standards, the Columbia River at the project is classified as a Class A water body. Water quality of this class must meet or exceed the requirements for all uses. The characteristic beneficial uses for the project segment of the Columbia River include fish and wildlife (including salmonid species) habitat, water supply (domestic, irrigation, industrial), recreation, navigation, and commerce. Table 1 summarizes selected numeric criteria for Class A water quality.

Table 1. Summary of selected WDOE water quality criteria. (Source: WAC 173-201A)

| Parameter | Class A |
|---|---|
| Temperature | Must not exceed 18.0ºC[a] |
| pH | Within 6.5 to 8.5 units[b] |
| Dissolved oxygen | Must exceed 8.0 mg/l |
| Total dissolved gas | Not to exceed 110%[c,d] |
| Turbidity | Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more |
| Fecal coliform | Not to exceed geometric mean of 100 colonies/100 ml, or more than 10% of all samples exceeding 200 colonies/100 ml |

Notes: % – percent
°C – degrees Celsius
mg/l – milligrams per liter
ml – milliliter
NTU – nephelometric turbidity unit
WAC – Washington Administrative Code

[a] Human activities shall not result in more than a 0.3°C increase when water temperatures naturally exceed this maximum criterion. Maximum incremental increase for non-point sources is 2.8°C.

[b] Human-caused variation must be within 0.5 units.

[c] This criterion does not apply when stream flow exceeds the 7-day, 10-year frequency flood (7Q10).

[d] Special condition for this reach of the Columbia River establishes TDG levels above 110% for spill for fish passage (tailrace average of 12 highest hours ≤120%, no single hour >125%).

Water quality in the Columbia River in and near the project area has met all water quality standards for Class A waters except for the numeric criteria for TDG and temperature on a seasonal basis. Table 2 lists documented historical exceedances of state water quality criteria in the Columbia River in and near the project area. This table represents exceedances from all sources in the project area but does not necessarily represent numeric criteria exceedances attributable to the project.

Table 2. Exceedances of numeric water quality criteria applicable to the Columbia River near the Rocky Reach Project area.

| Parameters Exceeding Numerical Criteria | Monitoring Station Location and Study Timeframe | Total Exceedances during Study Timeframe (month of occurrence and number of days) | |
|---|---|---|---|
| >120% TDG (average of highest 12 hours in tailrace) | Rocky Reach DFMS located approximately 4 miles downstream of dam (1997–2002)[a] | April:<br>May:<br>June:<br>July: | 7 days<br>31 days<br>51 days<br>13 days |
| Dissolved oxygen >8 mg/l | WDOE ambient monitoring station at RM 450.9 (1971–1990)[b] | Month: | 1 day[c] |
| Temperature >18.0°C[d] | WDOE ambient monitoring station at RM 450.9 (1971–1990)[b] | July:<br>August:<br>September:<br>October: | 10 days<br>16 days<br>12 days<br>3 days |
| | Rocky Reach DFMS (1997–2002)[a] | July:<br>August: | 13 days<br>119 days |

Notes: % – percent
°C – degrees Celsius
DFMS – downstream fixed monitoring site
EPA – U.S. Environmental Protection Agency
mg/l – milligrams per liter
TDG – total dissolved gas
WDOE – Washington Department of Ecology

[a] Source: Chelan PUD (2004a).

[b] EPA STORET (storage and retrieval database) data for 205 grab samples from Columbia River at RM 450.9 (USGS gage no. 12462600, Columbia River below Rock Island dam; and Washington and WDOE station 1744A070, Columbia River below Rock Island dam).

[c] In 1971, there was 1 event below criterion (7.9 mg/l).

[d] The numeric water quality criteria for temperature for a Class A water body is either 18.0°C or no more than a 0.3°C increase over natural. Therefore, natural conditions may account for some of the temperatures above 18.0°C referenced above and may not, in fact, involve an exceedance of the applicable numeric temperature criteria.

The 1998 303(d) list recognizes three water quality concerns within the project area waters (WDOE, 2002). The Columbia River was listed for TDG, based on high values reported for the Wells Project tailrace and the Rocky Reach forebay and downstream of the Rocky Reach dam. A temperature listing for the Columbia River is based on high water temperatures in the inflow to the Wells hatchery at the upper end of the project's reservoir. The Columbia River also was listed for water column bioassay[18] based on reduced reproduction rates of daphnid water fleas (*Ceriodaphnia dubia*) made near Wenatchee in July 1995. Contradicting results of additional bioassays that were conducted from 1999 to 2001 (Johnson and Era, 2001) resulted in this reach of the Columbia River not being included on the 2002/2004 303(d) list that was recently approved by the EPA (WDOE, 2005a).

WDOE and EPA Region 10 have been developing TMDL to address the water quality impairments for TDG and temperature in the project area and other segments of the Columbia River. On July 27, 2004, EPA approved WDOE's TMDL for TDG in the Columbia River reach that includes the project area (EPA et al., 2004). The TMDL for temperature has been delayed to further information exchange and consultation.

**Regional Water Quality Data**

Historical information on water quality that is applicable to the project reservoir and its major tributaries is available from several sources, including recent water quality studies within the project area, studies at Wells dam conducted by Douglas PUD, and recent data from a monitoring station near the Rock Island Project. These data suggest that water quality measurements within the project area are comparable to concurrent readings for the Wells and Rock Island projects. For this reason, when no historical data exist at Rocky Reach, we use historical data from the Wells and Rock Island Project areas to represent historical conditions within the Rocky Reach project area.

Data from WDOE's water quality monitoring station (WDOE station 44A70) located approximately 2.3 miles downstream of the Rock Island dam are considered to provide the most comprehensive, long-term, historical characterization of water quality relevant to the project. The period of record for monthly grab-sample water quality data from this WDOE station is 1977 to 1990. Table 3 provides average values for monthly water quality data from this source.

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[18] A test of the potency of compounds by their effects on organisms.

Table 3. Average values for water quality monthly grab samples at the WDOE monitoring station below Rock Island Hydroelectric Project dam, 1977–1990.

| Month | Mean Flow[a] (cfs) | Mean Temp. (°C) | Dissolved Oxygen (mg/l) | Dissolved Oxygen Saturation (%) | pH (units) | Turbidity (NTU) | Specific Conductance (μmhos/cm) | Fecal Coliform (MFM-FCBR) per 100 m/l) | Total Suspended Solids (mg/l) | Total[b] (mg/l) | Unionized Ammonia (mg/l) | Nitrite (mg/l) | Nitrate (mg/l) | Nitrite + Nitrate (mg/l) | Total Phosphates (mg/l) | Dissolved Ortho-P (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 135,425 | 3.6 | 12.9 | 98 | 7.9 | 2 | 156 | 12 | 3 | 0.02 | 0.0001 | 0.010 | 0.119 | 0.146 | 0.033 | 0.015 |
| February | 136,245 | 4.3 | 13.5 | 104 | 7.8 | 4 | 165 | 3 | 11 | 0.02 | 0.0001 | 0.010 | 0.176 | 0.130 | 0.035 | 0.018 |
| March | 121,100 | 8.4 | 13.9 | 113 | 8.1 | 3 | 166 | 6 | 33 | 0.03 | 0.0003 | 0.010 | 0.160 | 0.188 | 0.038 | 0.009 |
| April | 132,000 | 7.6 | 13.7 | 116 | 7.9 | 3 | 167 | 8 | 5 | 0.03 | 0.0001 | 0.010 | 0.178 | 0.135 | 0.035 | 0.017 |
| May | 156,758 | 10.5 | 13.1 | 118 | 8.0 | 4 | 156 | 44 | 13 | 0.05 | 0.0001 | 0.010 | 0.160 | 0.118 | 0.038 | 0.010 |
| June | 160,567 | 14.3 | 11.8 | 117 | 8.0 | 5 | 130 | 80 | 10 | 0.03 | 0.0002 | 0.010 | 0.105 | 0.057 | 0.042 | 0.013 |
| July | 141,327 | 17.6 | 11.2 | 119 | 8.0 | 3 | 135 | 124 | 12 | 0.04 | 0.0003 | 0.010 | 0.082 | 0.065 | 0.029 | 0.015 |
| August | 113,200 | 19.1 | 10.2 | 111 | 8.0 | 3 | 140 | 86 | 10 | 0.02 | 0.0010 | 0.010 | 0.089 | 0.082 | 0.025 | 0.017 |
| September | 106,745 | 19.2 | 10.1 | 110 | 8.2 | 2 | 141 | 61 | 5 | 0.03 | -- | 0.010 | 0.117 | 0.228 | 0.036 | 0.017 |
| October | 100,979 | 16.6 | 10.4 | 108 | 8.1 | 2 | 147 | 17 | 4 | 0.03 | 0.0006 | 0.010 | 0.150 | 0.137 | 0.030 | 0.015 |
| November | 103,443 | 11.8 | 10.7 | 100 | 7.9 | 2 | 146 | 33 | 6 | 0.02 | 0.0003 | 0.010 | 0.207 | 0.135 | 0.035 | 0.013 |
| December | 122,269 | 6.8 | 11.4 | 94 | 7.7 | 2 | 161 | 22 | 6 | 0.02 | 0.0002 | 0.010 | 0.163 | 0.183 | 0.046 | 0.015 |
| No. Months Sampled | | 147 | 147 | 147 | 147 | 142 | 147 | 145 | 142 | 140 | 13 | 82 | 78 | 64 | 136 | 139 |
| Mean | | 11.6 | 11.9 | 109 | 8.0 | 2.9 | 151 | 40 | 10 | 0.03 | 0.0003 | 0.010 | 0.142 | 0.129 | 0.035 | 0.014 |
| Maximum | | 36.0[c] | 16.3 | 146[c] | 9.2 | 11 | 202 | 700 | 300 | 0.26 | 0.0010 | 0.010 | 0.630 | 0.420 | 0.140 | 0.060 |
| Minimum | | 0.8 | 7.9 | 76 | 6.7 | 1 | 96 | 0 | 1 | 0.00 | 0.0001 | 0.010 | 0.010 | 0.010 | 0.010 | 0.000 |
| Standard Deviation | | 6.1 | 1.7 | 13 | 0.4 | 2 | 20 | 107 | 28 | 0.03 | 0.0003 | 0.000 | 0.098 | 0.083 | 0.020 | 0.009 |

Note: -- – no data
mg/l – milligrams per liter
NTU – nephelometric turbidity unit

[a] Flow is computed as mean of daily values at which samples were collected.

[b] $NH_3$+$NH_4$,

[c] These data points may be inaccurate due to instrument error.

In coordination with the Corps, Chelan PUD has monitored water temperature at the Rocky Reach fishway since 1965 and TDG in the Rocky Reach forebay since 1982. Chelan PUD intensified its temperature and TDG monitoring in 1996. The monitoring data sets consist of daily temperature only (1965 to 1981), hourly temperature and TDG for the Rocky Reach forebay (April to August each year from 1982 to present), and hourly TDG and temperature at a downstream fixed monitoring site (DFMS) approximately 4 miles downstream of the Rocky Reach dam (April to August each year from 1997 to present). TDG monitoring with improved equipment and calibration procedures was initiated in 1995 for the forebay and 1997 for the DFMS (McDonald and Priest, 1997; Koehler and McDonald, 1997, 1998).

Douglas PUD has conducted similar studies at Wells dam, at the headwaters to the project reservoir. Transparency data are available for both the Rocky Reach dam forebay and the Wells dam forebay (1993 to present) as Secchi depth readings from the fishways. Additional information sources include studies done for site-specific projects, including the Daroga Park development (Johnstone and Mih, 1987) and the license amendment application to raise the Rocky Reach reservoir pool elevation (Chelan PUD, 1991). Regional data for the mid- and upper-Columbia Rivers also were reviewed to provide background descriptions of water quality.

### Rocky Reach Project Vicinity, Water Quality Data

*Nutrients*

The nutrient balance within an aquatic ecosystem is an important determinant of the biological and aesthetic quality of an aquatic environment (Cooke et al., 1993). Nitrogen and phosphorous are the two primary nutrients of concern. Generally, the mid-Columbia River is a low nutrient system; the large volume of water flow and the regional geology, combined with a mostly rural watershed, are factors affecting nutrient levels.

The range of total nitrogen ($NH_3^+$ and $NH_4^+$) concentrations reported for monthly grab samples collected by WDOE at the Rock Island Project monitoring station from 1977 through 1990 was 0.00 to 0.26 milligrams per liter (mg/l); the average for these monthly concentrations was 0.03 mg/l (table 3). Total nitrogen is typically highest in the spring (due to runoff contribution from the watershed) and is low again by August due to primary production use. Nitrates ($NO_3$) are highest in the winter months and at seasonal lows in July and August. The average nitrate concentration for the monthly samples is 0.142 mg/l. Johnstone and Mih (1987) reported similar nitrate levels for samples collected in the vicinity of Daroga Park, which is located along the reservoir at RM 487.7 (figure 2) in summer 1986 (0.05 mg/l or less for the river and embayment). Nitrate levels in the Daroga lagoon were also low but displayed some localized spikes, possibly due to either inflow from elevated nitrate concentrations in groundwater caused by infiltration of fertilizers or by trout food in the trout pond. Total nitrogen and nitrate levels suggest the

project reservoir is oligo-mesotrophic, low to moderately low primary productivity (Chelan PUD, 2004a).

Phosphorous often limits algae and aquatic plant growth in rivers and lakes (Cooke et al., 1993). The primary sources of phosphorous for aquatic bodies are soil erosion associated with surface runoff, release of phosphorous from sediments and plants referred to as internal loading, and anthropogenic contributions. Phosphate concentrations in Daroga Lagoon reported by Johnstone and Mih (1987) as part of development of a swim beach ranged from 0.017 to 0.020 mg/l; these levels indicate phosphate is not a water quality concern within the lagoon. Reported phosphate levels in the Daroga embayment fluctuated more widely (0.015 mg/l to 0.046 mg/l). Reported total phosphorus concentrations for the project area waters indicate that the project reservoir is oligo-mesotrophic (Carlson, 1977).

*Turbidity, Light, and Transparency*

The Columbia River generally has low turbidity. The project area consists of igneous and metamorphic rock at the base of the Cascade Mountains to the west, basaltic material from the lava flows that created the Waterville Plateau to the east, and glacial outwash materials from the deep carving of the river valley itself. The tributaries that feed the mid-Columbia are primarily glacially carved, resulting in very low sediment loads.

Turbidity increases during periods of high inflow from the tributaries. Turbidity data collected daily by Chelan PUD and reported by the Corps' Data Access in Real Time (DART) information system (University of Washington, 2005) for the project forebay indicate an overall mean turbidity of 13.3 nephelometric turbidity units (NTU) from 1996 to 2004. Annual mean turbidity values for the forebay ranged between 4 and 8 NTU from 1996 to 1999 and between 14 and 18 NTU from 2000 to 2004. The cause for these higher values is not apparent, although it could be partially due to a more even sampling rate among spring, summer, and fall seasons in the latter years. Average monthly turbidity tends to be highest during the summer and fall. Chelan PUD (2004a) reported that turbidity in the project forebay is inversely correlated with discharge and positively correlated with water temperature. Temperature and discharge also correlate, which may explain the relationship between turbidity and discharge. It appears that turbidity may increase slightly in May with the onset of spring runoff and then show a slight increase again in July as primary productivity increases. Turbidity values reported for the project forebay are at comparable levels to the upstream Wells forebay and downstream Rock Island forebay.

Secchi disk transparency (visibility) in the reservoir is generally over 12 feet during late summer months, but can be lower during spring and early summer when snowmelt runoff in the tributaries is high. Chelan PUD monitors Secchi depths in the

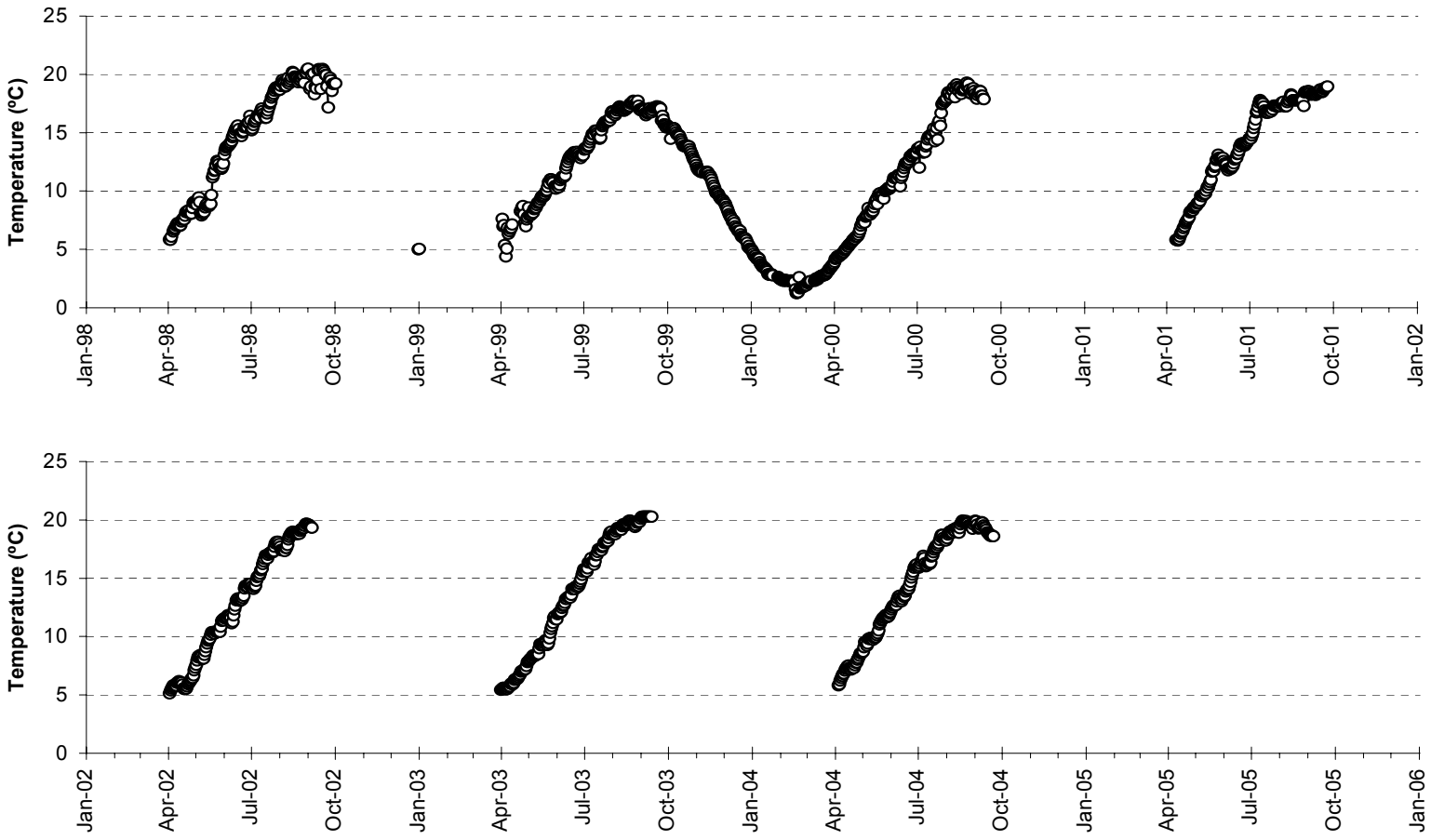
vicinity of the fishway during the fish counting season (April 16 to November 15). Secchi depths are rarely below 5 feet in May and June and typically exceed 17 feet from August through the fall. These Secchi depths suggest Rocky Reach reservoir is borderline oligotrophic (average 9.9 feet, range 5.4–28.3 feet for oligotrophic lakes; Carlson 1977).

*Temperature*

Chelan PUD collected water temperature data at the forebay and the DFMS located approximately 4 miles downstream of the project dam. Temperature monitoring in the project forebay was initiated in 1982. Between 1984 and 1997, 3 to 6 hourly values were reported daily to the Corps. After 1997, continuous recording devices were installed. The current fixed monitoring station in the forebay is on the west side of the dam, and temperature is generally monitored from April through September. Data for this and other Columbia River sites are made available as part of the DART information system on the internet (University of Washington, 2005). Mean daily temperatures reported for the 1998 to 2004 continuous recordings are presented in figure 3.

Thermal stratification is not evident in the Rocky Reach reservoir (Chelan PUD, 1991; Johnstone and Mih, 1987). The run-of-river operation of the project results in a rapid turnover rate in the reservoir, likely precluding stratification. The reservoir's hydraulic residence time at elevation 707 feet is 24.8 hours when the average discharge is 131,000 cfs (typical flows in May) and 65.2 hours when the average discharge is 84,800 cfs (typical flows in July) (Chelan PUD, 1991).

Water temperature in the project reservoir begins warming in March, reaches peak annual temperatures in late July through early September (monthly average daily temperature for August and September at the forebay is 18.6ºC), then cools again during the fall and winter months to average temperatures in the 2ºC to 4ºC range (figure 3). Daily variability is typically less than 0.5ºC but can range up to nearly 2ºC during summer. Water temperatures appear to change very little as water flows through the Rocky Reach reservoir. Monthly comparisons of daily mean temperatures for the same days (1998 through 2004) suggest that there are minimal temperature changes. Monthly averages of temperature differences between the Rocky Reach forebay and DFMS compared to the Wells project tailrace are generally less than 0.3ºC. Slightly larger (0.4ºC) average differences occur in July between the Rocky Reach DFMS and Wells




[a] These data were reviewed and corrected for anomalies (e.g., >2ºC change in 24 hours, and temperatures that do not follow temporal trends and are substantially different than scroll case temperatures).

Figure 3. Daily mean water temperatures at the Rocky Reach forebay (RRH), 1998–2004.[a]
(Source: University of Washington, 2005, as modified)

project tailrace. Chelan PUD (2004a) reported that the daily temperature change between the upper and lower end of the reservoir exhibited no pattern or statistically significant relationship to discharge or percent spill at the project.

WDOE's water temperature criterion for this reach of the Columbia River is that human-caused increases in water temperatures shall be limited to no more than 0.3ºC above natural conditions when the natural conditions exceed 18ºC. Allowable human-caused increases coinciding with cooler natural periods are a function of the background temperature and are as high as 2.8°C. Table 4 summarizes the frequency of daily mean temperatures exceeding the 18ºC criterion at the Rocky Reach Project and other upstream and downstream hydroelectric projects. Although the sampling periods varied somewhat by location, this summary indicates that daily mean temperatures of discharges from the project (RRDW) exceed 18ºC at about the same frequency as inflows to the project reservoir (WELW). The different sampling periods may have led to the project forebay (RRH) exceeding 18ºC less frequently than both upstream and downstream stations in August and September. We discuss the results of project reach modeling studies in section 3.3.2.2, *Water Quality, Temperature*.

Table 4. Summary of daily mean temperatures greater than 18.0ºC (in percent), 1998–2004. (Source: University of Washington, 2005, as modified)

| Month | Wells Forebay (WEL) | Wells Tailrace (WELW) | Rocky Reach Forebay (RRH) | Rocky Reach DFMS (RRDW) | Rock Island Forebay (RIS) |
|---|---|---|---|---|---|
| July | 10% | 9% | 12% | 14% | 13% |
| August | 77% | 77% | 67% | 76% | 61% |
| September | 90% | 91% | 74% | 92% | 65% |
| October [a] | 67% | 0% | 3% | -- | 3% |

Note: -- – no data

[a] Limited number of days with reported data. Zero days of data reported for RRDW, 3 days of data reported for WEL and WELW, and 32 days of data for RRH and RIS.

*Dissolved Oxygen*

Dissolved oxygen (DO) is an important indicator of aquatic eutrophication and a major determinant of coldwater fisheries viability. Salmonids generally require DO concentrations of 7 to 9 mg/l and are less tolerant of low DO concentrations than warmwater fishes, which can tolerate DO concentrations as low as 3 to 4 mg/l (EPRI, 1990). As discussed above, the project reservoir does not thermally stratify. DO levels in the reservoir are favorable for salmonids and provide a healthy aquatic environment throughout the year. Chelan PUD (2004a) states that the WDOE assigned the Rocky

Reach reservoir as category 1 for DO in its preliminary 2002/2004 303(d) listings, indicating that it typically meets the applicable DO standard.

Detailed historical DO monitoring data are not available for the project reservoir, but information from downstream locations is considered representative of conditions in the project. The annual average DO concentrations at the downstream WDOE monitor station downstream of Rock Island dam is 11.9 mg/l. Annual variation is influenced by water temperature (warmer water retains less oxygen). The range in DO concentrations recorded downstream of Rock Island dam is 7.9 to 16.3 mg/l (76 to 146 percent saturation). Monthly DO levels for this location are listed in table 3.

From 1977 to 1990, only one DO concentration of less than the 8.0-mg/l criterion was reported at the WDOE gage station below Rock Island. Johnstone and Mih (1987) report similar DO concentrations within the project reservoir, with the water fully saturated at all times. They also note diurnal fluctuation, with peak DO concentrations at 3:00 p.m. in summer months. Photosynthesis by aquatic plants may account for the high DO levels and diurnal fluctuation.

*pH and Alkalinity*

Alkalinity is a measurement of the buffering capacity of water to limit fluctuations in pH (Wetzel, 1975). Alkalinity in the river measured at Daroga Park (Johnstone and Mih, 1987) ranged from 55 to 66 mg/l as calcium carbonate ($CaCO_3$). This is considered to be relatively high alkalinity, indicating high carbonate concentrations, which promote biological growth.

The Columbia River pH level at WDOE's monitoring station below Rock Island dam averages 8.0 units, which is slightly basic. Although pH readings varied between 6.7 and 9.2 units for 147 monthly measurements taken between October 1977 and January 1990, no correlation appears to exist between pH and flow levels, temperature, or seasons of the year. Growth of phytoplankton and macrophytes can influence pH through the utilization of carbon dioxide for photosynthesis, and can lead to alkaline pH levels when excessive growth occurs. Johnstone and Mih (1987) reported a diurnal variation in pH of 7.1 to 8.6 units for the Columbia River at Daroga Park, and attributed this to the effects of photosynthesis. WDOE lists the Rocky Reach reservoir as category 1 for pH in its preliminary 2002/2004 303(d) listings, indicating that it typically meets the applicable pH standard (Chelan PUD, 2004a).

*Specific Conductance*

Specific conductance below Rock Island dam averaged 151 $\mu$mhos/cm for the 1977 to 1990 monthly data, and remained relatively stable throughout the year (table 3) in this reach of the Columbia River.

*Bacterial Contamination*

Fecal coliform organisms are present in the intestinal tracts and feces of warm-blooded animals. Their presence and level of concentration are indicators of human or other warm-blooded animal pollution. The overall average of 40 fecal coliform organisms per 100 milliliter (ml) for the station below Rock Island dam is less than the geometric mean criterion of 100 organisms per 100 ml that is applicable to the project waters. Less than the 10-percent allowable limit of samples (6.2 percent) exceeded 200 organisms per 100 ml, which is within an acceptable range of the fecal coliform standard. WDOE listed the Rocky Reach reservoir as category 1 for coliform bacteria in its preliminary 2002/2004 303(d) listings, which indicates that the reservoir typically meets the applicable fecal coliform standard (Chelan PUD, 2004a).

Johnstone and Mih (1987) assessed bacteria in Daroga Park and reported generally low bacterial concentrations for enterococci, total E. coli, and fecal coliform. Localized high fecal coliform counts were found in July, followed by relatively low bacterial counts in August. The high counts were attributed to concentrated waterfowl usage within the area.

The Chelan-Douglas Health District has jurisdiction over individual onsite domestic sewage systems within the two-county area straddled by the project's reservoir. Since 1981, it has been the policy of the Chelan-Douglas Health District to issue individual onsite sewage disposal permits that require a 100-foot horizontal drain field setback from the river and a 3-foot vertical separation between the bottom of the drain field trench and seasonal high groundwater (Chelan PUD, 1991).

In its Preliminary Draft Environmental Assessment (PDEA) for relicensing this project, Chelan PUD (2004a) stated that it conducted a survey in 1981 of septic tanks and drain fields in the vicinity of the reservoir. These drain fields predate the 1981 health district policy changes, and some of these drain fields encroach upon the health district's current horizontal and vertical separation criteria. However, based on the very low bacteria concentrations noted above, it does not appear that these septic systems have caused any detectable contamination of the project reservoir.

Two municipal sewage treatment facilities are located near the project area. The treatment plant at Chelan Falls serves the lower Lake Chelan area; the other at Entiat serves that city. These sewage treatment plants operate under National Pollutant Discharge Elimination System (NPDES) permits that require treatment to protect water quality in the Columbia River. In addition, a small wastewater treatment facility serves the project dam and operates under NPDES Permit No. WA-005079-2.

*Heavy Metals, Pesticides, and Contaminants*

Much of the land adjacent to the project reservoir is for agricultural use, primarily orchards. Fertilizers, pesticides, and herbicides used in managing the orchards and other lands along the project reach, including Chelan PUD's parks, could have detrimental effects on the aquatic ecosystem if it were allowed to concentrate in the river at high levels. However, by requiring that applicators of chemicals be licensed, take continuing education courses, and maintain meticulous records about use of chemicals, the potential risk is limited. In its comments on the draft EIS, the City of Entiat noted that farmers attempt to reduce their use of chemicals by a number of means, including participating in an integrated pest management program. Chelan PUD indicates that analysis of soils from areas where the PUD removed orchards along the river to develop parks shows minimal levels of residual fertilizers and herbicides. Chelan PUD (2004a) reported that some residual lead-arsenic from pre-World War II orchard operations has been found at depth in heavy clay soils. The Forest Service and City of Entiat indicate that the elevated lead-arsenic levels may have originated from upstream mining operations in Canada. Concentrations of these contaminants are below regulated thresholds. Sandy soils have not shown any residual effects in these areas.

Chelan PUD uses and stores petroleum products (gasoline, oil, and grease) to maintain and operate the project facilities. Spillage of petroleum products, even in small amounts, may be toxic to aquatic life. WDOE reports that Chelan PUD has been responsible for two oil spills of greater than 10 gallons in the past 10 years (e-mail from G. Clear, ERTS/SEPA Coordinator, WDOE, Yakima, WA, to B. Mattax, Senior Aquatic Scientist, The Louis Berger Group, Bellevue, WA, dated November 30, 2005). On November 5, 1998, a valve left open by project operators resulted in a 700-gallon oil spill into the Columbia River at the Rocky Reach dam (WDOE, 1998). Observations at the Rock Island dam did not reveal a visible sheen, and no adverse effects to fish or wildlife in the Rock Island reservoir were observed during a reconnaissance survey of Rock Island reservoir conducted about 1 day after the spill (WDOE, 1998; letter from R. Salter, Director Lands and Facilities, Chelan PUD, Wenatchee, WA, to J. Lewis, Spill Responder, Central Regional Office, WDOE, Yakima, WA, November 20, 1998)[19]. During transfer of governor oil from unit 2 to unit 1 on October 28, 2002, 25 gallons of oil was spilled into the Columbia River (e-mail from R.E. Johnson, Records Analyst/Public Disclosure Coordinator, WDOE, Yakima, WA, to B. Mattax, Senior Aquatic Scientist, The Louis Berger Group, Bellevue, WA, December 14, 2005.). No distressed wildlife species were observed during this event. Chelan PUD has made operational improvements to prevent another spill from occurring.

[19] Both of these references are included in the e-mail from R.E. Johnson, Records Analyst/Public Disclosure Coordinator, WDOE, Yakima, WA, to B. Mattax, Senior Aquatic Scientist, The Louis Berger Group, Bellevue, WA, December 14, 2005.

To minimize potential releases of petroleum products into the Columbia River, Chelan PUD implements a Spill Prevention Control and Countermeasure Plan. This plan, which was developed in June 2002 and revised in 2005, is designed to fulfill the requirements of 40 CFR 112, EPA Oil Pollution Prevention Regulations. This plan describes practices, procedures, structures, and equipment at the facility to prevent spills and to mitigate or preclude any adverse effect on the environment. Under existing regulations, the project's Spill Prevention Control and Countermeasure Plan is reviewed and revised at least every 3 years or within 60 days of a spill. The plan provides the locations, quantities, and contents of oil products stored at the project, a description of potential spill situations and control systems, and a detailed list of spill prevention measures associated with specific runoff and other drainage systems, storage locations, oil-containing equipment, maintenance activities, and personnel training.

*Total Dissolved Gas*

Spilling water at hydroelectric projects can entrain atmospheric gas in the tailwater, forcing this gas into solution and potentially leading to supersaturation of TDG (Weitkamp and Katz, 1980). High levels of TDG supersaturation can be detrimental to a wide array of aquatic animals and may cause a potentially lethal condition known as GBT in fish. GBT develops when dissolved gas in the bloodstream of animals comes out of solution and forms bubbles in the internal and external tissues.

Chelan PUD, in coordination with the Corps and other Columbia River hydroelectric project operators, has been spilling water to aid downstream fish passage at the project since 1976. Spill is a tool used for improving survival of anadromous salmonids during their downstream migration. Spill can also occur when high stream flows exceed the hydraulic capacity of the powerhouse (approximately 201,000 cfs) or, occasionally, when demand for energy is low and river flows are high. In the Columbia River Basin, a regional effort has been undertaken to monitor and control TDG supersaturation and its biological effects.

Although Washington's numeric water quality standard is 110 percent for TDG supersaturation in the Columbia River, an exception is made for times when spill is being used to increase downstream passage survival of juvenile salmon. This exception allows the project and other projects to spill water for fish passage as long as the TDG level in the tailrace does not exceed 120 percent (daily average of highest 12 consecutive hours), and no single hourly TDG measurement exceeds 125 percent. In addition, the spill must be controlled so that the TDG level in the forebay of the next dam downstream (i.e., Rock Island Project) does not exceed 115 percent.

In coordination with the Corps, Chelan PUD has monitored TDG levels in the project forebay since 1982. The monitoring data are composed of hourly TDG levels in the forebay (April to August of 1982 to present) and hourly TDG levels downstream of

the project dam (April to August of 1997 to present). Some tailrace data from a barge in the Rocky Reach tailrace are available for 1996. TDG monitoring with improved equipment and calibration procedures during the spring and summer seasons was initiated in 1995 for the forebay and 1997 for the site downstream of the project dam.

Chelan PUD has reported TDG levels for the forebay and downstream of the dam that are in compliance, with the exception to the WDOE standard described above. Study methods and results are reported in McDonald and Priest (1997), Koehler and McDonald (1997, 1998), and in annual compliance reports submitted to WDOE since 2000. TDG, temperature, and barometric pressure are recorded every 15 minutes, and the averages for the hour are stored in a database and transmitted to the Corps. The data are measured at a fixed station located in the forebay with the instrument probe deployed at a depth of approximately 15 feet. The downstream monitor is approximately 4 miles downstream from the project dam at the Odabashian Bridge.

TDG levels in the forebay and downstream of the dam vary throughout the spring and summer. This variation is attributable, in part, to changing spill volumes and upstream TDG levels associated with spills at upstream projects. The effect of the Rocky Reach dam on TDG levels is shown in table 5. Generally, the average TDG at the DFMS is 2 percent higher than the TDG level measured in the forebay. In 1996, the tailrace data, which were measured much closer to the spillway, show a greater increase in TDG (averaging 5 to 7 percent). The highest TDG levels upstream and downstream of the project's dam were recorded in 1997, due to high river flows and spill levels in that year, which had the highest stream flows since 1970.

Table 5. Total dissolved gas as percent saturation in the Rocky Reach forebay and downstream of the Rocky Reach dam, 1996–2003. (Source: Chelan PUD, 2004a)

| | **Spring[a] (average and range of hourly measurements)** | | **Summer[a] (average and range of hourly measurements)** | |
|---|---|---|---|---|
| **Year** | **Forebay** | **DFMS** | **Forebay** | **DFMS** |
| 1996 | 114.7 (103.5–126.6) | 121.2 (108.9–140.5) | 109.5 (103.4–116.7) | 115.1 (108.9–128.6) |
| 1997 | 123.7 (98.5–133.5) | 126.0 (108.1–138.3) | 111.0 (99.8–120.8) | 113.1 (106.8–128.3) |
| 1998 | 108.8 (100.4–121.3) | 111.3 (105.8–127.6) | 108.1 (97.9–114.8) | 110.9 (105.3–118.9) |
| 1999 | 108.8 (97.3–116.4) | 110.1 (101.7–27.3) | 110.6 (103.6–122.4) | 112.7 (108.0–24.5) |

| Year | Spring[a] (average and range of hourly measurements) | | Summer[a] (average and range of hourly measurements) | |
|---|---|---|---|---|
| | Forebay | DFMS | Forebay | DFMS |
| 2000 | 107.6 (100.1–20.5) | 110.7 (102.9–32.2) | 108.6 (101.6–12.7) | 110.1 (105.3–14.6) |
| 2001[b] | 107.9 (104.1–13.3) | 108.3 (104.6–13.0) | 108.8 (104.1–13.4) | 109.1 (105.5–12.1) |
| 2002 | 110.6 (104.2–28.0) | 112.5 (105.2–27.6) | 114.9 (108.5–35.7) | 115.6 (108.7–32.2) |
| 2003 | 107.6 (103.7–12.5) | 108.9 (104.0–13.8) | 110.8 (104.6–18.9) | 112.1 (109.6–16.0) |

Note: DFMS – downstream fixed monitoring station

[a] The periods of time defined as spring and summer have varied from year to year. The spring period was approximately April 1 to June 30 for 1996 to 2001, April 14 to June 21 for 2002, and April 3 to May 31 for 2003. The summer period was approximately July 1 to August 31 for 1996 to 2001, June 22 to August 25 for 2002, and June 1 to August 31 for 2003.

[b] There was no spill at the Rocky Reach dam in 2001. Thus, data for this year serve as a baseline for TDG levels with no spill-related TDG effect from the project.

Chelan PUD used regression analysis to evaluate the relationship between the change in TDG levels from the forebay to the DFMS and the spill rate (kcfs) as well as the percent of total flow spilled. Data were stratified by spring and summer. The correlation between TDG level and spill level has been highly variable, typically with correlation coefficients well below 0.5 for both total spill rate and percent of river flow spilled. This poor correlation is because spill at the project does not greatly increase TDG when the TDG level in the forebay is above 110 percent.

The Rocky Reach dam consists of a powerhouse parallel to the river flow, located on the west bank of the river and a spillway perpendicular to the flow located on the east bank of the river. Because of this configuration, TDG levels are expected to be higher in the east portion of the channel than in the west portion of the channel. Results of monitoring TDG at transects across the channel downstream of Rocky Reach dam indicates that there is a slight trend of TDG levels decreasing from the east channel to the west, as expected (Corps, 2003). The Chelan PUD (2004a) reported that this observation has been consistent during 8 years of transect monitoring.

Comparison of forebay to DFMS data showed an increase in TDG levels when there is little or no spill. The increase in TDG from forebay to DFMS when no spill occurred leads to the conclusion that factors other than spill may also influence TDG, or

there are potentially undetected vertical and/or horizontal gradients in TDG across the river channel that are not accounted for by monitoring at the fixed station.

The results of 8 years of TDG monitoring indicate that TDG levels at the forebay of the Rock Island dam largely depend on TDG levels reaching the Rocky Reach forebay. Although the effects of spills at the Rocky Reach dam on TDG are sometimes evident, results have not demonstrated a strong causal relationship between the project spill rate and TDG levels that exceed the applicable criterion for the forebay of Rock Island dam. In 1998, the spill pattern for fish passage at the project generally resulted in an increase in TDG levels from the forebay at the Rocky Reach dam to the forebay at the downriver Rock Island dam (Koehler and McDonald, 1998). Similar findings were reported for 1996 (McDonald and Priest, 1997). During the high flows in 1997, spill at the Rocky Reach dam was distributed across either 7 or 11 spillway bays, and the TDG data showed decreasing trends from the project to the Rock Island Project (Chelan PUD, 2004a). However, in recent years using different spill patterns, the TDG level arriving at Rock Island dam has been only slightly higher, and sometimes lower, than the TDG level in the forebay of the project (Chelan PUD, 2006b).

*Groundwater*

Groundwater in the study area is contained in shallow, unconfined aquifers composed of glacial drift deposits overlying basalt. In the vicinity of the project reservoir, the depth to high water table is more than 6 feet. The principal water-bearing units consist of sand and gravel in glacial outwash and glacial till. Well depths range from 50 to 250 feet. The water-yielding capability of the glacial drift aquifer is highly variable due to the spatial variability of the constituent materials.

Groundwater from the glacial drift aquifer is used as a source of domestic water supply in the region surrounding the project reservoir. Groundwater quality in the glacial drift aquifer is generally good, with some problems related to contamination from agricultural practices, including high levels of nitrates, phosphorus, and coliforms (FERC, 1996).

Minimal levels of residual fertilizers and herbicides were detected near the surface in soils within the project area. Residual lead-arsenic levels from pre-World War II orchard operations were found at depth in heavy clay soils; however, the measured levels were below the regulatory thresholds and have not been shown to affect groundwater quality in the project area.

The Columbia River Basalt Aquifer underlies the glacial drift aquifer and consists of alternating layers of dense but locally fractured basalt and interbeds of unconsolidated sand and gravel. Groundwater from the Columbia River Basalt Aquifer is used predominantly for irrigation. Well depths generally range from 50 to 750 feet, but may exceed 900 feet (USGS, 1985, as cited in FERC, 1996).

### 3.3.2 Environmental Effects

#### 3.3.2.1 Water Use and Quantity

Water quality can be affected when water is consumed or when a non-consumptive use takes water out of the river channel over some distance, reducing flows in a bypassed reach. Water quality can also be affected when water is used for processes that contaminate the water with pollutants. The project does not take water away from the river channel for power generation; therefore, there is no bypassed reach. The amount of water used to irrigate parks and other project properties is minor, and the quantity used is regulated through flow measurements required by existing water rights. Water used at the project's fish hatcheries is non-consumptive, and the discharges from them are regulated through NPDES permits.

In the PDEA, Chelan PUD did not identify any adverse effects on water quality that result from the project's uses of water for irrigation, fish hatcheries, domestic consumption, or other uses associated with operation of the project, and Chelan PUD does not propose any new use of the project's water rights for power production or other uses.

In the Settlement Agreement, Chelan PUD proposes to continue operating the project under the Hourly Coordination Agreement to optimize the management of flows and power generation through the seven dams from Grand Coulee to Priest Rapids. Chelan PUD also proposes to continue to abide by the Vernita Bar Agreement and the recently executed renewal and expansion of these efforts through the Hanford Reach Agreement. The Hanford Reach Agreement allows use of active storage from the project reservoir to assist Grant PUD in meeting the discharge requirements for the Priest Rapids Project. The Hourly Coordination Agreement allows the project to meet a high proportion of the peaking load of power purchasers who have the rights to the output of both the Rocky Reach Project and Grant PUD's projects when the Priest Rapids and Wanapum projects are constrained by the Hanford Reach Agreement's anti-stranding provisions. In comments on the draft EIS, BPA stated that Grant PUD's purchasers lose some of their ability to request power for their needs at the Priest Rapids and Wanapum projects, although those who also have purchased generation rights to Rocky Reach may choose to exercise more of their rights at Rocky Reach to continue to meet their power requirements.

Consistent with Chelan PUD's proposal, CRITFC and other stakeholders have stated that the operations of the project should continue to support the protection of fall Chinook salmon in the Hanford Reach of the Columbia River, specifically via the Vernita Bar Agreement and operations to prevent stranding of juvenile Chinook salmon. The Priest Rapids Project does not have the ability to meet all project purposes and re-regulate the daily flow releases from the other projects. For this reason, the Hanford Reach

Agreement was developed to provide for the release of water from 1 foot of active storage at the Rocky Reach Project to supplement flows, when needed, after active storage at the Priest Rapids and Wanapum projects has been used. As part of their 10(a) recommendations, the Confederated Tribes of the Umatilla Indian Reservation (Umatilla Tribes) and the Yakama Nation recommend that the project be operated in accordance with the Hourly Coordination Agreement, which enables providing more stable flows for fall Chinook salmon in the Hanford Reach. In addition to recommending that Chelan PUD follow the Hourly Coordination Agreement, the Umatilla Tribes recommend that project operations not deviate from hourly coordination during the susceptible period for Hanford fall Chinook salmon spawning and juvenile rearing and migration.

*Our Analysis*

Information we present in section 3.3.1.2, *Water Use and Quantity*, indicates that the project's consumptive uses of water are minimal, and the total flow rate of surface water consumptive use water rights issued by WDOE for all users is just 326.5 cfs. These withdrawals have little effect on the flows of the Columbia River, particularly given that transmission losses from irrigation systems return to the river.

The project's use of water for irrigation, fish hatcheries, domestic consumption, and other uses associated with operation of the project is currently managed under the appropriate use-specific regulations (i.e., water rights, NPDES permits) that apply to each use. Under Chelan PUD's proposal, the water used for power production would continue to be managed through FERC license articles, the Hourly Coordination Agreement, the Vernita Bar Agreement, and the Hanford Reach Agreement, which is consistent with the recommendations of CRITFC, WDFW, the Umatilla Tribes, and the Yakama Nation. There is nothing on the record to indicate that other requirements or restrictions on the project's use of water are necessary or desirable.

#### 3.3.2.2 Water Quality

To determine the current effects of project operations on water quality, the Natural Sciences Working Group (NSWG) helped develop nine studies, as follows:

1. Water Quality Monitoring Report—Rocky Reach Reservoir—Water Year 2000 (Parametrix and Rensel Associates, 2001)
2. Rocky Reach Reservoir Temperature Studies (Parametrix and TRPA, 2002)
3. Technical Report on the Development of a CE-QUAL-W2 Model for the Rocky Reach Hydroelectric Project (WEST Consultants, 2005)
4. Analysis of TDG Data, Rocky Reach Dam, 1997–2000 (Parametrix, 2000a)
5. TDG Supersaturation in the Natural River Environment (Parametrix, 2000b)

6. Total Dissolved Gas Exchange during Spillway Operations at Rocky Reach Dam, April 26–May 3, 2002 (Corps, 2003)
7. Gas Abatement Techniques at Rocky Reach Hydroelectric Project (MWH, 2003)
8. Operational and Structural Total Dissolved Gas Management (Schneider and Wilhelms, 2005)
9. Total Dissolved Gas Biological Effects, 2002 (Parametrix and RL&L, 2002)

The purposes of these studies were to confirm, expand, and update information contained in the historical record summarized in the ICD (Chelan PUD, 1999). Furthermore, these studies were specifically designed to determine if there were project effects on water quality that had not been previously identified and to better delineate the extent of project effects that were known to occur. These studies included an extensive, broad-brush study of overall water quality that was conducted in water year 2000. The purpose of this study was to provide a definitive basis for water quality certification by WDOE for the project. In addition, the study was to provide information about project-related effects on parameters that might not meet water quality standards (Parametrix and Rensel Associates, 2001).

**Water Quality Parameters Meeting Standards**

The parameters measured during the water year 2000 water quality study included DO, pH, turbidity, and fecal coliform, which correspond to parameters specified in the Washington State water quality standards (Parametrix and Rensel Associates, 2001). Other commonly monitored parameters were also studied, including total suspended solids, total dissolved solids, transparency (Secchi depth), specific conductance, total alkalinity, total hardness, various forms of phosphorous and nitrogen, chlorophyll-*a*, phytoplankton, zooplankton, and attached benthic algae. In addition, nitrogen to phosphorous ratios and trophic state indices were computed from the data collected. This study facilitated determination of both compliance with water quality standards and biological function of the project waters for those parameters (table 6). The other parameters important for water quality certification, temperature and TDG, were also measured and reported in the Water Quality Monitoring Report (Parametrix and Rensel Associates, 2001). In addition, much more extensive information for temperature and TDG was obtained under separate studies and monitoring programs. The information and studies pertaining to water temperature and TDG are discussed later in this section.

Table 6. Average values for pelagic water quality samples from Rocky Reach reservoir, water year 2000. (Source: Parametrix and Rensel Associates, 2001)

| Month | Dissolved Oxygen (mg/l) | Dissolved Oxygen Saturation (%) | pH (units) | Turbidity (NTU) | Specific Conductance (μmhos/cm) | Fecal Coliform (CFU per 100 ml) | Total Suspend Solids (mg/l) | Total N[a] (mg/l) | Nitrite (mg/l) | Nitrate (mg/l) | Total Phosphates (mg/l) | Dissolved Ortho-P (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| October | 9.44 | 96.3 | 8.1 | 2.1 | 116 | 1 | 1.0 | .0060 | .0026 | .0810 | .0060 | .0026 |
| November | 9.70 | 92.9 | 7.8 | 1.9 | 111 | 5 | 1.3 | .0057 | .0016 | .0943 | .0077 | .0032 |
| December | 11.25 | 97.5 | 7.9 | 1.1 | 120 | 10 | 1.0 | .0077 | .0035 | .1034 | .0064 | .0032 |
| January | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| February | 12.99 | 100.3 | 7.9 | 1.9 | 130 | 1 | 2.3 | .0092 | .0002 | .1369 | .0072 | .0010 |
| March | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| April | 12.37 | 105.6 | 8.0 | 2.9 | 130 | 1 | 2.0 | .0104 | .0006 | .2066 | .0254 | .0028 |
| May | 11.43 | 106.7 | 7.9 | 2.8 | 126 | 1 | 2.3 | .0083 | .0007 | .0763 | .0295 | .0018 |
| June | 10.55 | 96.3 | 7.9 | 2.2 | 120 | 4 | 2.9 | .0099 | .0010 | .0702 | .0196 | .0014 |
| July | 10.05 | 105.6 | 8.0 | 1.9 | 119 | 2 | 3.0 | .0110 | .0027 | .0574 | .0249 | .0020 |
| August | 9.43 | 102.3 | 7.7 | 1.6 | 125 | 1 | 5.0 | .0087 | .0021 | .0518 | .0148 | .0013 |
| September | 8.32 | 89.9 | 7.8 | 1.6 | 127 | 1 | 1.8 | .0061 | .0010 | .0744 | .0154 | .0022 |
| Mean | 10.55 | 99.3 | 7.9 | 2.0 | 122 | 2.7 | 2.2 | .0083 | .0016 | .0952 | .0157 | .0022 |
| Maximum | 12.99 | 106.7 | 8.1 | 2.9 | 130 | 10 | 5.0 | .0110 | .0035 | .2066 | .0295 | .0032 |
| Minimum | 8.32 | 89.9 | 7.7 | 1.1 | 111 | 1.0 | 1.0 | .0057 | .0002 | .0518 | .0060 | .0010 |

Notes: -- – no measurements made
CFU – colony forming units
ml – milliliter
mg/l – milligram per liter
NTU – nephelometric turbidity unit
μmhos/cm – micromhos per centimeter

[a] $NH_3+NH_4$

In addition to sampling the physical and chemical parameters, biological sampling demonstrated that the project's waters are favorable for the maintenance of a healthy aquatic ecosystem. This is particularly important to the function of the reservoir as a rearing environment for juvenile salmonid fishes and for other native fish species. The nutrient levels, chlorophyll-*a* concentrations, and low turbidity levels indicate that the trophic status of Rocky Reach reservoir falls within the lower mesotrophic range (Parametrix and Rensel Associates, 2001). Analysis of zooplankton samples demonstrated large biovolumes of Daphnia from July through September, while free-drifting chironomids (midges that lack piercing mouthparts) and oligochaetes (aquatic annelids that lack a specialized head) were particularly prevalent in April and May (Parametrix and Rensel Associates, 2001). These organisms may be important food sources for migrating and rearing anadromous fish.

The Rocky Reach reservoir and tailrace were also studied for other biological and physical components of healthy aquatic ecosystems. The levels of attached benthic algae in the reservoir were high (Parametrix and Rensel Associates, 2001). A number of native fish species graze on benthic algae, including suckers and chiselmouth. A survey of benthic organisms (DES and RL&L, 2000), conducted as part of the fisheries resources studies, found healthy benthic communities in a variety of habitat types. In terms of density, midges, caddisflies, sow bugs, clams and mussels, and scuds accounted for most of the benthic macroinvertebrates collected. These organisms typically are important sources of food for fish (Wydoski and Whitney, 1979). Largely owing to the variability of habitats, each study site tended to be unique with regard to the number of taxonomic groups, total number of invertebrates, and the relative contribution of dominant taxa (percent composition) (DES and RL&L, 2000). These assessments of the aquatic community indicate that the Rocky Reach reservoir generally meets the objectives of the water quality standards by supporting a healthy, diverse aquatic community. In comments on the draft EIS, the Umatilla Tribes indicated that the aquatic community within the project area is less diverse and less productive than it would be in a free-flowing river.

Sampling stations selected for the water year 2000 water quality monitoring study were dispersed over a broad array of locations in the project area (figure 4). Results of this study confirmed that, with the possible exception of the numeric criteria for temperature and TDG, the Columbia River within the project area meets the applicable water quality standards (refer to tables 1 and 6).

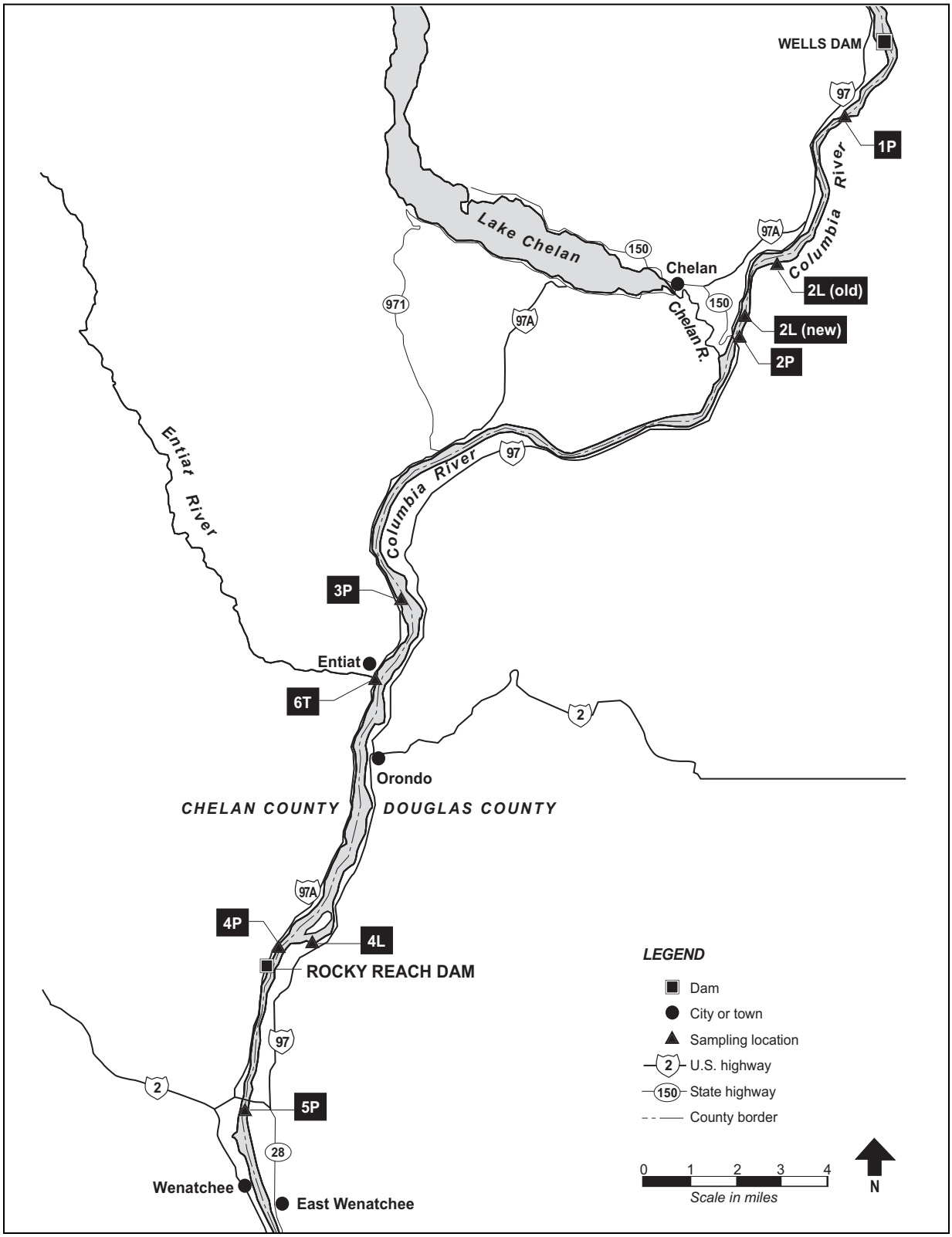



Figure 4. Rocky Reach Project water quality sampling locations. (Source: Parametrix and Rensel Associates, 2001, as modified by staff)

In the PDEA, Chelan PUD indicated that three water quality issues would likely require management through implementation of compliance plans: (1) water temperature, (2) TDG, and (3) oil and hazardous material spill prevention and countermeasures. Currently, these issues are individually governed by separate water quality actions. Chelan PUD has consolidated these separate actions and the results of the nine water quality studies into a single Water Quality Plan(Chelan PUD, 2006b) that provided WDOE with the basis for issuing the water quality certification

The issues of temperature, TDG, and oil and hazardous materials spill prevention are each discussed separately below. Environmental measures for each of these issues are addressed by the Water Quality Plan that is part of the Settlement Agreement. This plan is described herein as it relates to each of these issues. As parties to the Settlement Agreement, WDOE and Interior concur with Chelan PUD's proposal.

In the PDEA, Chelan PUD indicated that it expected WDOE's water quality certification under Section 401 of the federal CWA to include a condition that requires periodic monitoring of parameters that currently meet water quality standards to ensure that the project does not impair water quality in the future. Chelan PUD has proposed to monitor the temperature, DO, and pH of shallow waters in Rocky Reach reservoir. WDOE included this as a condition of the Section 401 certificate.

In their comments on the PDEA, the Umatilla Tribes and American Rivers indicate that the project should be operated to comply with state water quality standards, which is consistent with Chelan PUD's proposal.

As part of their 10(a) recommendation 14 of March 14, 2005, the Umatilla Tribes recommend completing all modeling and implementing all project modifications needed to ensure compliance with Washington State water quality standards that are applicable throughout any new license period while achieving quantitative and qualitative performance standards and goals for salmon, Pacific lamprey, and white sturgeon. This approach is generally consistent with Chelan PUD's proposal, although the Umatilla Tribes also recommend that Chelan PUD establish a water quality committee to interact with the Fisheries Technical Committee to resolve water quality issues over the term of a new license. We discuss portions of these measures that specifically address water temperature, TDG, and oil and hazardous spills in the separate sections of this EIS addressing those issues.

*Our Analysis*

Chelan PUD has indicated (Chelan PUD, 2004a) that it expected the WDOE water quality certification for the project to contain an appropriate level of water quality monitoring requirements to ensure that the project does not impair water quality over the term of any new license. Based on consultations with WDOE, Chelan PUD developed a

schedule for implementation that would ensure that the project complies with applicable water quality standards within 10 years as required by WAC 173-201A-510(5).

Chelan PUD developed and iteratively revised a Water Quality Plan that summarizes the results of recent studies conducted to evaluate existing water quality in the project area and potential options for resolving water temperature and TDG issues and identifies measures to address water quality in the project area (Chelan PUD, 2006b). Chelan PUD developed a CE-QUAL-W2 temperature model for the project's reservoir.[20] Since issuance of the draft EIS, Chelan PUD has incorporated the results of the CE-QUAL-W2 modeling effort into the February 3, 2006, version of the Water Quality Plan that forms part of the Settlement Agreement, which has made the plan more comprehensive with respect to knowledge of water temperature (Chelan PUD, 2006b). Implementation of this Water Quality Plan should reduce any adverse project effects on water quality and beneficial uses. In the Settlement Agreement, Chelan PUD indicated that it may petition WDOE to initiate a process to modify the applicable water quality standards for TDG and/or temperature, if the existing numeric criteria are not satisfied.

In comments on the draft EIS, the Yakama Nation indicated that the macrophyte beds may potentially depress DO concentrations and thus result in adverse effects on fish residing in them. DES (2001a) estimated that aquatic macrophyte beds in the Rocky Reach reservoir covered an area of about 386 acres in 1999. Chelan PUD currently monitors and controls aquatic invasive species through separate programs. These programs include routine harvesting of Eurasian watermilfoil at public access points and recreational facilities. In the Settlement Agreement, Chelan PUD proposes to develop a 1-year sampling program, in consultation with WDOE, to determine if water quality criteria for temperature, DO, and pH are met in shallow water habitats in the reservoir. If measurements show that the water quality criteria are not satisfied, Chelan PUD would conduct further monitoring in coordination with the RR Fish Forum and WDOE to determine the adverse effects on aquatic habitat and what reasonable and feasible actions may protect aquatic organisms. Chelan PUD would determine any needs for additional monitoring and reasonable and feasible corrective actions through coordination with the RR Fish Forum and WDOE. Implementation of this proposed measure would address potential adverse effects of the macrophyte beds on DO levels and, consequently, on fish habitat.

Establishing and actively using a water quality committee according to the recommendations of the Umatilla Tribes would provide a forum for water quality discussions and coordination of water quality and fishery actions. However, we anticipate that it also would be redundant with WDOE's water quality certification and TMDL processes and result in an additional layer of oversight and burden on Chelan PUD and resource agencies. In comments on the draft EIS, Chelan PUD indicated that

[20] This modeling effort uses version 3.2 of CE-QUAL-W2, a two dimensional hydrodynamic and water quality model (Portland State University, 2005).

the RR Fish Forum would be available to assist WDOE and Chelan PUD, if needed. Therefore, we conclude that establishing a separate water quality committee would provide only minimal benefit in managing aquatic resources.

**Temperature**

The maximum numeric temperature criterion for the project segment of the Columbia River is currently 18°C under EPA-approved water quality standards. WDOE adopted revisions to the water quality standards that changed the water temperature criterion to 17.5°C (as the highest average of seven consecutive daily maximum temperatures) for the Columbia River reach that includes the project (WDOE, 2005b), although EPA recently disapproved portions of WDOE's revised standard that address water temperature.[21] Under both the existing and revised criteria, allowable human-caused increases are a function of the background temperature with the maximum allowable increase over the natural water temperature being 2.8°C and the minimum allowable increase being 0.3°C above the natural water temperature, which is applicable when natural conditions cause water temperature to exceed 18°C (or 17.5°C). Ecology will propose a new set of standards to fix the deficiencies identified by EPA.

Historically, the Columbia River exceeded the 18°C criterion under natural conditions in the area that is now the project area. Data from Rock Island dam demonstrate frequent exceedances of 18°C prior to construction of any upstream hydroelectric project dams. Studies by Sylvester (1957), Davidson (1969), and EPA, as summarized by Parametrix and Rensell Associates (2001), have all shown that the Columbia River typically exceeded 18°C in August. However, the Columbia River's thermal regime changed following construction of Grand Coulee dam and other large storage reservoirs.

During development of the license application and PDEA for this project, the NSWG participated in the design and review of two studies that focused on water temperatures within the Rocky Reach reservoir: (1) a monitoring study in water year 2000 (Parametrix and Rensel Associates, 2001), and (2) a water year 2001 monitoring study along with a modeling study for water year 2000 and 2001 (Parametrix and TRPA, 2002). To better model water temperatures, the CE-QUAL-W2 model was selected and used to model water temperatures in the project reach.

In water year 2000, an extensive temperature monitoring effort was conducted to assess whether water temperature increased as water traveled through the reservoir and to assess whether there was thermal stratification within the reservoir (Parametrix and Rensel Associates, 2001; Chelan PUD, 2006b). Monitoring results indicate that little variation in water temperature in either vertical (surface-to-bottom) or lateral (shore-to-

[21] Available at: http://www.ecy.wa.gov/programs/wq/swqs/disapproval_docs/epa_disapprove_ltr.pdf

shore) directions generally occurred, although littoral stations appeared to be slightly warmer in summer than stations located in the thalweg of the reservoir. Vertical profiles of water temperatures were monitored at 10 to 11 stations along 8 transects in the morning and afternoon of September 1 and 2, 2001. Chelan PUD (2006b) reported that most transects had temperature differences ranging from 0.2 to 0.6°C in the morning and 0.8 to 2.1°C in the afternoon. Water temperatures at all Rocky Reach reservoir monitoring locations exceeded the 18°C Class A numerical criterion during late summer. Generally, differences in water temperatures in the Rocky Reach tailrace compared with the Wells dam tailrace did not exceed 0.3°C, although they did slightly exceed 0.3°C on a few days. This study was not able to distinguish if the water temperature increases through the project area were from natural warming processes or if the increases were, in part, attributable to the project's effects.

As part of developing the temperature TMDL for the Columbia River, EPA used RBM10, a dynamic one-dimensional water temperature model, to simulate water temperatures for a 30-year period. Results of this modeling indicate that generally the Columbia River temperatures increase during spring and summer at about the same rate as before construction of the hydroelectric project dams (Yearsley, 1999, as cited in Chelan PUD, 2006b). The model predicted that without reservoirs the river had much lower flows in late summer, and water temperature was much more variable in response to changes in climatic conditions. Peak water temperatures during hot weather were often higher than those that currently occur, but on average the river exceeded 18°C less of the time before the hydroelectric project dams were constructed (EPA, 2002). EPA has issued a review draft TMDL for temperature on the Columbia River. Supporting data presented by EPA at public workshops show that most of the temperature changes due to human effects are the result of large storage reservoirs. The smaller run-of-river projects, including this project, have much less effect on water temperatures.

To better define the extent of project influences on temperature increases, the NSWG reviewed the available modeling techniques and approved an intensive temperature study plan for 2001. The chosen study design included collecting temperature data adequate to support either a one-dimensional or a two-dimensional model. Because it appeared that the reservoir did not significantly thermally stratify either vertically or laterally, the NSWG approved a study plan to analyze the data collected in 2000 and 2001 using a one-dimensional model, the Stream Network Temperature (SNTEMP) model. The SNTEMP model was used to simulate Columbia River temperatures within the reservoir reach under variable conditions of flow and weather, both with and without the Rocky Reach dam and reservoir in place (Parametrix and TRPA, 2002).

Water temperatures monitored during the extremely low summer flows of 2001 indicate that the mainstem flow is generally well mixed. However, the warmest temperatures were monitored in shallow water near the shoreline and in near-surface

waters during the afternoon (Parametrix and TRPA, 2002). Longitudinal temperature differences also occurred during the summer of 2001. Data available prior to selection of the temperature model indicated little vertical or lateral stratification of the reservoir and hence supported the use of SNTEMP. However, using SNTEMP to simulate reservoir temperatures for 2001 encountered challenges that are related to the steady-state assumption of the model. The model is not capable of transferring mass or energy between time steps, so it may not accurately predict temperatures in situations where hydrological or climatic conditions are varying between time steps used (Theurer et al., 1984). Reliance on daily time steps limited the capability of the model to accurately simulate temperatures for the low flows in 2001 because the daily time step did not adequately represent the transfer of water through the reservoir.

Parametrix and TRPA Associates (2002) adapted the SNTEMP model to mitigate for the low flows in 2001 by treating the Rocky Reach reservoir as three separate stream segments. In the process of calibrating the SNTEMP model, the simulated temperatures under the measured climatic and hydrological conditions in 2001 were as expected for the upper reservoir (Beebe Bridge), but preceded the observed temperatures by 1 day at mid reservoir (Daroga Park) and by 2 days at the Rocky Reach dam. Chelan PUD applied the FloodWav model to the project reservoir in 2001 to determine water travel times. FloodWav, maintained by the National Weather Service, computes water travel times in a depth and width-averaged manner (i.e., one-dimensional, plus-time scale), predicted travel time from the Wells dam under the average 2001 study period flow of 60,000 cfs (extreme drought conditions). The resulting predicted water travel times from Wells dam were 0.44 day to Beebe Bridge, 1.56 days to Daroga Park, and 3.51 days to the Rocky Reach dam. This predicted delay in water movement within the reservoir generally matched the downstream temperature data delay recorded by the installed thermographs.

This water travel time information was then used to modify the study by segmenting the reservoir into three separate models. This effort partially compensated for the steady-state limitations of the SNTEMP model. However, even though the reservoir was segmented into three sub-reach SNTEMP models (and starting temperatures for each sub-reach used observed temperatures at their upstream boundaries), the delayed transport of warmed (or cooled) water from upstream still prevented accurate temperature simulation that would correspond to the observed temperatures on a daily basis. An additional factor may have been the increasing water volume closer to the dam (in relation to total flow) that retains heat energy with less potential for water surface/atmospheric interchange. Still, some conclusions can be drawn from the SNTEMP model study that support and expand on information developed with EPA's RBM10 model.

To assess the warming or cooling effect of the Rocky Reach reservoir on Columbia River temperatures, researchers constructed a pre-dam stream model by modifying the previously calibrated SNTEMP model. Water surface elevations, channel

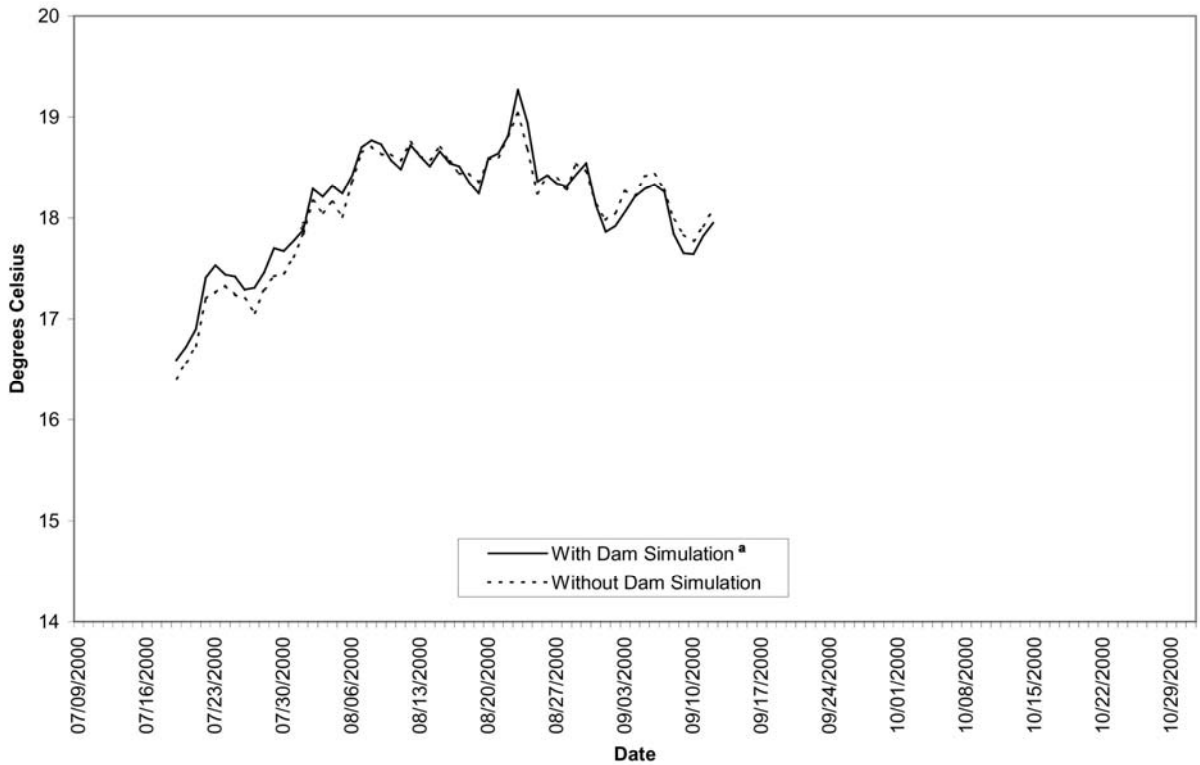
widths, and topographic shade were the key structural input data changed for the model to allow for a simulation under "natural" conditions. The without-dam model was used to simulate stream temperatures within the three study reaches using 2001 and 2000 climatic and hydrologic data. At Beebe Bridge, in both 2001 and 2000, the dam exhibited minimal influence on water temperatures. Under 2001 (drought) conditions at Daroga Park, there is more evidence that the reservoir was having a warming effect early in the summer. This effect held until late September, when simulated without-dam temperatures were warmer than with-dam temperatures. This same relationship held true under 2000 conditions (normal flow year), but the crossover occurred earlier, in early August. At the Rocky Reach dam (lower reservoir sub-reach), the same relationships held true in both years, except the magnitude of the temperature differences was amplified.

In the broadest sense, SNTEMP model results suggest that Rocky Reach reservoir causes some warming in the river during July and early August and some cooling during later August, September, and October. This seasonal effect is most apparent downstream in the reservoir near the dam, and both the magnitude and timing of the effect are influenced by river flow. Accurate quantification of the effect, however, is limited within the SNTEMP model by the delay in the reservoir's temperature response to changes in climate, particularly air temperature. The delay most likely results from the transport of warmed (or cooled) water from upstream to downstream over several days, plus the greater resistance of the large volume of impounded water to change temperature. Because the water travel time of the unimpounded river over a given distance would be less than for the reservoir, comparison of daily differences with and without the dam is not appropriate. A more reasonable estimate of change could be derived from the simulations by shifting the comparison in phase with the travel time for a given flow. Because making this type of shift would also have to account for daily changes in flow and because these changes were large in 2000 and 2001, a shift was not attempted.

The SNTEMP model results can be used to make general predictions about the relative effect of the project on water temperatures under different flows and climatic conditions. The maximum warming effect of the project would occur during a combination of low river flow, high air temperature, and greatest day length. Warming effects for all days in 2000 (a more normal water year) and on days without extremely low river flow, high air temperature, and long day lengths in 2001 were all less than for the 2001 extremes. Figures 5 and 6 show the simulated effect of the project on water temperatures under the historical climate and flow conditions (FCRPS-augmented, not natural) experienced in 2000 and 2001. Total flow in the Columbia River appears to be

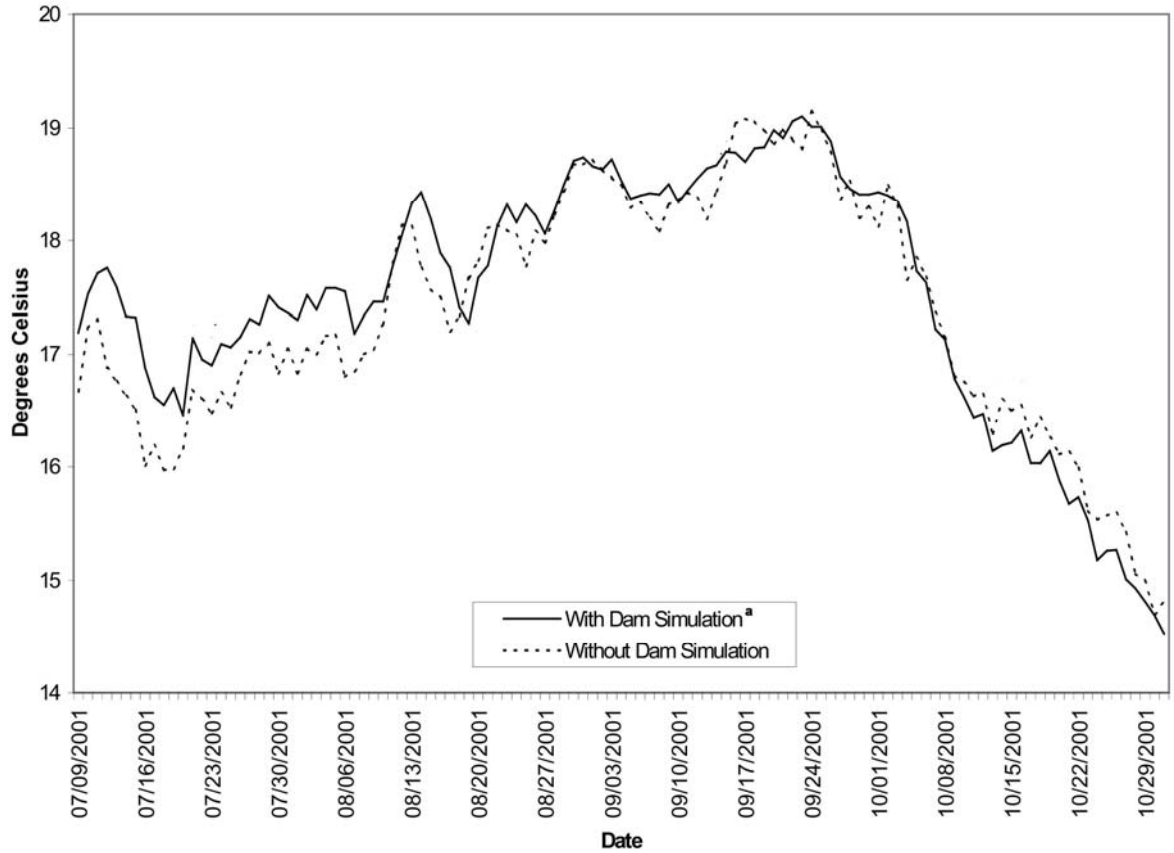
the principal factor determining the effect of the Rocky Reach dam on water temperature. The important trends to note from these model results are:

- The project had very little daily effect on water temperatures in 2000.
- Temperatures in 2001 were more affected by the project in July before the river reached its peak temperatures.
- The project had no consistent effect on the peak temperatures in August and September of 2001.
- The project contributed to accelerated cooling of water in early October, when Chinook salmon begin mainstem spawning in the Rocky Reach reservoir and the Hanford Reach of the Columbia River.




[a] The "with dam simulation" assumes historical hydrology and operations. The "without dam simulation" assumes the same hydrology, although water surface elevations, channel widths, and topographic shade were altered to compensate for the Rocky Reach dam not being in place.

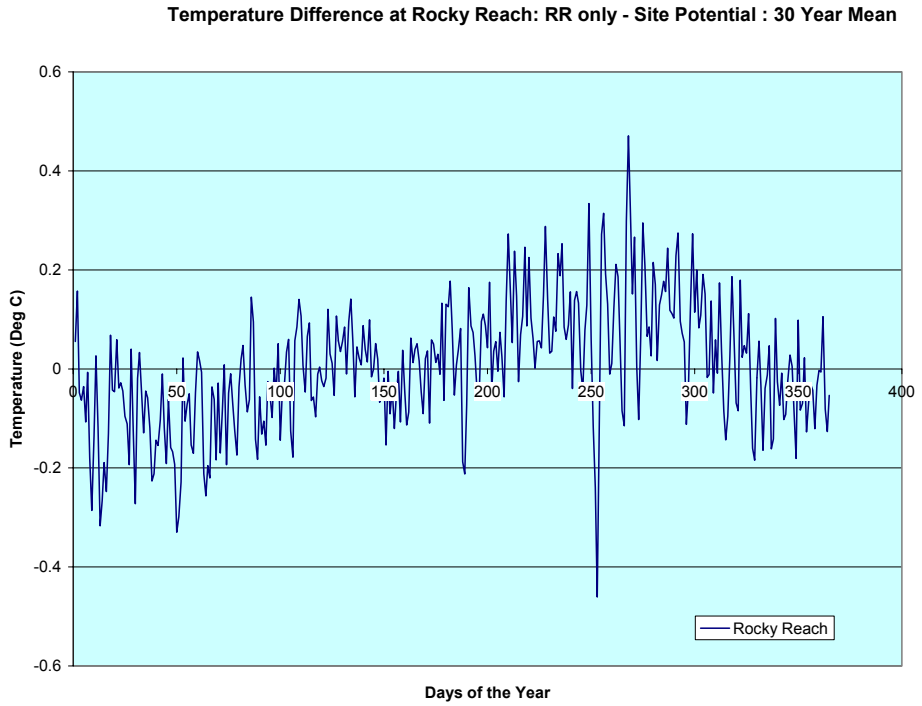
Figure 5. SNTEMP modeled Columbia River daily average water temperatures for reach 3 of the Rocky Reach Project using 2000 data. (Source: Parametrix and TRPA, 2002, as modified by staff)




[a] The "with dam simulation" assumes historical hydrology and operations. The "without dam simulation" assumes the same hydrology, although water surface elevations, channel widths, and topographic shade were altered to compensate for the Rocky Reach dam not being in place.

Figure 6. SNTEMP modeled Columbia River daily average water temperatures for reach 3 of the Rocky Reach Project using 2001 data. (Source: Parametrix and TRPA, 2002, as modified by staff)

An important difference in the predicted effect of the project on temperature exists between the EPA RBM10 model and the predictions from the SNTEMP model used by Parametrix and TRPA (2002). The RBM10 predictions, which use natural conditions as the basis for comparison (figure 7), show a continued heating or heat retention effect of the reservoir in the late summer and fall (days 230–325). In contrast, the SNTEMP modeling effort, which compares temperatures under existing conditions to the same flow regime without the Rocky Reach dam, predicted that the reservoir has a cooling effect beginning in late August. Both models are one-dimensional and thus subject to the same limitations regarding vertical and lateral differences in daily maximum stream temperatures, although SNTEMP' steady-state assumption limits its ability to simulate longitudinal differences. However, the SNTEMP model predictions by Parametrix and




[a] Comparison to a theoretical river segment with the Rocky Reach reservoir removed and all upstream dams removed.

Figure 7. RBM10 modeled effect of Rocky Reach reservoir on Columbia River water temperature, 30-year mean.[a] (Source: EPA, 2002)

TRPA (2002) used more detailed bathymetry, channel width, and shade information than was used by EPA for the RBM10 modeling. The EPA model predictions used a much broader 30-year data set of streamflow and climatic conditions, thus the RBM10 model predictions include a broader perspective of flow and climatic extremes.

To overcome some of the limitations caused by using a one-dimensional model and SNTEMP's steady-state assumptions, Chelan PUD funded development and use of a CE-QUAL-W2 model. The CE-QUAL-W2 modeling effort was done by WEST Consultants in collaboration with WDOE; Chelan PUD; a peer review group of water temperature modeling experts; and the Water Quality Technical Group, a subcommittee of stakeholders in the relicensing settlement process. Following issuance of the draft EIS, Chelan PUD released the results of the CE-QUAL-W2 model (WEST Consultants, 2005). Initially, the model was developed and calibrated using data from 2000 and 2001, and then it was used to simulate "without project" temperatures by revising the bathymetry and changing the vertical eddy viscosity formulation to represent riverine conditions. Following this, WEST Consultants used CE-QUAL-W2 to model with and without project temperatures for 2002, 2003, and 2004.

Chelan PUD (2006b) states that WDOE used existing water temperature and flow regimes entering the project's boundary as the background condition for the section 401 certification analysis of compliance with the temperature standard. To evaluate compliance with the existing water temperature standard and WDOE's 2003 revision of the temperature standard, the Commission staff used WEST Consultants' (2005) analysis of compliance with these standards, which was based on flow-weighted and volume-weighted averages of model results for with and without project conditions. The flow-weighted averages are more representative of the main body of flow moving through the project, whereas the volume-weighted averages give greater importance to areas that are not in the main flow of the river, such as the shallow areas along the margin. WEST Consultants (2005) reported that flow-weighted averages of daily maximum temperatures did not exceed the existing water temperature standard at Beebe Bridge or Daroga Park in any cases during the 5-year period of 2000 to 2004. In the forebay, flow-weighted averages exceeded the allowable increase on 20 days in the 5-year period, although only 5 of these days had increases that exceeded the allowable limits by more than the accuracy of the temperature probe (±0.2°C).

Results of comparing the volume-weighted averages to the existing water temperature standard were similar to the flow-weighted averages. During the 5-year period, allowable increases were exceeded on zero days at Beebe Bridge, 2 days at Daroga Park, and on 22 days in the forebay. Of all these exceedances of the allowable increases, only 6 days were greater than the accuracy of the temperature probe above the allowable increase. Comparison of the 7-day averages of daily maximum temperatures to the 2003 revision of the water temperature standard indicated that the allowable increase would be exceeded only on one 7-day period at the forebay for flow-weighted averages and two 7-day periods for volume-weighted averages, and all of these increases were within the accuracy of the temperature probe. In its response to comments from agencies and other intervenors, Chelan PUD stated that a statistical analysis of CE-QUAL-W2 model results shows that there is no significant ($p$ value = 0.1815) evidence Rocky Reach dam causes exceedances of temperature standards.

EPA's development of a temperature TMDL for the Columbia River from the United States/Canada border to RM 4 has been delayed to allow discussions and information exchange (EPA, 2005). The TMDL is expected to set load allocations for all dams downstream of the Canadian border on the Columbia River. Based on technical analysis made available by EPA, the project would likely receive a load allocation that is equivalent to the project's current effects on water temperature. The final load allocation will not be available until the TMDL is completed. The EPA TMDL will be accompanied by a Summary of Implementation Strategies (SIS), prepared by WDOE. The SIS will lead to a detailed implementation plan that must be completed within 1 year after the final TMDL is issued. The measures in the detailed implementation plan recommended for run-of-river dams with minor temperature effects are yet to be determined. However, the suite of potential actions is limited because these dams,

including Rocky Reach, have minimal control of Columbia River flow volumes. The SNTEMP and CE-QUAL-W2 models predict that flow is the main factor influencing temperature response in the Rocky Reach reservoir (Parametrix and TRPA, 2002; WEST Consultants, 2005). The TMDL also will include an implementation strategy for water temperature management that is being developed by WDOE and the federal agencies that control the storage reservoirs that are responsible for most of the effects on water temperatures.

In the Settlement Agreement, Chelan PUD proposes to implement the Water Quality Plan that contains measures that address project-related effects on water temperature. The plan includes the following specific actions that are supported by the WDOE.

- Monitor hourly water temperatures from April through October in the project forebay and tailrace;
- Monitor water temperature in the juvenile bypass system and upstream fishway for at least one year;
- Conduct another 5-year temperature modeling analysis to confirm compliance with numeric temperature criteria;
- Participate in EPA Region 10's development of the temperature TMDL by supplying water temperature monitoring and modeling information;
- Participate in tributary restoration, water quality planning, and tributary TMDL implementation planning for the Wenatchee and Entiat rivers; and
- Develop a 1-year sampling program to evaluate compliance of DO, water temperature, and pH in shallow water habitats of the reservoir.

As previously noted, the Umatilla Tribes recommend that the water quality standards be met throughout any new license term while achieving quantitative and qualitative performance standards and goals for salmon, Pacific lamprey, and white sturgeon, which is consistent with Chelan PUD's proposed general approach to enhancing water quality. The tribes also recommend three additional measures, indicating that Chelan PUD should: (1) contribute funding to the regional effort to evaluate temperature control or modification operations at upstream storage projects when EPA finalizes the temperature TMDL for the Columbia River, (2) collect additional temperature data, and (3) conduct infra-red imaging of the reservoir to discover localized hot spots. In comments on the draft EIS, the Umatilla Tribes recommend that temperature effects within the narrow river margin area be part of a monitoring and mitigation plan.

*Our Analysis*

As discussed above, the effect of the project on water temperature is relatively minor, compared to the large storage projects that exist upstream from the project. The project affects temperature by impounding water in the reservoir upstream of its dam, which changes the thermodynamic response of the Columbia River to ambient climatic conditions.

Results of previous water temperature modeling efforts suggest that the project has some minor warming effects during portions of the summer depending on climatic and hydrological conditions. However, the one-dimensional nature of the RBM10 and SNTEMP models and the steady-state assumption of the SNTEMP model limit the accuracy of their predictions. To more accurately predict water temperatures in the Rocky Reach reservoir and determine if the project complies with the state water quality criteria, Chelan PUD funded development and use of a CE-QUAL-W2 model. The model was developed by WEST Consultants (2005) and peer reviewed by water temperature modeling experts. Once properly calibrated, this two-dimensional hydrodynamic and water quality model was used to provide more accurate predictions of water temperatures in the reservoir and a better basis for quantifying the effects of the project on temperature. This analysis indicates that the project generally satisfies the existing water temperature standard and WDOE's 2003 revision of the water temperature standard.

Chelan PUD has considered the potential to reduce the warming effect of the Rocky Reach reservoir by increasing river flow through storage release, operating the project with the forebay drawn down to an elevation of 704 feet, selective withdrawal for powerhouse and spill flows, cooling towers, chillers, increasing shade on the reservoir through establishment of riparian vegetation, and increasing shade on the pool and weir section of the upstream fishway. Chelan PUD (2006b) determined that none of these potential options would substantially reduce the warming effects of the reservoir, and some of them were not feasible due to their conflict with the Hourly Coordination Agreement or the loss of water through evaporation.

In their justification and support for their recommendations, the Tribes request that Chelan PUD contribute funding to the regional effort to evaluate temperature control or modification operations at upstream storage projects when EPA finalizes the temperature TMDL for the Columbia River. The CE-QUAL-W2 modeling effort that was funded by Chelan PUD increased the knowledge base of the effects of the project on the thermal regime of the Columbia River and indicated that the project generally complies with the applicable water temperature state standards.

Implementation of the February 3, 2006, Water Quality Plan would include hourly water temperature monitoring in the Rocky Reach forebay and tailrace from April through October, as well as monitoring temperature in shallow-water habitats of the

Rocky Reach reservoir during an unspecified period of the year (Chelan PUD, 2006b). Chelan PUD does not specify the method that it intends to use to monitor temperature in the shallow-water areas, but it does note that it would develop a plan, in consultation with WDOE, to monitor water temperature and other water quality parameters (DO and pH) to determine if water quality criteria are satisfied in shallow-water habitats of the Rocky Reach reservoir. In their justification and support for their recommendations, the Umatilla Tribes requests that Chelan PUD conduct infra-red imaging to discover localized hot spots in the project's reservoir. We note that it would be beneficial for Chelan PUD to consider the use of infra-red technology along with other technologies to develop an adequate evaluation of whether the project complies with applicable water quality criteria in shallow-water areas of the reservoir. In addition, we note that implementation of Chelan PUD's proposed temperature monitoring as described in the February 3, 2006, Water Quality Plan alone would provide temperature data for critical periods in late summer or early fall, and would provide data necessary to support more robust modeling of the project's effects on the thermal regime of the Columbia River.

Using CE-QUAL-W2 to model water temperatures for an additional 5-year period, as described by Chelan PUD (2006b) in the February 3, 2006, Water Quality Plan, would document whether the project complies with the applicable water temperature standard in the first 5 years of any new license period. By sharing the temperature monitoring data and model with EPA, as proposed, Chelan PUD would aid EPA in the development of a temperature TMDL that would be consistent with the recommendations of Umatilla Tribes. Chelan PUD also proposes to assist with maximizing the benefit of HCP tributary projects by participating in restoration, water quality planning, and TMDL implementation for the Wenatchee and Entiat rivers.

Chelan PUD has investigated the potential for warming in the adult and juvenile fishways. From May 29 to October 21 in 2001 and from August 19 to October 17 in 2004, Chelan PUD monitored hourly water temperatures of shallow and deep source water, make-up water, and at the end of the pool and weir section (Chelan PUD, 2006b). Average differences in paired temperatures were less than 0.1ºC and the maximum difference was generally less than 0.5ºC. Based on data collected in 2004, after installation of the surface collector that results in the adult fishway being supplied with vertically mixed water from the project's forebay, Chelan PUD (2006b) reports no significant ($p$ value = 0.05) changes in temperature within the adult fishway and no evidence that the fishway concentrates warmer water from the surface of the forebay. Chelan PUD (2006b) indicates that the temperature of water in the juvenile fishway is not warmer than ambient temperatures in the Columbia River and the temperature does not increase during transit since the bypass pipe shields it from solar radiation and limits warming from warm air. To further evaluate temperatures in the adult and juvenile fishways, Chelan PUD proposes to monitor water temperatures in both fishways for one year, and review, in consultation with WDOE, the data collected in this and earlier studies to determine if further monitoring is needed. Because the existing data suggest

that temperature differences within the fishways do not form thermal barriers to fish migration, it appears that the combination of existing data and temperature data obtained for the fishways by implementing the Water Quality Plan included in the Settlement Agreement (Chelan PUD, 2006b) would provide adequate information to assess the thermal regime of the project's fish passage facilities.

*Total Dissolved Gas*

The project currently uses spill to improve juvenile fish passage survival during April through August. Chelan PUD manages these controlled spill levels with the goal of not exceeding WDOE's special fish passage condition allowance for TDG of 120 percent saturation (average of highest 12 hours per day) downstream of the tailrace and 115 percent saturation of water arriving at the forebay of Rock Island dam.[22] Spill management to meet this water quality standard is accomplished through use of spillgate sequences and spill reductions when necessary. Rocky Reach Project spills are also managed to promote adult fish passage at the Rocky Reach dam.

Studies conducted under the NMFS biological opinions (1995 and 2000) for operations of the FCRPS have shown few adverse effects on salmonid fishes migrating through and residing in the Columbia River when TDG levels are managed to stay within the levels allowed by WDOE's special fish passage condition for TDG (NMFS, 2000, 2005). NMFS (2005) reported that the prevalence of externally visible subcutaneous emphysema, a sign of GBT, in juvenile salmonids was minor when TDG was 120 to 125 percent of saturation, but was generally 10 percent or greater when TDG was greater than 125 percent of saturation. The effects of GBT in juvenile salmonids appeared to be benign, signs were minimal to nonexistent, and there was no apparent GBT-related mortality when tailrace and forebay TDG levels were maintained at no more than 120 and 115 percent of saturation, respectively (Maule et al., 1997, as cited by NMFS, 2005; letter from R. Williams, Chair, Independent Scientific Advisory Board, Portland, OR, to W. Stelle, Regional Administrator, NMFS, Portland, OR, and J. Etchart, Chair, Northwest Power Planning Council, Portland, OR, January 5, 1999). This could be partially due to juvenile salmonids residing at depth where they gain the advantage of a 10 percent reduction in the surface TDG saturation per meter of depth below the surface. Results of using depth-sensitive radio tags to track juvenile salmonids between Ice Harbor and McNary dams indicate that they tended to use depths of 1.8 to 2.5 meters (Beeman et al., 1998, as cited in NMFS, 2005). The effects of elevated TDG on adult salmonids have been studied much less than the effects on juvenile salmonids, and, as a result, they are less understood. However, monitoring of adult salmonids at Bonneville and Lower Granite dams since 1994 and intermittently at Ice Harbor and Priest Rapids dams did not

[22] Washington's numeric criteria for TDG are not applicable at flows greater than the 7-day, 10-year frequency flood, which is 252 kcfs for the Rocky Reach Project (EPA et al., 2004).

reveal signs of GBT in adult salmonids at TDG levels of 115 percent in the forebays and 120 percent in the tailraces (NMFS, 2005).

NSWG assisted in the design and review of six studies directed at better understanding the effects of the project on levels of TDG in the Columbia River and the effect on aquatic organisms downstream of the Rocky Reach dam during the annual spill season. The studies conducted for NSWG focused on two areas: (1) the effect of the project on levels of TDG in the river and how operations could minimize that effect (Parametrix, 2000a; Corps, 2003; MWH, 2003; Schneider and Wilhelms, 2005) and (2) the effects of TDG on the biological organisms inhabiting the tailrace and downstream areas (Parametrix, 2000b; Parametrix and RL&L, 2002).

*TDG Monitoring Data Analysis*

As discussed above in section 3.3.1, Chelan PUD has been monitoring TDG levels and evaluating different spill operations for their effect on TDG for many years. Addition of the fixed monitoring station downstream of the project's tailrace in 1997 provided more detailed information about the effects of different spill levels and spillgate configurations than were previously available. NSWG sought a more detailed analysis of how different operations affect TDG entrainment at the project than was available in the annual reports from the 4 years of monitoring data (1997 to 2000). The subsequent analysis of TDG and other pertinent data collected in 1997 to 2000 (Parametrix, 2000a) determined that spill at the project has a lower TDG entrainment effect than is observed at most other Columbia River projects. Parametrix (2000a) concluded:

Spill at Rocky Reach dam only produces minor increases [in] TDG levels. During the years of 1998–2000 TDG levels increased only slightly during the spill period (1–3 percent of saturation on average, range –5 percent to +15 percent). Average TDG levels during these years remained below 110 percent of saturation, although point measurements ranged from 100 percent to 120 percent of saturation. These conditions occurred with total river flows ranging from less than 100 kcfs to about 275 kcfs. Increases in TDG levels were only slightly greater at higher river flows.

In other words, even during very high river flows and spill volumes, the project did not increase TDG levels, on average, more than 3 percentage points above the TDG levels arriving at the Rocky Reach dam. In fact, at flow levels above 300 kcfs (which occurred only in 1997) the increase in TDG level between the forebay and downstream monitoring sites was less than at lower river flows (Parametrix, 2000a).

The analysis also determined that the TDG level at the DFMS, 4 miles downstream of the dam, is more influenced by the TDG level arriving at the Rocky Reach forebay than by the rate of spill at the project. During the high flow and high spill conditions in 1997, the spill at the Rocky Reach dam in many instances did not increase the TDG level above the saturation level of water arriving at the dam. The analysis did

indicate that different types of spill operations can affect the entrainment of air and resultant TDG level. Parametrix (2000a) reported that evaluations of different spill gate configurations used at Rocky Reach dam suggest that configurations using a greater number of gates tend to minimize the increases in TDG from the forebay to the tailrace. The analysis also determined that TDG levels dissipate somewhat when traveling through the Rock Island reservoir, with more reduction in TDG at lower flows than at higher flows (Parametrix, 2000a).

*Near-field Effects Study*

The near-field effects study was conducted to further explore the manner in which different spillway and powerhouse operations affect TDG entrainment (Corps, 2003). This was done by measuring TDG levels directly below the turbulent, aerated zone immediately downstream of the spillway's stilling basin and at other locations near the spillway and powerhouse. As stated in the study plan, the dissolved gas production characteristics of the existing projects must be thoroughly understood to evaluate structural and operational gas abatement alternatives. This study quantified gas transfer over a range of spillway and powerhouse operations that occurred during the 2002 spill season. The measurements were taken at various levels of spill discharge, spill pattern (gate openings), powerhouse discharge, and tailwater elevation conditions.

Based on results of the near-field study, the Corps (2003) concluded that spillway operations at the project increased TDG saturation in the Columbia River by 1.6 to 8.6 percent over levels arriving at the Rocky Reach forebay. Various spillgate configurations were tested, including the standard spill pattern (spill distributed over gates 2 through 8 with different flow rates per gate) and a uniform pattern (spill distributed evenly over gates 2 through 12). Study results indicate that the uniform spill pattern produces slightly less TDG than the standard pattern for total spills of about 50 kcfs. The entrainment of powerhouse flows into aerated spillway releases influenced TDG levels, but could be minimized by spilling at bays farther from the powerhouse (by using spill bays 2 through 12) and by maintaining a south powerhouse priority for unit operations. The current DFMS data were found to not be representative of maximum or average TDG, but the forebay monitoring site did represent TDG levels in the Columbia River arriving at the project. The Corps (2003) concluded that TDG exchange at the Rocky Reach dam is similar to TDG exchange at Lower Granite dam, which has been modified with TDG abatement structures, including spillway deflectors.

The Corps' Engineer Research Development Center (Schneider and Wilhelms, 2005) conducted an independent study to evaluate the potential to further reduce TDG during spills by implementing operational changes or making structural modifications. This evaluation consisted of a detailed technical assessment of the TDG exchange characteristics of Rocky Reach dam for current operations and nine different operational and structural TDG management alternatives, along with an evaluation of risk of injury to

juvenile salmon smolts passing through the spillways. The gas exchange processes observed during the Corps'2002 near-field study and determined from the data collected during that study served as the basis for assessing the effects on TDG.

Schneider and Wilhelms (2005) concluded that one operational and two structural alternatives would potentially reduce TDG in the river downstream of Rocky Reach dam. The operational alternative consisted of changing the spill pattern from the standard method of using gates 2 through 8 to a uniform spill from gates 2 through 12. The two structural modifications identified as potential measures for reducing TDG include the following: (1) construction of an entrainment cutoff wall that would maintain a separation between powerhouse and spillway flows, and (2) a combination of constructing spillway flow deflectors and raising the tailrace.

Limited testing of operating the project with a uniform spill from gates 2 through 12 indicates a potential reduction in the average cross-sectional TDG levels of up to 2 percent of saturation. However, Chelan PUD (2006b) states that this operation would potentially affect upstream passage of adult salmon and steelhead seeking the entrance to the upstream fishways.

Under standard operations, powerhouse discharges are directed laterally across the channel and into the path of highly aerated spillway releases. Construction of an entrainment cutoff wall could substantially reduce entrainment of powerhouse discharges into the stilling basin and overall loading of TDG immediately downstream of the dam, although it would not alter peak TDG. Schneider and Wilhelms (2005) estimated that preventing any of the flow from the powerhouse from entering the spillway would reduce average TDG by as much as 1.6 percent of saturation at a total river flow of 250 kcfs. Reductions in average TDG for smaller total river flows of 200 kcfs and 150 kcfs were estimated as 1.3 and 1.0 percent of saturation. The cutoff wall would prevent any juvenile salmonids that pass through the powerhouse from becoming entrained in the stilling basin's turbulent high TDG environment.

The combination of spillway flow deflectors and raising the tailrace channel would reduce the initial plunge of entrained air in the stilling basin and promote stripping of TDG in the tailrace channel. Schneider and Wilhelms (2005) based their evaluation of this potential measure largely on conditions at Ice Harbor dam, which has spillway deflectors on all 10 spill bays and a shallow tailrace channel. This evaluation assumes that the tailrace would be raised to an elevation of 608 feet for a distance of 300 feet downstream of the gates 2 through 12, and that the operational policy of 25 percent of the total flow being spilled would remain in effect. Resulting estimates of reduction in peak TDG for total river flows of 150 to 250 kcfs ranged from 4.0 to 4.6 percent of saturation, while corresponding estimates in the reduction of average cross-section TDG ranged from 1.6 to 1.9 percent of saturation. Schneider and Wilhelms (2005) noted that the continuous baffles and the stilling basin end sill would interfere with the deflected surface jets and could alter the trajectory and TDG exchange properties and, therefore,

extensive hydraulic model studies would be required to develop a design that would provide safe stilling action of spill, accommodate guidance of adult and juvenile salmonids, and provide effective TDG management.

*Biological Effects Studies*

Two studies were conducted to evaluate the biological effects of TDG: (1) a general overview of biological effects relative to hydroelectric projects, and (2) a field study specific to the project. The general overview of the biological effects of TDG on anadromous and resident fish is reported in *TDG Supersaturation in the Natural River Environment* by Parametrix (2000b). This report discusses the physical and biological factors that contribute to the common observation that neither anadromous nor resident fish species exhibit many symptoms of GBT in Columbia River reservoirs when TDG levels remain at or below 125 percent. Although the sampling techniques used take primarily the shallowest portion of the migrant population, which overestimates the effects on the entire population, Parametrix (2000b) concludes that natural behavior patterns and depth distribution of both anadromous salmonids and resident fish prevents a high severity of GBT from developing when TDG levels range from 110 percent to 130 percent. These results are similar to those reported for resident fish in the lower Clark Fork River (Parametrix and Avista, 2002).

Field studies of the biological effects of TDG levels in the project tailrace area were completed in 2001 and 2002 (Parametrix and RL&L, 2002, 2003). These studies focused on determining the biological effect of elevated TDG levels on resident fish (i.e., non-salmonid fishes) and benthic macroinvertebrates. Salmonids were not studied because annual GBT monitoring has been reported for sampling at Rock Island dam since the 1980s, and the FCRPS 2000 biological opinion (NMFS, 2000) has an extensive discussion of the effect of TDG levels in its appendices. Also, due to ESA-listed species present in the Rocky Reach reservoir, the sampling permit required minimal handling of any salmonids incidentally captured. Information about resident fishes is less common, and no studies of these species have been conducted in the project area since 1974.

The first year of the biological effects study occurred during the 2001 drought when there was no spill. Consequently, there were no instances of highly elevated TDG in the Columbia River that year. The information gathered in 2001 served as a good test of the study method and provided a baseline frame of reference for comparison with 2002 data. In 2002, TDG levels ranged from slightly less than 110 to 134 percent. The highest TDG levels were not caused by spill at the Rocky Reach dam, but were generated during a high-flow period that coincided with turbine maintenance outages at the upstream Wells Project. The high spill levels that occurred at the Wells Project led to TDG levels exceeding 130 percent, which is the highest TDG recorded in the Rocky Reach forebay in more than a decade.

This event provided a range of TDG levels for the biological effects study. The incidence of GBT in resident fish and benthic macroinvertebrates was very low in both 2001 and 2002 (Parametrix and RL&L, 2003). In 2001, there were no signs of GBT in the 3,777 resident fish examined, and only two cases of GBT were observed in the 7,405 macroinvertebrates examined. During the spring monitoring period of 2002 (April 19 to June 26, with TDG ranging from 103 to 127 percent), none of the 2,134 resident fish that were examined during weekly sampling events exhibited any signs of GBT, despite being collected from shallow water where the development of GBT symptoms is most likely to occur. During the summer monitoring period of 2002 (July 9 to August 21, with TDG ranging from 107 to 134 percent), 160 (18 percent) of the 866 resident fish that were examined for GBT signs exhibited GBT symptoms, primarily hemorrhages in the fins.

These symptoms were first observed on the July 9 sampling session, which occurred at the end of the week with the highest TDG levels of the season. The TDG levels from July 1 to July 8 exceeded 125 percent of saturation about 25 percent of the time that week, including 53 consecutive hours between July 2 and July 4. In addition, TDG levels between July 2 and July 3 exceeded 130 percent of saturation about 15 percent of the time, including 23 consecutive hours. Despite these high TDG levels, the GBT symptoms (predominately subcutaneous hemorrhages, mostly in fins) were low level indications of chronic, rather than acute, GBT. Hemorrhages are believed to be the result of small bubbles that produce ruptured blood vessels. Only one fish (a 3-spine stickleback) was observed with a tissue bubble.

Samples of benthic macroinvertebrates in 2002 did not show adverse effects, despite the high TDG levels. Only 2 (0.02 percent) of the 9,885 organisms (representing 111 different taxonomic groups) examined exhibited GBT symptoms. Even organisms artificially exposed to constantly elevated TDG on artificial substrates suspended for 7 days at 1 meter of depth did not develop GBT (none of the 404 organisms examined had GBT symptoms).

Chelan PUD currently submits plans and schedules for compliance to WDOE. These plans are updated periodically at the direction of WDOE and include studies and operational measures. The current version of the *Gas Abatement Schedule for Compliance* (Chelan PUD, 2004b) has been reviewed and approved by WDOE. This document lists completion of measures and studies scheduled for 2003 and activities anticipated for completion in years 2004–2008. Actions completed in 2003 included construction of the permanent juvenile fish bypass system, a review and synthesis of operational and structural methods used in TDG abatement efforts at other hydroelectric projects, and an assessment of the applicability of those structural methods to the project (MWH, 2003). Gas abatement tools identified in this document include:

1. potential reductions in voluntary spill for fish passage survival based on fish survival studies and effectiveness of the juvenile fish bypass system;

2. studies to further investigate the feasibility of optimizing the use of spill through gates 2 through 12 during times when at least 50 kcfs is spilled;
3. once the long-term need for fish survival spill is determined, development of a priority ranking for potential abatement measures for further exploration, potential modeling, and testing of specific technologies, if any are identified to be practical and feasible at the project; and
4. investigation of the feasibility and potential benefits (TDG abatement) and detriments (fish survival) of modifying the depth of the stilling basin and structure of dentates/baffle blocks in the stilling basin.

In the PDEA (Chelan PUD, 2004a), Chelan PUD indicates that it also monitors TDG levels and biological response to TDG levels and uses this information to achieve compliance with water quality standards through real-time management of spill for fish passage in accordance with the *Rocky Reach Operational Plan for Total Dissolved Gas* (an internal document for plant operators). In addition to the current process for the special fish passage condition standard, WDOE and EPA jointly prepared a TMDL for TDG that sets load allocations for compliance with TDG water quality standards for the Columbia River dams from the Canadian border to the Hanford Reach (EPA et al., 2004). The project is one of the seven dams included in this TMDL. EPA has approved this TMDL, and WDOE and the Spokane Tribe prepared a summary implementation strategy that describes proposed measures that could be used to reduce TDG levels in the Columbia River.

In the Settlement Agreement, Chelan PUD proposes to implement the Water Quality Plan (Chelan PUD, 2006b) that includes annually submitting a gas abatement plan, accompanied by an up-to-date operations plan, a fisheries management plan, physical monitoring plan, and biological monitoring plan; and conducting the following measures, which are also supported by WDOE as a party to the Settlement Agreement:

- fish passage management with the objective of maintaining as much of the spill level scheduled without exceeding the tailrace TDG numeric criteria;
- minimizing voluntary fish passage spills;
- minimizing spill due to maintenance;
- minimizing spill past unloaded turbine units caused by imbalances between upstream flow releases and projected power demand;
- maximizing powerhouse discharge;
- testing alternative spillway operations using any of the gates 2 through 12;
- conducting hourly monitoring of TDG levels in the project forebay and tailrace at the juvenile fishway outfall;

- continued monitoring of the biological effects of TDG on salmonids, resident fish, and macroinvertebrates;
- preparing a TDG compliance report in year 5 of the new license, and
- continuing efforts to comply with the numeric TDG criteria.

The Umatilla Tribes include recommendations in their 10(a) proposals that are associated with the effects of the project on TDG and GBT in aquatic organisms. As part of their March 14, 2005, 10(a) recommendation 6, the Umatilla Tribes recommend development and annual review of a detailed operations plan to best meet performance goals and objectives for salmon. The Umatilla Tribes' recommendation does not specifically mention water quality. These recommendations are consistent with Chelan PUD's proposal to submit a gas abatement plan each year, accompanied by an up-to-date operations plan, a fisheries management plan, physical monitoring plan, and biological monitoring plan.

*Our Analysis*

Measures proposed by Chelan PUD would provide for development and, when feasible and beneficial, implementation of operational and structural modifications to ensure compliance with water quality standards for TDG. Under the proposed action, Chelan PUD would conduct hourly TDG monitoring in the project's forebay and tailrace from April through August for the term of any new license or until WDOE no longer requires it. Chelan PUD's evaluation of the TDG results from this monitoring effort, along with TDG data collected at the Rock Island forebay, would document the efficacy of reducing TDG levels through operational and structural measures and determine the project's compliance with applicable TDG standards. Chelan PUD's proposed monitoring for GBT symptoms in salmonids, resident fish, and macroinvertebrates, combined with GBT data collected at the Rock Island Project, is expected to adequately document the extent and severity of adverse effects on aquatic organisms.

This effort would be closely coordinated with the HCP requirements to ensure that fish passage survival objectives are met, while still allowing the TDG abatement studies to be conducted as soon as practical. Based on WDOE's proposed conceptual approach for water quality certification (Tebb, 2005; Chelan PUD, 2006b), the water quality certification contains all the necessary requirements for meeting water quality standards, including TDG, within a 10-year period. This would include an 8-year period for adaptively developing and implementing TDG abatement measures, followed by a 2-year period to pursue other means of satisfying Washington State water quality standards. Implementation of Chelan PUD's approach of providing up-to-date operations plans annually would facilitate this adaptive approach to managing TDG and fish passage.

Chelan PUD identified operational and structural modifications that would be reasonable and feasible and would implement these measures, if necessary, to comply with water quality standards in an adaptive fashion. Using the available information, Chelan PUD has developed estimates of the effects that each of these measures would have on TDG in the project's tailrace and forebay of Rock Island dam for worst-case conditions (table 7). These estimates are based on the maximum total river flow to which the numeric criteria apply (i.e., the 7-day, 10-year frequency flood of 252 kcfs) and assuming one of the turbines is not operational.

Schneider and Wilhelms (2005) concluded that monitoring TDG at a station located near the existing juvenile fishway outfall (FOP1, near the left channel bank about 1,600 feet below the spillway) would provide representative values for the maximum TDG just downstream of the highly aerated flow below the spillways. For this reason, along with the fact that the shore-based monitoring station would be readily accessible, we conclude that monitoring TDG and temperature at this station on an hourly interval would adequately reflect Chelan PUD's proposal, which is supported by WDOE's recommendation that the tailrace monitoring station be moved upstream to the juvenile fishway outfall.

By preparing an operations plan and consulting the RR Fish Forum regarding the plan, Chelan PUD would facilitate adapting project operations to current knowledge regarding fish passage and TDG issues at the dam and thereby improve survival of fish passing the dam and reduce the incidence of GBT in aquatic organisms. As long as the state of knowledge is expanding for the effects of spill on TDG and fish passage and health, it would be useful to revise this plan annually. Revising the operations plan on an annual basis after that point may provide little additional benefit. Thereafter, Chelan PUD could continue to follow the last in the series of annually revised plans, which would continue to represent the state of knowledge.

**Oil and Hazardous Spill Prevention**

The prevention and countermeasures for spills of oil and other hazardous materials is managed by Chelan PUD through implementation of a Spill Prevention Control and Countermeasure Plan, which is approved by EPA and WDOE in accordance with 40 CFR 112. The current Spill Prevention Control and Countermeasure Plan was prepared in June 2002 and revised in 2005. The Spill Prevention Control and Countermeasure Plan specifies the management practices that are used to prevent and contain spills, both internal and external reporting requirements for spills, and a schedule for periodic review, evaluation, and revision of the Spill Prevention Control and Countermeasure Plan as necessary to incorporate improved prevention and control technology.

Table 7. Estimates of compliance with Washington State total dissolved gas standard under worst-case conditions. (Source: Chelan PUD, 2006b)

| Gas Reduction Scenarios | Estimated Date of Completion | September–March % of time TDG criterion is met at FOP1 | | April–August Tailrace Criterion: % TDG at FOP1[a] | April–August % TDG at Rocky Reach LD Transect (mixed flow)[a] | April–August Forebay criterion: % TDG at Rock Island Forebay | April–August Instantaneous: % TDG at FOP1[b] |
|---|---|---|---|---|---|---|---|
| | | *Criterion: 110%* | | *Criterion: 120%* | *Criterion: 120%* | *Criterion: 115%* | *Criterion: 125%* |
| Base conditions | Current operations | Years 1995–1999<br>93.4% (Lg. down)<br>95.4% (Sm. down)<br>94.6% (weight. avg.) | Years 2000–2004<br>99.5% (Lg. down)<br>99.6% (Sm. down)<br>99.6% (weight. avg.) | 120.3% (Sm. down)<br>120.9% (Lg. down) | 117.2% (Sm. down)<br>117.6% (Lg. down) | Averages > 115% | 0% |
| Maximum powerhouse discharge | Effective date of new license | Years 1995–1999<br>96.1% (Lg. down)<br>96.7% (Sm. down)<br>96.4% (weight. avg.) | Years 2000–2004<br>99.7% (Lg. down)<br>99.8% (Sm. down)<br>99.8% (weight. avg.) | 119.3% (Sm. down)<br>119.9% (Lg. down) | 116.7% (Sm. down)<br>117.0% (Lg. down) | Averages < 115% | 0% |
| Spill from gates 2 through 12 | Testing <1 year of high water year | Same as base condition | | Unknown, likely around 2% below base | Unknown, likely around 2% below base | Unknown, likely slightly lower than base case | 0% |
| Entrainment cutoff wall | If TDG and GBT adverse biological effect, <10 years | Same as base condition | | Same as base condition<br>120.3% (Sm. down)<br>120.9% (Lg. down) | 116.4% (Sm. down)<br>116.6% (Lg. down) | Averages <115% | 0% |
| SD&RTW | TDG and GBT adverse | Unknown, likely the same as base condition | | 116.3% (Sm. down) | 115.5% (Sm. down) | < 115% | 0% |

| | September–March % of time TDG criterion is met at FOP1 | April–August Tailrace Criterion: % TDG at FOP1[a] | April–August % TDG at Rocky Reach LD Transect (mixed flow)[a] | April–August Forebay criterion: % TDG at Rock Island Forebay | April–August Instantaneous: % TDG at FOP1[b] |
|---|---|---|---|---|---|
| biological effect<15 years | | 116.7% (Lg. down) | 115.7% (Lg. down) | | |

Notes: Worst Case Assumptions:

1. 7Q10 flow of 252 kcfs.
2. The highest discharge for base condition within turbine efficiency curve is 204 kcfs. The capacity for the turbines is approximately 17.15 and 21 kcfs for the small (units 1–7) and large (8–11) turbines, respectively. Spill under 7Q10 flow (calculated by subtracting the missing turbine capacity from the base 204 kcfs and then subtracting that quantity from the 7Q10 flow of 252 kcfs) is 65.2 and 69 kcfs for having a small and large turbine down, respectively.
3. Maximum powerhouse discharge is 212 kcfs. The capacity for the turbines is approximately 17.8 and 21.85 kcfs for the small (units 1–7) and large (8–11) turbines, respectively. Spill under 7Q10 flow is 57.8 and 61.9 kcfs for having a small and large turbine down, respectively.
4. For the purpose of the calculations forebay TDG levels never exceeds 110% from September to March or 115% from April to August, which match the forebay criteria. FOP1 is monitoring location approximately 1600 feet downstream from the dam, which is consistent with the required TMDL measurement location.

[a] Values are estimated using regressions. The TDG at FOP1 is calculated at 0.1355 times the discharge plus 111.5. The TDG at the LD transect is calculated by multiplying the TDG in the forebay by the volume of water through the powerhouse and adding to the TDG calculated in the spill times the volume of water passed through the spillgates. The TDG at LD transect is calculated by multiplying the flow by 0.1509 and adding 111.61. The values provided have a known error of ±0.6% associated with them due to the error of the regressions used to generate them.

[b] Using Schneider's regression, 99.6 kcfs of spill are required. This would require 7Q10 flow and 2 turbines down which exceeds worst case assumptions and therefore can be assumed as 0%.

Provisions for the continuation and improvement of the existing Spill Prevention Control and Countermeasure Plan are provided within the Water Quality Plan (Chelan PUD, 2006b). As specified in the Water Quality Plan, Chelan PUD proposes to continue to implement and revise the Spill Prevention Control and Countermeasure Plan. The Columbia-Snake River Spill Response Initiative is currently being developed to provide additional protection from oil spills, and Chelan PUD proposes to implement the viable portions for which it is responsible. Chelan PUD indicates that it is not certain of the scope and intent of this initiative and that Chelan PUD will request further guidance from WDOE.

In its justification and support for its March 14, 2005, 10(a) recommendation 14, the Umatilla Tribes recommend that Chelan PUD conduct daily monitoring of all dam facilities to ensure that oil, grease, and other contaminants are not leaking and entering into the river.

*Our Analysis*

The existing Spill Prevention Control and Countermeasure Plan (Chelan PUD, 2003a) fulfills the requirements of 40 CFR 112, *EPA Oil Pollution Prevention Regulations*. Under the current plan, the plant operators conduct routine visual plant inspections at least twice daily and the maintenance staff conduct thorough weekly inspections of the facilities. To continue to comply with 40 CFR 112, Chelan PUD needs to periodically review and revise the plan for the project. Continued implementation of the current inspection schedule, along with other practices implemented as components of the Spill Prevention Control and Countermeasure Plan (e.g., training personnel in appropriate notification and cleanup procedures), would continue to ensure that project spills would be identified before they could enter project waters or cause much biological harm. Implementing daily project facility inspections as recommended by the tribes would make it a little more likely that any spills would be observed earlier, although this benefit is expected to be minimal because the current monitoring plan and measures appear to be sufficient to minimize the frequency and extent of spills at the facility. Implementing relevant measures identified in the Columbia-Snake River Spill Initiative, as is being proposed by Chelan PUD, may provide further protection from oil spills.

### 3.3.3 Cumulative Effects

Water temperature is slightly influenced by the project, with the project's effect being to increase the rate of heating or cooling depending on the difference between the water temperature and ambient climatic conditions. Upstream dams influence water temperatures entering the Rocky Reach reservoir. In general, the river is cooler in the spring and early summer and warmer in the late summer and fall than would occur in the absence of the other dams. This is primarily an effect of the Grand Coulee and other upstream storage reservoirs in the United States and Canada (EPA, 2002).

The cumulative effects on TDG levels largely depend on flows through spillways and powerhouses. Generally, routing water through powerhouses does not elevate TDG levels, whereas routing water through spillways and their stilling basins can entrain air and thereby elevate TDG, depending on many different factors. Spills at upstream dams can result in elevated TDG levels in water reaching the project. The effects of the project depend on the TDG levels in water reaching the project and the extent and configuration of spills at the project. The project may result in an overall increase in the level of TDG if it is spilling water and the TDG saturation of water arriving at the project is low (generally less than 115 percent). When incoming water has higher TDG levels, the project generally causes an overall reduction in TDG unless the total river flow exceeds approximately 250 kcfs. Whether increases in TDG at the Rocky Reach tailrace result in a cumulative effect downstream of the Rock Island dam depends on the spill actions at the downstream Rock Island Project and the amount of dissipation in the Rock Island reservoir.

### 3.3.4 Unavoidable Adverse Impacts

In spite of the measures proposed by Chelan PUD and recommendations of others, the project would still result in small adverse increases in water temperature and TDG under certain conditions.

## 3.4 FISHERIES RESOURCES

### 3.4.1 Affected Environment

#### 3.4.1.1 General Description of the Fish Community and Habitats

Approximately 41 species of fish occur within the project area (from the tailwater of Wells dam to the Rocky Reach tailrace) (BioAnalysts, 2000a). Of the fish that have been identified in the project area, 15 are coldwater species, 18 are coolwater species, and 8 are warmwater species. In addition to the fish species that have been identified, it is probable that several species of sculpins (family Cottidae) also exist in the project area; however, sculpins have not been collected in the project area and are not included among the 41 species mentioned above.

Most of the 41 species are native to the project area, but 16 species have been introduced. Eleven of the 15 coldwater species and 14 of the 18 coolwater species that have been identified are native to the area (table 8). The Columbia River watershed upstream from the Rocky Reach dam supports naturally reproducing populations of Chinook and sockeye salmon and steelhead. Coho salmon were historically present, but the endemic stock was extirpated by the 1940s (Mullan, 1984).

Table 8. List of fishes that occur in the Rocky Reach Project reservoir.

| Common Name | Species | Native (N) or Introduced (I) |
|---|---|---|
| **Coldwater species** | | |
| White sturgeon | *Acipenser transmontanus* | N |
| Chinook salmon | *Oncorhynchus tshawytscha* | N |
| Coho salmon | *Oncorhynchus kisutch* | N |
| Sockeye/kokanee | *Oncorhynchus nerka* | N |
| Steelhead/rainbow | *Oncorhynchus mykiss* | N |
| Cutthroat trout | *Oncorhynchus clarki* | N |
| Brown trout | *Salmo trutta* | I |
| Atlantic salmon | *Salmo salar* | I |
| Bull trout | *Salvelinus confluentus* | N |
| Brook trout | *Salvelinus fontinalis* | I |
| Mountain whitefish | *Prosopium williamsoni* | N |
| Lake whitefish | *Coregonus clupeaformis* | I |
| Burbot | *Lota lota* | N |
| Longnose sucker | *Catostomus catostomus* | N |
| **Coolwater species** | | |
| Longnose dace | *Rhinichtys cataractae* | N |
| Peamouth | *Mylocheilus caurinus* | N |
| Chiselmouth | *Acrocheilus alutaceus* | N |
| Northern pikeminnow | *Ptychocheilus oregonensis* | N |
| Redside shiner | *Richardsonius balteatus* | N |
| Sand roller | *Percopsis transmontana* | N |
| Bridgelip sucker | *Catostomus columbianus* | N |
| Mountain sucker | *Catostomus platyrhynchus* | N |
| Largescale sucker | *Catostomus macrocheilus* | N |
| Pacific lamprey | *Lampetra tridentata* | N |
| River lamprey | *Lampetra ayresi* | N |
| Western brook lamprey | *Lampetra richardsoni* | N |
| Threespine stickleback | *Gasterosteus aculeatus* | N |
| Pumpkinseed | *Lepomis gibbosus* | I |
| Walleye | *Stizostedion vitreum* | I |
| Yellow perch | *Perca flavescens* | I |
| Smallmouth bass | *Micropterus dolomieu* | I |
| Sculpin | *Cottus species* (spp.) | N |
| **Warmwater species** | | |
| Channel catfish | *Ictalurus punctatus* | I |
| Black bullhead | *Ameiurus melas* | I |
| Brown bullhead | *Ameiurus nebulosus* | I |

| Common Name | Species | Native (N) or Introduced (I) |
|---|---|---|
| Tench | *Tinca tinca* | I |
| Common carp | *Cyprinus carpio* | I |
| Bluegill | *Lepomis macrochirus* | I |
| Black crappie | *Pomoxis nigromaculatus* | I |
| Largemouth bass | *Micropterus salmoides* | I |

The four coldwater species that have been introduced to the project area include brown trout, brook trout, lake whitefish, and Atlantic salmon. The four introduced coolwater species include pumpkinseed, walleye, yellow perch, and smallmouth bass. All warmwater species that currently exist in the project area are non-native species (table 8).

In addition to fish that currently occur naturally in the project area, some species are stocked. These fish originate from hatchery facilities that produce Chinook salmon and steelhead. Steelhead hatcheries produce a stock derived from steelhead endemic to the Upper Columbia River. Chinook salmon hatchery production is generally derived from a mixture of endemic and introduced stocks. The exception is the Wells Hatchery program, which raises summer Chinook salmon solely derived from fish that are endemic to the Upper Columbia River.

#### 3.4.1.2 Aquatic Habitat

Aquatic habitat mapping (DES, 2001a) indicated that the lower portion of the 43-mile-long reservoir from the Rocky Reach dam upstream to the Entiat River (Reach 1) consists of deep, slow-water habitat. The upper section (from Beebe Bridge upstream to Wells dam; Reach 3) has more constrictive characteristics, with higher water velocities and generally well-armored banks with bedrock, cobble and sandy soil shorelines. The middle section of the reservoir (Entiat River upstream to Beebe Bridge; Reach 2) is a transition zone between the predominantly slower-moving, deeper habitat in the lower section and the more riverine habitat in the upper section of the reservoir. The middle section includes the confluences of the Entiat River and the Lake Chelan Project tailrace with the project reservoir.

Generally, depths increase in the reservoir from upstream to downstream. The shallowest, most riverine portion of the project reservoir is found near the Wells dam tailrace, with depths increasing downstream to the Rocky Reach forebay. Substrate and cover were quantified in a 1999 study based upon a flow of 220,000 cfs (DES, 2001a). Silt was the most abundant substrate type found (25.6 percent), followed by large cobble (17.7 percent) and sand (17.4 percent). Combined, small cobble and gravels, which are important for salmonid spawning, make up 22 percent of the substrate. Boulders were

the most abundant cover type available in the reservoir, accounting for almost 90 percent of the available cover, followed by submerged aquatic vegetation and submerged terrestrial grasses.

Aquatic habitat mapping of the project area estimated the total acreage of aquatic macrophyte beds at 386 acres in 1999 (DES, 2001a). Acreages of aquatic plant communities are summarized in table 9. Non-native Eurasian watermilfoil is the most abundant aquatic plant species. Approximately one third of all the macrophyte bed acreage in the project area is vegetated by dense Eurasian watermilfoil-dominant growth. Close-leaved pondweed (*Potamegeton foliosus*) is the second most abundant species occurring throughout the project reservoir. This native species is often dominant within native plant beds as well as co-dominant within many Eurasian watermilfoil beds.

Table 9. Acreages by aquatic plant communities. (Source: DES, 2001a)

| | **Acres of Aquatic Plants[a]** | | | |
|---|---|---|---|---|
| **Description** | **Total Project Area** | **Reach 1[b]** | **Reach 2[b]** | **Reach 3[b]** |
| >90% EWM, dense | 39.63 | 11.24 | 24.75 | 3.64 |
| >90% EWM, sparse | 14.61 | 6.12 | 6.95 | 1.54 |
| Mixed 50–90% EWM, dense | 99.75 | 35.42 | 53.22 | 11.11 |
| Mixed 50–90% EWM, sparse | 23.49 | 9.34 | 7.80 | 6.35 |
| Mixed 30–50% EWM, dense | 20.38 | 0.18 | 16.48 | 3.72 |
| Mixed 30–50% EWM, sparse | 3.16 | 1.09 | 1.61 | 0.46 |
| Mixed native dominant, dense | 75.44 | 35.22 | 39.82 | 0.40 |
| Mixed native dominant, sparse | 41.52 | 19.53 | 21.99 | 0.00 |
| POCR dominant, dense | 33.60 | 12.78 | 20.44 | 0.38 |
| POCR dominant, sparse | 34.35 | 22.39 | 10.46 | 1.50 |
| **Total** | **385.93** | **153.31** | **203.52** | **29.10** |

Notes: EWM – Eurasian watermilfoil, *Myriophyllum spicatum*
POCR – curly pondweed, *Potamogeton crispus*

[a] Data are inclusive of small isolated sloughs within the project boundary that are separated by highways from the reservoir. Mouths of the Entiat and Chelan rivers are included within the project boundary. Daroga Park lagoon is not included.

[b] Reach 1 (Rocky Reach dam to Entiat River); Reach 2 (Entiat River to Beebe Bridge); Reach 3 (Beebe Bridge to Wells dam)

#### 3.4.1.3 Benthic Invertebrates

DES (2000) documented 72 different taxonomic groups of benthic macroinvertebrates among samples collected from the project area. The benthic macroinvertebrate community of the project area (from the tailwaters of Wells dam to the Rocky Reach dam) was dominated by midges (*Chironomidae*), caddisflies (*Trichoptera*), sow bugs (*Isopoda*), clams and mussels (*Bivalvia*), snails (*Gastropoda*), scuds (*Amphipoda*), water mites *(Acari*), and bristle worms (*Oligochaeta*). Combined, these taxa contribute 95 percent to the total number of animals in the samples collected.

Overall, midge larvae appear to be the most prevalent of taxa, accounting for between 21 and 92 percent of the animals at a given site. Midges are the most abundant major taxon among all the sampling sites, contributing greater than 50 percent to total numbers at nearly all sites.

DES and RL&L (2000) documented three species of bivalves and five species of gastropods within the project area. The bivalves that were identified include *Anodonta kennerlyi*, *Anodonta oregonensis*, and *Corbicula fluminea*. The gastropods that were identified include *Radix auricularia, Fossaria (B.) bulimoides cockerelli, Stagnicola (Hinkleyia) caperata, Stagnicola (S. traski)*, and *Physella (Physella) propinqua nuttalli*.

The survey found bivalves at every site except the Wells dam tailrace, and gastropods were found at seven of the 12 surveyed sites. No Washington priority or candidate species were encountered.

#### 3.4.1.4 Anadromous Fish Species

There are six species of anadromous fish that occur within the project area. These include two evolutionarily significant units (ESU) of Chinook salmon (the Upper Columbia River spring-run Chinook salmon and the Upper Columbia River summer/fall-run Chinook salmon), steelhead, coho salmon, sockeye salmon, and Pacific lamprey.

Of the two Chinook salmon ESUs, the Upper Columbia River spring-run Chinook salmon are stream-type salmon that spend a year in the rivers before migrating downstream to estuaries, where they rapidly move out to sea. The Upper Columbia River summer/fall-run Chinook salmon are ocean-type salmon that migrate downstream immediately after they emerge from the gravel and spend several weeks in the estuaries before moving out to sea (Quinn, 2005). Both forms spawn in the fall. In the Columbia River, adult Chinook salmon passing Bonneville dam before June 1 are classified as spring-run, adult Chinook salmon passing Bonneville dam between June 1 and July 31 are classified as summer-run, and adult Chinook salmon passing Bonneville dam after July 31 are classified as fall-run (FPC, 2005a).

### Upper Columbia River Spring-run Chinook Salmon

Spring Chinook salmon use the project area as a primary migration corridor during their upstream and downstream movements. Adult spring Chinook salmon pass the project dam on their way to spawning grounds in upstream tributaries, including the Entiat River, a tributary to the project reservoir (Peven, 1992). This typically occurs from late April to late June (Stuehrenberg et al., 1995), with the highest rate of passage (90 percent of all fish passed) occurring from May through the beginning of June (FPC, 1995).

Juvenile spring Chinook salmon (stream-type) that pass the project dam during their downstream migration to the ocean originate from natural spawning sites in upstream tributaries, as well as from hatchery releases. Both hatchery and naturally produced spring Chinook smolts pass the project dam in the spring, with on average, 90 percent of the spring migration (including steelhead) occurring from the last week of April through May (Chelan PUD, 2004a).

Limited observation suggests that the residence time of juvenile stream-type spring Chinook salmon in the Rocky Reach Project reservoir is no more than a few days to a week because these fish use the Columbia River only as a navigation route, not rearing habitat (Chelan PUD, 1991). Therefore, it is assumed that stream-type spring Chinook juveniles are not using the project reservoir for extended rearing, but are migrating actively while in the reservoir.

Observations of adult spring Chinook salmon passage at Rocky Reach dam are presented in figure 8.

### Upper Columbia River Summer/Fall-run Chinook Salmon

Juvenile and adult Upper Columbia River summer and fall-run Chinook salmon also use the project area as a migration corridor. Ninety percent of adult summer and fall Chinook salmon pass the Rocky Reach dam from the end of June through the middle of November (FPC, 1995). Counts of summer-run and fall-run Chinook adult passage at Rocky Reach dam are shown in figures 9 and 10, respectively. Summer and fall Chinook salmon spawn in tributaries to the Rocky Reach reservoir, including the Entiat River and the Lake Chelan Project tailrace (Giorgi, 1992; Chapman et al., 1994a). However, unlike the spring-run Chinook salmon that do not typically spawn in the mainstem Columbia River, summer/fall-run Chinook salmon spawning has been documented in the reservoirs and tailraces of the Wells and Rocky Reach dams.

Summer/fall-run Chinook salmon juveniles migrate downstream during the summer as subyearlings. Juvenile migration timing at the Rocky Reach dam is similar to juvenile passage at the downstream Rock Island dam, where 90 percent of juvenile passage occurs during June and July. The size of naturally produced juvenile

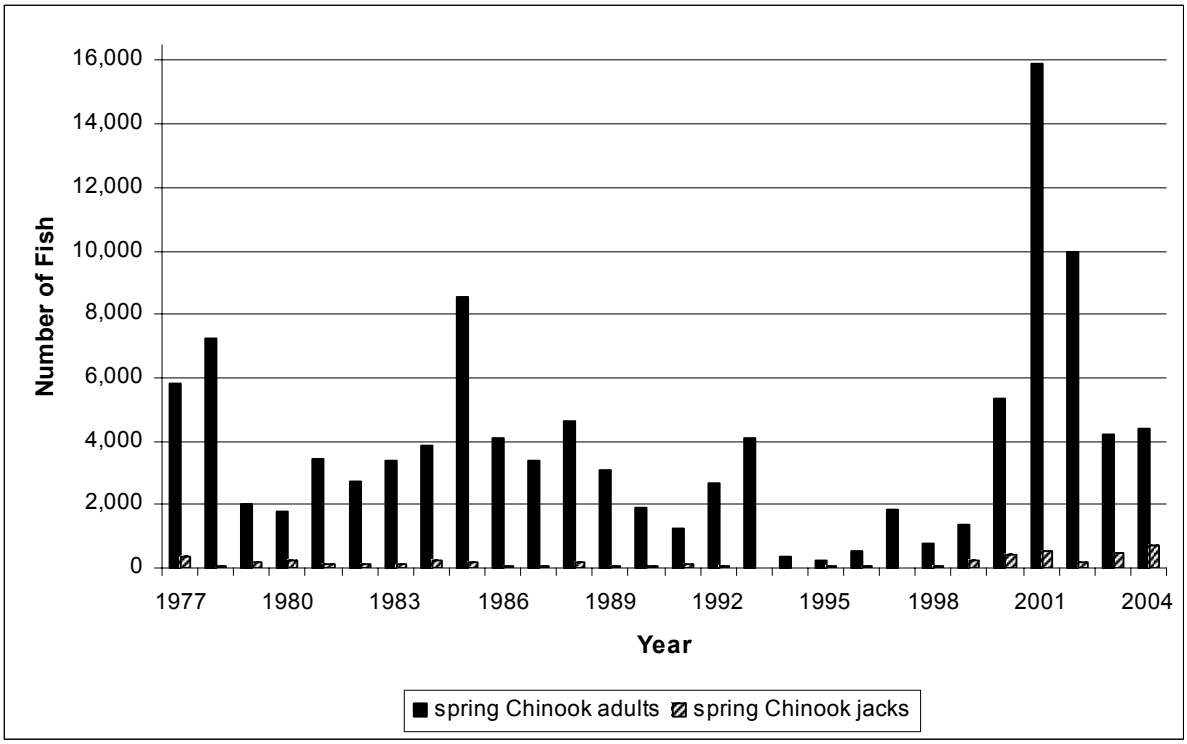



Figure 8. Spring Chinook salmon adult passage at Rocky Reach dam for years 1977–2004. (Source: FPC, 2005b)

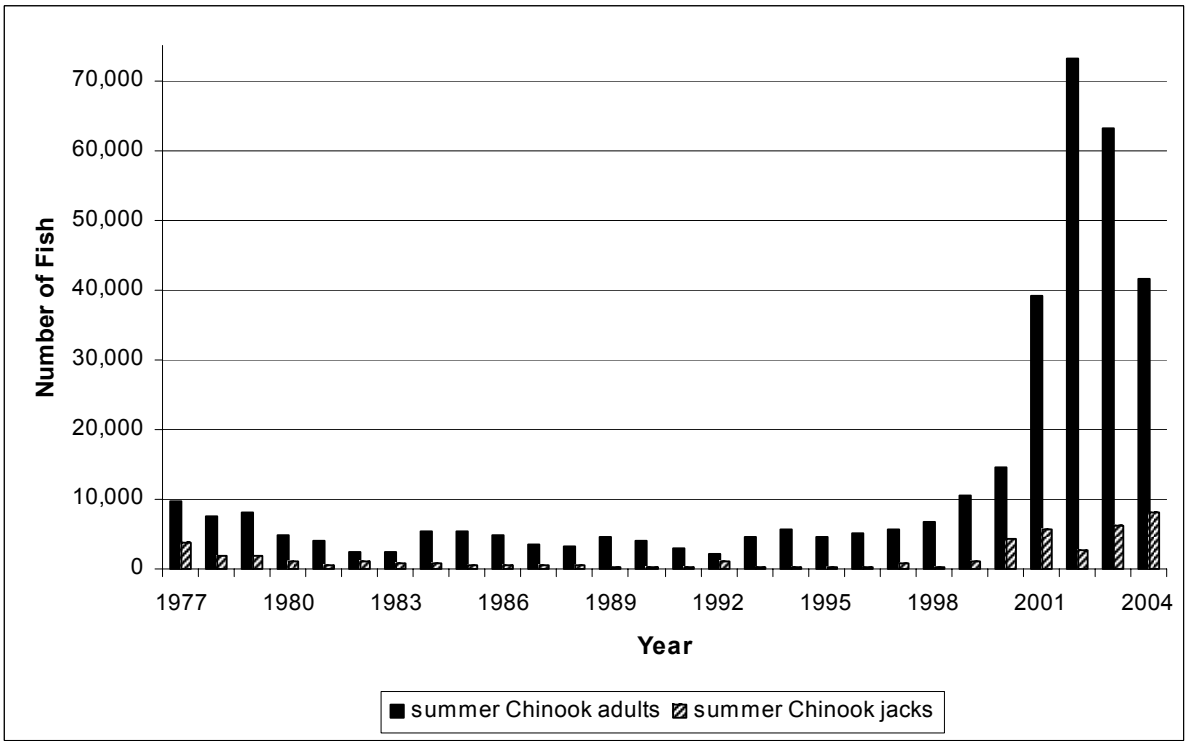



Figure 9. Summer-run Chinook salmon passage counts at Rocky Reach dam for years 1977–2004. (Source: FPC, 2005b)

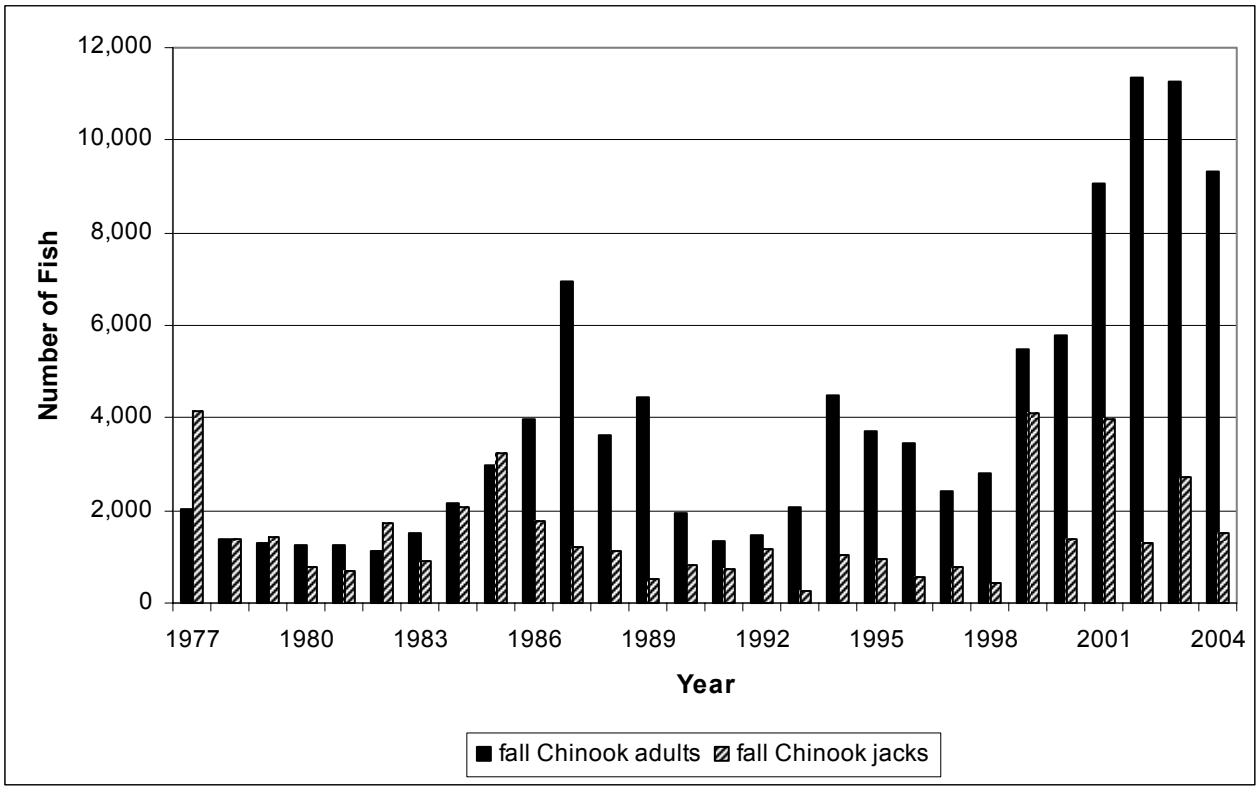



Figure 10. Fall-run Chinook salmon passage counts at Rocky Reach dam for years 1977–2004. (Source: FPC, 2005b)

summer/fall-run Chinook salmon at Rock Island dam ranges from 30 mm to 50 mm in late May/early June and increases to 80 mm to 120 mm by late July (Peven and Duree, 1990). Juvenile summer/fall-run Chinook salmon are likely to spend time rearing in the project reservoir.

**Coho Salmon**

Historically, coho salmon migrated through the project area to spawning areas in tributaries above the project, but became extinct in that area in the early 1900s (CBFWA, 2002). During the 1980s, Chelan PUD produced coho at its Turtle Rock hatchery, but adult returns were not strong enough to establish a population.

More recently, the Yakama Nation began a hatchery program using coho salmon from lower Columbia River broodstock and releasing them into the Wenatchee and Methow basins in an attempt to re-establish naturally reproducing coho salmon populations in mid-Columbia River basins. Their goal is to produce coho salmon in numbers at or near carrying capacity, which would provide opportunities for significant tribal and non-tribal harvest. Since 2000, adult passage at Rocky Reach dam has ranged from 550 to 1,628 fish (figure 11).

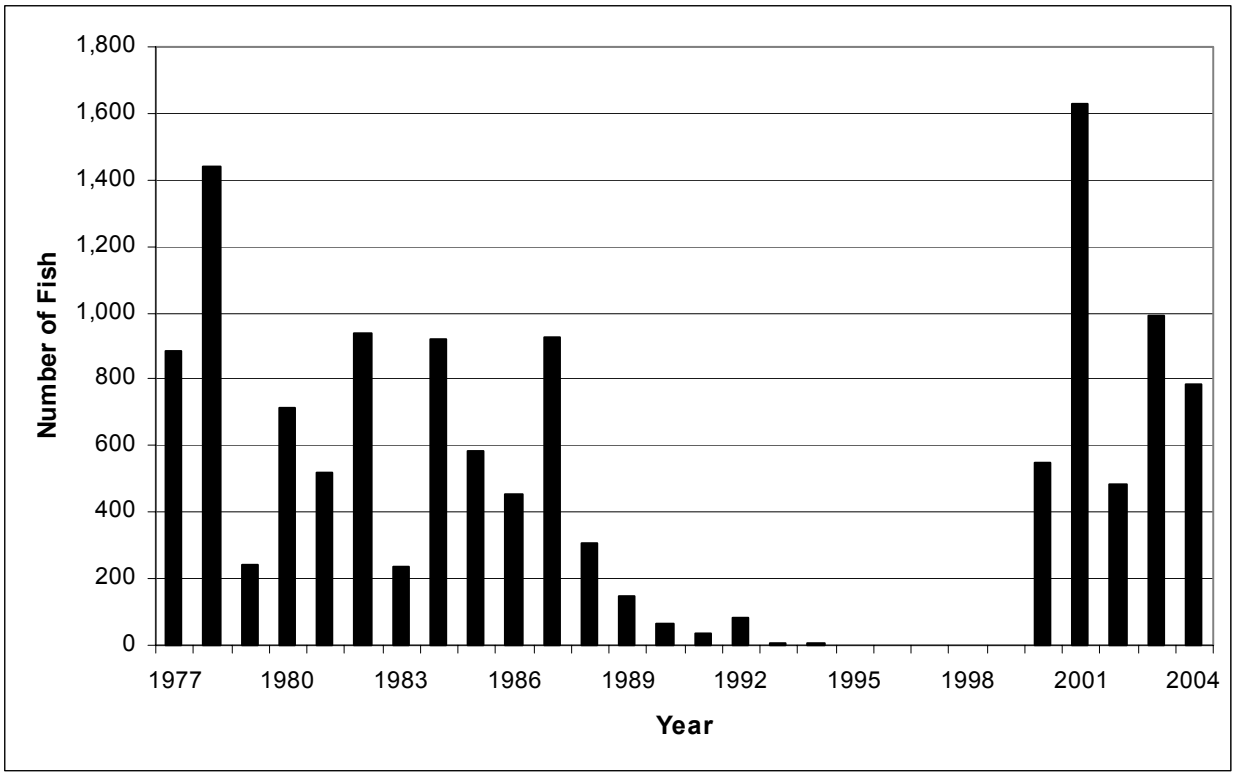



Figure 11. Coho salmon adult passage counts at Rocky Reach dam for years 1977–2004. (Source: FPC, 2005b)

**Sockeye Salmon**

Adult and juvenile sockeye salmon use the project area as a migration corridor. Adult sockeye pass the Rocky Reach dam on their way upstream to spawning grounds upstream of Lake Osoyoos on the Okanogan River. This passage typically occurs from late June through early August (FPC, 1995), with a vast majority of the adult sockeye passing the project dam in July.

Juvenile sockeye salmon that pass the project dam during their downstream migration originate from natural spawning areas upstream of Lake Osoyoos, as well as from hatchery releases. Sockeye salmon juveniles emigrating from Lake Osoyoos pass the Rocky Reach dam primarily during May (Peven et al., 1995).

Counts of adult sockeye passage at Rocky Reach dam are presented in figure 12.

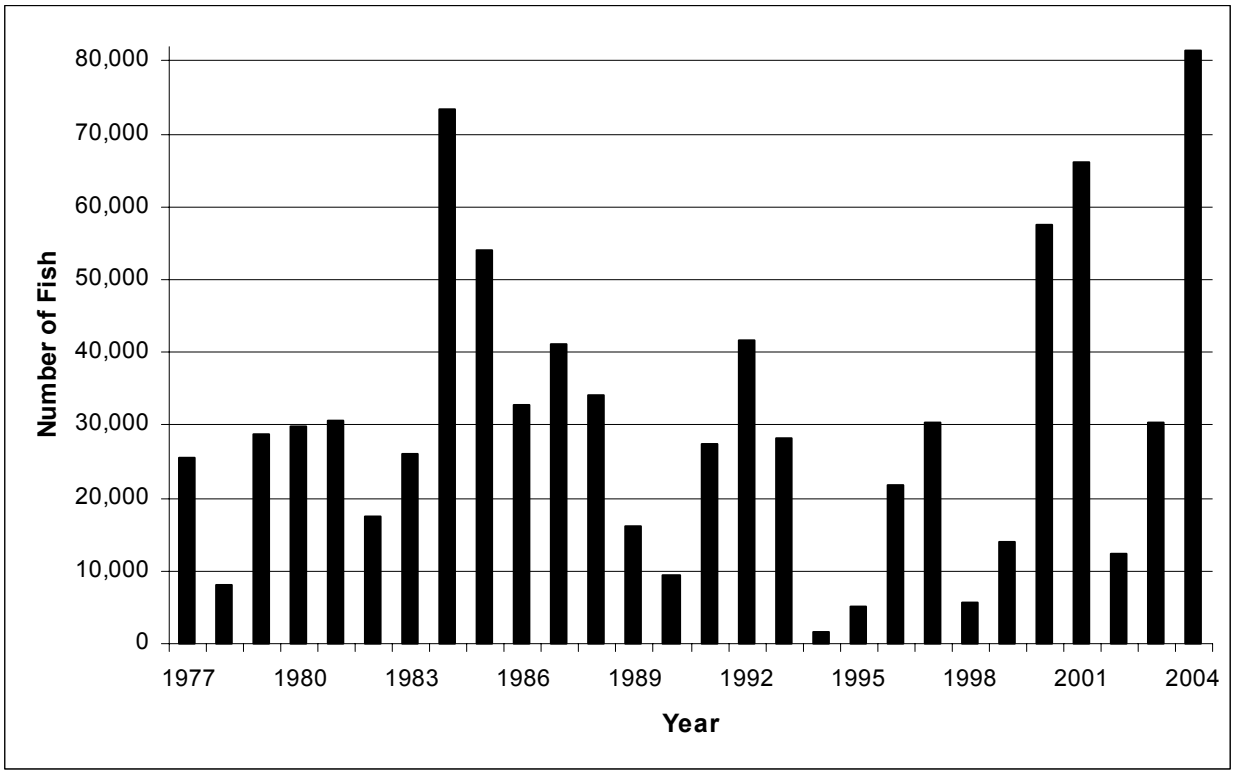



Figure 12. Sockeye salmon adult passage counts at Rocky Reach dam. (Source: FPC, 2005b)

**Upper Columbia River Steelhead**

NMFS listed the Upper Columbia River steelhead as endangered on August 18, 1997 (62 FR 43937). Juvenile and adult Upper Columbia River steelhead use the project area as a migration corridor. The majority of Upper Columbia River steelhead returning to the mid-Columbia River is of hatchery origin, but some natural production occurs in the Entiat River, a tributary to the project reservoir (Chapman et al., 1994b). Upper Columbia River steelhead adults pass the Rocky Reach dam from early July through early November (FPC, 1995). Observation of adult passage at Rocky Reach dam area presented in figure 13.

Juvenile Upper Columbia River steelhead typically rear in the fresh water tributaries for 2 to 3 years (ranging from 1 to 7 years) before migrating downstream as smolts. Hatchery smolts are released as yearlings. Both hatchery and naturally-produced steelhead pass the project dam in May (McGee, 1984; Peven et al., 1995). Juvenile steelhead, from hatchery and natural tributary origins, appear to migrate actively in the project reservoir, and residence time in the reservoir is, as for spring-run Chinook salmon, limited to a period of days (Chelan PUD, 1991).

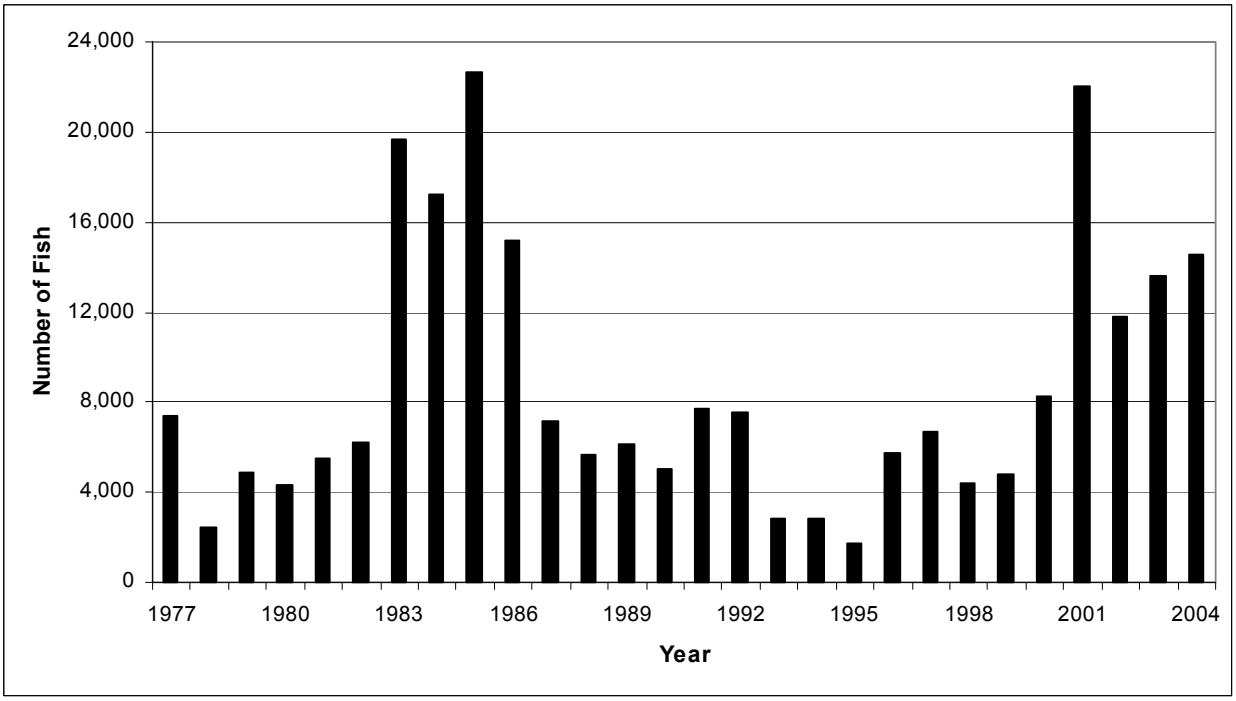



Figure 13. Steelhead adult passage counts at Rocky Reach dam for years 1977–2004. (Source: FPC, 2005b)

**Bull Trout**

Bull trout populations have been identified in the Wenatchee, Entiat, and Methow rivers, while they are thought to be extirpated from the Okanogan River. Although bull trout occur in the project area, they were probably never abundant in the mainstem mid-Columbia River (Mongillo, 1993).

The Columbia River bull trout populations were listed as threatened under ESA in June 1998 (63 FR 31647). Factors contributing to the decline of bull trout populations include overfishing, dams, forest management practices, livestock grazing, agriculture, water diversions, roads, and mining (Beschta et al., 1987; Brown, 1992). In addition, poaching and competition from non-native fish species are adversely affecting bull trout populations (Mongillo, 1993). Brook trout have replaced bull trout in South Fork Beaver Creek, a tributary of the Methow River.

Four general forms of bull trout are recognized (anadromous, adfluvial, fluvial, and resident), with each exhibiting a specific behavioral or life-history strategy (Brown, 1992; Wydoski and Whitney, 2003). Anadromous bull trout are typically found in coastal and Puget Sound river drainages, and are not found in the mid-Columbia River region (Nehlsen et al., 1991). The adfluvial form matures in lake environments and spawns in tributaries, where the young reside for one to three years. Fluvial bull trout have a similar life history, except that they move between the mainstem rivers and

smaller tributaries. Fluvial bull trout are the form most likely to be found in the project area. Resident bull trout typically spend their entire lives in smaller, high-elevation streams, apparently moving very little and seldom reaching a size larger than about 12 inches (Brown, 1994). Resident bull trout may have extensive seasonal movements or may change life-history strategies (from resident to adfluvial), depending on environmental conditions.

Observers frequently see bull trout in the adult and juvenile fish passage facilities of mid-Columbia River dams, but information is limited. Although bull trout have been enumerated by fish counters stationed in the viewing windows of fish ladders during adult salmon passage periods, counts prior to 1998 typically did not differentiate bull trout from other trout. Bull trout are observed passing the dams between April and November, with 75 to 90 percent passing during May and June. For the years 2000–2003, bull trout counts at Rocky Reach were 212, 204, 194, and 246, respectively (letter from M. Smith, Licensing and Compliance Manager, Public Utility District No. 1 of Chelan County, WA, to M.R. Salas, Federal Energy Regulatory Commission, Washington, DC, December 27, 2004).

**Pacific Lamprey**

Pacific lamprey *(Lampetra tridentate)* are a federal species of concern (SOCs) (FWS, 2004a) that occur, during their migration stages, in most tributaries to the Columbia River and in the mainstem Columbia River. They have cultural, utilitarian, and ecological significance in the basin because Native American Indian tribes have historically harvested them for subsistence, ceremonial, and medicinal purposes (BioAnalysts, 2000b). Because of their low population levels, lamprey are currently used primarily for ceremonial purposes by Columbia River tribes. As an anadromous species, Pacific lamprey also contribute marine-derived nutrients to the basin.

Little specific information is known about the life history or status of lamprey in the mid-Columbia River watersheds. Upstream migration through the project area occurs from July through November, with peak migrations observed during August. They are known to occur in the Wenatchee, Entiat and Methow rivers; however, there are no indications that they currently use the Okanogan system (BioAnalysts, 2000b). Mid-Columbia River populations of adult lamprey passing Rocky Reach dam ranged from about 1,000 to 17,000 from 1961 to 1969, then declined to less than 200 by 1976 (Mullan et al., 1986). The number of lamprey counted at Rock Island dam showed a similar decline, with counts stabilizing at about 400 per year from 1977 to 1982. However, as shown in figure 14, counts at Rocky Reach dam have increased in recent years, reaching 767 in 2000, 805 in 2001, 1,842 in 2002, 2,521 in 2003, and 1,043 in 2004 (FPC, 2005b).

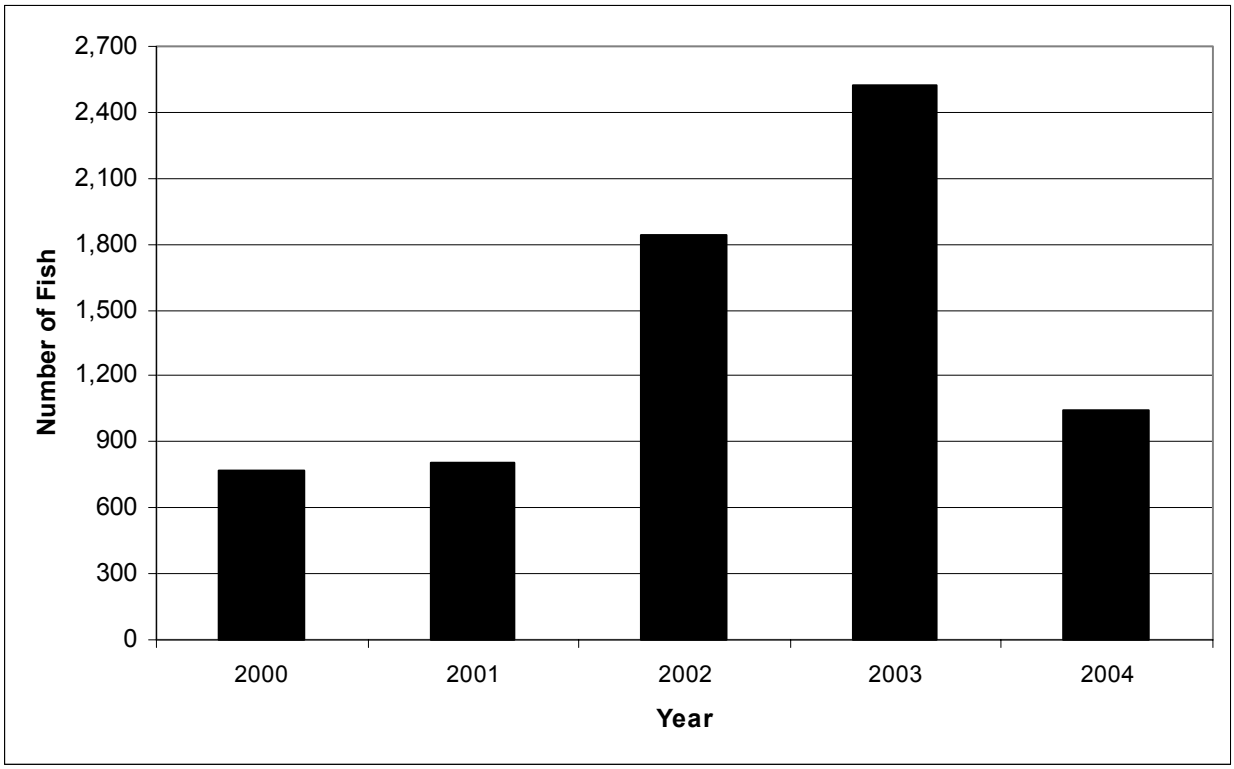



Figure 14. Lamprey adult passage counts at Rocky Reach dam for years 2000–2004. (Source: FPC, 2005b)

Benthic invertebrate studies conducted in 2002 resulted in the incidental capture of approximately 5.6 ammocoetes (juvenile lamprey) per square meter in sandy, depositional habitats within the project dam tailrace (Chelan PUD, 2004a).

#### 3.4.1.5 Resident Fish Species

The project reservoir has sufficient spawning habitat, rearing habitat and food supply to support sizeable populations of native catostomids (suckers), cyprinids (northern pikeminnow, chubs, shiners) and stickleback (Mullan et al., 1986; Dell et al., 1975; DES, 2001b). Mountain whitefish are also present, although spawning success in the reservoir is probably limited because of warm temperatures in the fall and early winter (Mullan et al., 1986). Rainbow trout are common but not abundant. Historical hatchery plantings of catchable-sized trout in the Entiat River and hatchery steelhead smolts that do not migrate to the ocean probably contribute to this population. Bull trout, federally listed as a threatened species under ESA, are present in the project area in limited numbers. Adult and juvenile white sturgeon are also present in limited numbers (RL&L, 2002).

A fish presence and habitat use study of the project reservoir found the fish species assemblage of the reservoir was dominated by non-sport fish species, which contributed

more than 99 percent to the total number of fish recorded (DES, 2001b). The major non-sport fish species included, in order of decreasing abundance, threespine stickleback, northern pikeminnow, redside shiner, sucker (various species, primarily largescale sucker), chiselmouth, and peamouth. The most abundant resident sport fish species recorded was the rainbow trout (anadromous Chinook salmon were the most abundant sport fish overall). Lesser numbers of mountain whitefish (native), and smallmouth bass (introduced) were captured. Mountain whitefish and smallmouth bass were relatively minor constituents of the sport fish population; only 10 mountain whitefish and 7 smallmouth bass were recorded, compared to 549 anadromous Chinook salmon and 62 resident rainbow trout.

Observers noted distinct spatial distribution patterns for the major fish species recorded in the reservoir with the patterns due primarily to the different physical characteristics of habitat in different sections of the reservoir. As noted in section 3.4.1.2, *Aquatic Habitat*, the lower section of the reservoir (Rocky Reach dam to the Entiat River) is lacustrine in character; it primarily supports species that prefer low-velocity habitats. The middle section of the reservoir, which includes the confluences with the Entiat and Chelan rivers, is a transition zone between the predominantly slower-moving, deeper habitat in the lower section and the riverine habitat in the upper section. The upper section of the reservoir (Beebe Bridge to Wells dam) has more constrictive characteristics, with higher water velocities.

Rainbow trout were recorded in all three sections of the Rocky Reach reservoir. However, the numbers of this species were highest in the upper section of the reservoir and declined with increasing distance downstream. Mountain whitefish and smallmouth bass were recorded only in the middle section of the reservoir.

Northern pikeminnow, redside shiner, and chiselmouth were distributed throughout the reservoir, but all of these species were most abundant in the lower section of the reservoir. The recorded numbers of these species declined with increasing distance upstream. Peamouth was also most abundant in the lower portion of the reservoir and occurred in low numbers in both the middle and upper sections of the reservoir. The abundance of threespine stickleback was greatest in the middle section of the reservoir and very low in the upper section. Suckers were distributed throughout the reservoir but were most abundant in the upper section. There was no apparent difference in the abundance of suckers between the lower and middle sections of the reservoir.

**White Sturgeon**

White sturgeon have recreational, commercial, and/or tribal importance (WDFW, 2002). They are a long-lived, primitive fish species that forages primarily along the bottom of large river systems in the Pacific Northwest. White sturgeon is the largest freshwater fish in North America and occurs throughout the U.S. portion of the Columbia River and many of its larger tributaries. Historically, white sturgeon moved throughout

the Columbia River and likely undertook extensive seasonal migrations among habitats to take advantage of scattered and seasonally available food resources (Beamesderfer et al., 1995).

Construction of hydroelectric dams on the Columbia River from 1938 to 1968 has altered white sturgeon access to habitats it previously occupied, reduced seasonal variation in habitat by controlling annual floods, and reduced habitat diversity by creating a series of reservoirs (Beamesderfer et al., 1995). It is believed that the creation of reservoirs on the Columbia River has resulted in the fragmentation of the white sturgeon population into a number of small populations, which may or may not be isolated. The population dynamics and factors regulating white sturgeon production within these reservoirs are poorly understood. Overfishing and loss of critical habitats have further affected these populations to the point where harvest fisheries are allowed only on a few relatively abundant stocks that occur in the lower Columbia River.

To gather additional information on sturgeon populations in the project reservoir, Chelan PUD commissioned a 2-year sampling program that began in 2001 (RL&L, 2002). During the course of the study, 24 white sturgeon were captured and tagged (with passive integrated transponder [PIT] tags) in the area from the Wells dam tailrace to 4 miles downstream of the Rocky Reach dam. Calculations based on the results of this study estimate that the population of white sturgeon in the Rocky Reach reservoir is approximately 50 fish, with a 95-percent confidence interval of 23 to 698 fish (Golder, 2003a). The confidence in this estimate is low due to the small number of fish marked and recaptured (n = 4) in the project reservoir.

**Northern Pikeminnow**

Northern pikeminnow (formerly northern squawfish) are a species native to the Columbia River. Northern pikeminnow are the most abundant predator species in the Columbia River System, and they account for more than 75 percent of the total catch of predator fish in the mid-Columbia River (Loch et al., 1994). They tend to concentrate in tailrace areas downstream of mainstem dams during the juvenile salmonid migration period, holding in relatively slow-moving water areas (less than about 3 feet per second) near passage routes. They also occur in tributary streams where slow-moving water occurs.

Northern pikeminnow are considered a nuisance species because they tend to prey upon desirable native and sport fish species. Since 1994, efforts have been made to remove numbers of northern pikeminnow from the project area. In 2003, the predator abatement programs resulted in the removal of 7,391 northern pikeminnow at Rock Island dam and 13,321 at the Rocky Reach dam. More than 2,568 northern pikeminnow were removed during the 2003 annual fishing derby conducted between the Rock Island and the Chief Joseph dams.

#### 3.4.1.6 Aquatic Invasive Plants

Non-native aquatic invasive plants in the project area and noxious weed SOCs in aquatic vegetation beds and emergent wetlands include curly pondweed (*Potamogeton crispus*), close-leaved pondweed (*Potamegeton foliosus*), purple loosestrife (*Lythrum salicaria*), yellow iris (*Iris pseudacorus*), and Eurasian watermilfoil (*Myriophyllum spicatum*). Eurasian watermilfoil is the most abundant aquatic plant species found in the project reservoir. Approximately one-third of all the macrophyte bed acreage in the project area is vegetated by dense Eurasian watermilfoil-dominant growth. Close-leaved pondweed is the second most abundant noxious aquatic species occurring throughout the project reservoir. This native species is often dominant within native plant beds as well as co-dominant within many Eurasian watermilfoil beds. Curly pondweed (*Potamogeton crispus*) was the third most abundant plant in the cumulative biomass samples and is likely the third most abundant plant. This species dominates approximately 19 percent of the total acreage of aquatic plant beds in the project reservoir.

Eurasian watermilfoil typically grows in areas with water depths between 4 and 12 feet. Its preferred habitat ranges from silty, sandy areas with low current to cobble areas with higher current. A typical vegetation pattern is for Eurasian watermilfoil to grow in dense beds within shallows, with a transition to curly pondweed dominance at a water depth of approximately 10 feet.

At Entiat Park, several EPA-approved aquatic herbicides have been applied in the swim beach and boat launch areas to control Eurasian watermilfoil. The designated areas were treated shortly after the weeds emerge from the sediments. This method proved to be approximately 50 to 60 percent effective in eliminating Eurasian watermilfoil in those areas (Chelan PUD, 1991). Aquatic herbicides are no longer used because there are currently no herbicides licensed for use in Washington's flowing waters.[23]

Chelan PUD has been using a harvester to reduce aquatic plant growth at selected high-use swimming areas and public boat launches. The harvester removes the vegetation but not the root mass. Because Eurasian watermilfoil can proliferate from root fragments, this method of harvesting does not eradicate this species. Harvesting is a maintenance measure and must be performed with some regularity to control Eurasian watermilfoil growth.

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[23] Rodeo™ is licensed by the U.S. Department of Agriculture for use near water, but not in flowing waters; therefore, it can be used in shoreline applications for species such as purple loosestrife but not for aquatic weeds such as Eurasian watermilfoil.

### 3.4.2 Environmental Effects

#### 3.4.2.1 Actions Covered by the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan

The HCP was the result of 10 years of deliberations between Chelan PUD, fisheries agencies, tribes, and NGOs in the region. Initial parties to the agreement include Chelan PUD, FWS, NMFS, WDFW, the Colville Tribes), and American Rivers. The HCP was incorporated into the existing license for the project on June 21, 2004. Orders implementing HCPs for the Rock Island Project and the Wells Project were issued by FERC at the same time. On July 14, 2005, the Yakama Nation filed signature pages with FERC indicating that it has become a party to the HCP agreement.

The HCP provisions apply to spring, summer, and fall Chinook salmon, sockeye salmon, coho salmon, and steelhead. As noted under the heading *Current Salmonid Fisheries Conservation Measures* in section 2.1.3.1, the goal of the HCP is to result in no net impact on the Plan Species through the implementation of a combination of mitigation tools to achieve fish passage survival rates and a virtual 100 percent survival of fish passing the project. These mitigation tools include fish passage measures for juvenile and adult Plan Species, hatchery programs, and a fund for habitat improvements.

The HCP agreement calls for establishment of an HCP Coordinating Committee composed of representatives of HCP signatory agencies. Non-signatory agencies and tribes were invited by letter to participate as non-voting members of the HCP Hatchery and Tributary committees.

The following sections discuss specific issues addressed by the HCP, including fish passage, hatchery programs for anadromous fish, and a tributary conservation program. Proposed measures to address non-Plan Species (white sturgeon, Pacific lamprey, and resident fish) are discussed under separate headings below. Proposed measures to protect bull trout are discussed in section 3.6*, Federally Listed Threatened and Endangered Species.*

**Fish Passage**

The project affects the upstream passage of adult fish and the downstream passage of juvenile and adult fish, particularly juvenile anadromous fish. Regardless of the fish passage facilities in place, some unavoidable impacts occur when fish pass the project (Mosey, 2004). Fish passage survival is an important issue for some species due to their listing under ESA or to existing low population levels.

To address anadromous fish passage under Chelan PUD's proposal, Chelan PUD would continue to implement measures described in the HCP. If the HCP terminates before the end of the license term, the provisions of the HCP call for Chelan PUD to

continue to implement the last-agreed-to measures until the Commission orders otherwise. However, FWS and NMFS have reserved authority under Section 18 of the FPA and could prescribe fishways for salmon and steelhead in the future.

As noted above, the HCP provides that no net impact on salmon and steelhead runs would be achieved on a specific schedule and maintained for the duration of the agreement. The no net impact goal has two passage components: (1) 91 percent combined juvenile and adult project survival achieved by project improvement measures implemented within the geographic area of the project; and (2) 9 percent compensation for unavoidable project mortality provided through hatchery and tributary programs, with 7 percent compensation provided through hatchery programs and 2 percent compensation provided through tributary programs.

*Downstream Passage and Project Survival*

Under Chelan PUD's proposal, it would continue implementation of elements of the HCP related to downstream passage, including modifying spill levels and operating the newly constructed juvenile fish bypass system.

The HCP is based on a survival standard of 91 percent combined juvenile and adult project survival. However, it is not currently technically feasible to measure achievement of the 91 percent goal, and measurement depends on developing new technologies that can assess natural mortality in the project area. The parties to the HCP agreed that adult passage mortality could not be distinguished from natural mortality due to other causes. They concluded that adult mortality is likely less than 2 percent and a juvenile project survival standard of 93 percent could be used to determine that the HCP survival objective has been achieved. If project survival cannot be measured, the HCP stipulates use of a juvenile dam passage survival standard of 95 percent. If juvenile dam passage survival cannot be measured, the HCP provides that Chelan PUD would calculate passage survival based on fish passage rates and survival rates through each route through the dam. The HCP relies on the juvenile fish bypass system as the primary method for increasing juvenile salmonid survival. As described in the HCP and the license application, Chelan PUD would continuously operate the juvenile bypass system from April 1 to August 31 each year to protect the juvenile fish migration.

The HCP also specifies spill as a means of increasing survival of juvenile salmonids as they pass through the project. The HCP specifies that Chelan PUD would provide spill to pass fish during a period that encompasses 95 percent of each species' downstream migration. Spill levels for 2004 through 2006 were set by the results of a 2003 juvenile fish passage efficiency (FPE) study. Under the terms of the HCP, the performance of the bypass system in 2003 in passing yearling Chinook salmon and steelhead was such that Chelan PUD is no longer required to provide spill for these species.

Spill levels would be 24 percent and 9 percent of the estimated daily average flow for sockeye and subyearling Chinook salmon, respectively. Survival studies are being conducted to assess whether Chelan PUD is meeting or exceeding its HCP survival standards, and accordingly, in 2007 and beyond, spill would supplement the bypass system as necessary to achieve the survival standards. Any modifications to the normal bypass operating period would be determined by the HCP Coordinating Committee.

*Upstream Passage*

Rocky Reach dam is equipped with a fishway with three entrances between spillway bays 8 and 9, at the center dam, and at the powerhouse service bay. Fish using these entrances follow passages to the center dam and then travel along the downstream side of the powerhouse to a fish ladder on the forebay wall. The proposed action continues use of the ladder to facilitate upstream passage for adult salmon and steelhead (as well as other fish species that use this pathway, including bull trout). The HCP establishes a survival standard for adult Plan Species that must be achieved when technology becomes available to measure adult survival. As of 2002, the HCP signatories agreed that adult fish survival cannot be conclusively measured for each Plan Species because the technology is not available to differentiate project-related mortality from natural adult losses and the parties to the HCP assumed adult mortality is less than 2 percent. Using this information, the parties agreed that Chelan PUD's achievement of the adult and juvenile survival standard of 91 percent would be determined based upon the measurement of the 93 percent juvenile project survival standard.

The HCP is to be implemented in three phases that provide for adjustments to ensure biological success. Beginning with the 2004 migration season, Chelan PUD implemented juvenile and adult operating plans and criteria to meet the survival standard and is monitoring and evaluating the results to determine compliance as part of Phase I of the HCP. Following completion of 3 years of juvenile survival studies, the HCP Coordinating Committee would determine whether the pertinent survival standard has been achieved for each Plan Species. If a standard has not been achieved for a particular Plan Species, Chelan PUD would proceed to Phase II, under which it has agreed to develop and implement additional measures to meet the pertinent survival standard. The HCP Coordinating Committee would decide on additional tools for Chelan PUD to implement to achieve the survival standard.

The HCP Coordinating Committee would select additional tools based on the likelihood of biological success, implementation time, and cost-effectiveness (if alternatives are comparable in their biological effectiveness). Chelan PUD would continue to implement Phase II until the standards are met or until the Coordinating Committee determines the standards are impossible to achieve. If the survival standard is achieved at the end of Phase I or anytime during Phase II, Chelan PUD has agreed to maintain the survival standard for the term of the HCP. Chelan PUD would proceed to

Phase III when the HCP Coordinating Committee has verified compliance with the combined adult and juvenile survival or juvenile survival standard of 93 percent; or has evaluated juvenile project survival between 91 and 93 percent; or has measured or calculated 95 percent juvenile dam passage survival. Initiating Phase III would indicate that the appropriate standard has either been achieved or is likely to have been achieved and provides additional or periodic monitoring to ensure that the survival of the Plan Species remains in compliance with the survival standards for the term of the HCP.

Under Chelan PUD's proposal, the HCP Plan Species would be continually monitored throughout the term of the license. The HCP sets a requirement for Chelan PUD to achieve the no net impact standard by 2013. If Chelan PUD fails to meet the no net impact standard in the required time frame or if the species are not rebuilding and the project is a significant factor in the failure to rebuild, the HCP agreement provides a mechanism for the fisheries parties to withdraw and pursue other legal remedies.

Furthermore, Chelan PUD would continue to meet the no net impact standard if stocks increase in the future, regardless of total numbers of Plan Species fish passing the project. In this manner, the HCP is designed to mitigate for potential project effects and would also provide for a response to regional impacts as future population levels change in accordance with the success or failure of regional actions relative to ESA or tribal recovery goals.

In letters to the Commission from NMFS, WDFW, WDOE, and the Yakama Nation (March 8, 2005, March 11, 2005, March 14, 2005 and March 14, 2005, respectively), the parties expressed their support for the continuation of HCP implementation. Interior expressed its support for HCP implementation in letters filed March 14, 2005 and June 1, 2005.

In their letter to the Commission dated March 14, 2004, the Umatilla Tribes' recommendation 2 states that Chelan PUD should be required to meet passage performance standards for salmon. Specifically these standards are: 1) direct and indirect mortality for juvenile salmonids through the project reservoir, dam, and tailrace should not exceed 8.5 percent by 2013; and 2) an 80 percent project juvenile FPE rate be achieved by 2013 and a 90 percent juvenile FPE rate be achieved by the year 2020. These goals are consistent with the Columbia River anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit* (Nez Perce et al., 1995). They also recommend that Chelan PUD assess indirect mortality and injury rates for juvenile salmon, and assess direct and indirect survival via smolt-to-adult evaluations.

The Umatilla Tribes' recommendation 3 states that Chelan PUD should meet adult salmon upstream survival rate of 97 to 98 percent by 2013, that adult fallback rates should be reduced, and that migrating steelhead kelts should achieve a "safe, timely, and effective passage standard." They base this standard on the 2000 FCRPS biological opinion.

The Umatilla Tribes' recommendation 4 states that Chelan PUD should contribute to the funding of regional evaluations of salmon stocks affected by the project. They state that it is uncertain how the Chelan PUD-proposed HCP provisions contribute to regional productivity/escapement goals for fish affected by the project, and that therefore the licensee's obligations to meeting those goals has yet to be defined.

The Umatilla Tribes' recommendation 5 states that Chelan PUD should index-test all powerhouse turbines for peak efficiency ranges and that once this range is determined, the turbines should be operated within these ranges to maximize fish passage protection.

The Umatilla Tribes' recommendation 7 state that Chelan PUD should adhere to the Hanford Reach and Hourly Coordination Agreements.

*Our Analysis*

In the final EIS for the Rocky Reach, Wells, and Rock Island HCPs, NMFS and FERC concluded that, based on their analysis for ESA-listed Upper Columbia River steelhead and Upper Columbia River spring-run Chinook salmon smolts, implementing the HCPs should provide survival levels that are greater than those actually measured in recent years at the project, and therefore implementing the HCPs would substantially increase survival rates of juvenile steelhead and spring-run Chinook salmon through the project (NMFS, 2002). NMFS and FERC also concluded that, for the unlisted Plan Species juveniles migrating through the entire HCP reach, survival should also improve compared to survival rates that were probably occurring prior to any HCP measures being implemented.

The ongoing monitoring and mitigation programs contained in the HCP would provide useful information to assess project influences on salmon stocks and other fish that pass through the dam, and through upstream and downstream passage facilities. The terms of the HCP agreement provide sufficient safeguards to ensure the passage and survival of Plan Species through the project. Furthermore, HCPs have also been incorporated into the existing licenses for the Wells and Rock Island projects, allowing for more regional collaboration than if different plans were approved for each project.

In its Master Order Granting Interventions; Approving Anadromous Fish Agreements, Settlement Agreement, and Applications to Amend Licenses; and Terminating Proceeding[24] and its Order Amending the Rocky Reach Project license[25], the Commission accepted the proposed HCP and its associated approach to attaining passage goals as described in the terms of the HCP, indicating that "the orders will serve the public interest by putting into place a long-term program to aid in the recovery of the endangered species and help to prevent other salmonids from becoming listed." The

[24] 107 FERC ¶ 61,280.
[25] 107 FERC ¶ 61,281.

Commission based its approval of the HCP on the environmental analysis presented in the final EIS (NMFS, 2002) for the HCP, with the Commission participating as a cooperating agency, and after consideration of all comments from other parties that pertained to the HCP. No new evidence or arguments have been presented that would cause us to change our previous conclusions regarding the HCP.

The Umatilla Tribes recommend adopting passage standards for juvenile and adult salmon through the entire project, with mortality defined as direct and indirect mortality. Additionally, the juvenile project survival percentage recommended by the Umatilla Tribes is lower than the juvenile project survival standard proposed by Chelan PUD, as contained in the HCP. The Umatilla Tribes do not provide any discussion of the derivation of their recommended standard or any explanation why their standard differs from the HCP standard. It is unclear how much additional benefit, if any, there would be from adopting the survival standard proposed by the Umatilla Tribe. Depending on the level of direct and indirect mortality that occurs within the project, the Umatilla standard could be more or less protective than the standard proposed by Chelan PUD and the agencies. Moreover, the HCP (and its associated survival standards) is an established plan that is working to recover small juvenile salmon such as summer Chinook salmon or fry.

In its reply comments to the Umatilla Tribes' recommendation to test and operate the powerhouse turbines to maximize fish passage protection, Chelan PUD stated that they have completed index-testing on units at Rocky Reach to identify peak efficiency ranges. Chelan PUD uses a computer program to maximize efficiency of all individual unit operation. Additionally, Chelan PUD operates units to provide maximum collection efficiency of the juvenile bypass system, thereby providing maximum fish passage protection to downstream migrating juvenile salmonids.

**Hatchery Programs for Anadromous Salmonids**

The HCP no net impact objective is a 91 percent combined adult and juvenile survival rate through the project area. The hatchery program, together with the tributary enhancement program, is intended to mitigate for the remaining 9 percent of unavoidable project mortality. The HCP agreement states that 7 percent of this compensation should be achieved through hatchery programs and 2 percent through tributary programs.

To meet its 7 percent compensation goal through hatchery programs, Chelan PUD proposes to provide funding for hatchery facilities operated and maintained by either Chelan PUD or a designated agent (such as WDFW). A Hatchery Committee, composed of voting representatives appointed by signatories to the HCP, would oversee the development, implementation, and monitoring of species-specific hatchery programs. The Hatchery Committee also would be responsible for determining periodic program adjustments in hatchery production levels and providing recommended implementation plans to Chelan PUD.

The HCP commits Chelan PUD to hatchery production goals through 2013. These production goals would be re-evaluated in 2013 and every 10 years thereafter. The hatchery program is designed to mitigate continuing effects on anadromous fish by the operation of the project.

Hatchery production goals are set for summer/fall Chinook salmon, spring Chinook salmon, steelhead and sockeye salmon. Coho salmon, which were extinct from the Upper Columbia River, are being reintroduced by the Yakama Nation (as noted in the Umatilla Tribes letter dated March 14, 2005) and would be covered by the HCP if "threshold population" levels are achieved. Because wild coho salmon are extinct in the portion of the Columbia River affected by the project, they are not protected under the ESA. Full no net impact protection as a Plan Species would be provided for coho salmon upon their successful reintroduction.

The HCP agreement stipulates that Chelan PUD spend $4,000,000 on capital improvements to hatchery facilities; $250,000 annually on HCP Hatchery Committee projects in the first 10 years of the license; and $100,000 annually in years 11 to 50 of the license. In addition, they anticipate spending $100,000 annually in the first 10 years of the license on hatchery management consultants.

As noted earlier, Interior, NMFS, WDFW, WDOE, and the Yakama Nation, in their March 2005 letters to the Commission, expressed their support for the continuation of HCP implementation.

In their March 14, 2005, letter to the Commission, the Umatilla Tribes recommend that Chelan PUD establish hatchery plans in coordination with and with the approval of a Fisheries Technical Committee, and that the plans contain state-of-the-art bioengineering and other applicable methods and standards. In their November 8, 2005 letter to the Commission, the Umatilla Tribes state that Chelan PUD needs to design and fund substantial project production facility improvements to increase the number of fish produced to mitigate for project losses and to provide for recovery of depleted populations above the project.

*Our Analysis*

Chelan PUD's proposal would compel the PUD to meet the production goals specified in the HCP. Hatchery supplementation of Plan Species would contribute fish to populations in the reservoir and mitigate for potential project-related mortality. An increase in the number of juveniles released to migrate to the ocean would potentially result in an increase in adult fish returning to the project area. Increased populations of adult fish would support Indian treaty fisheries as well as sport and commercial fisheries. Chelan PUD and representatives of the other HCP signatory parties who would make up the HCP Hatchery Committee, including NMFS, would be responsible for evaluating how to provide the most efficient and effective program for future hatchery needs to

achieve the goals stated in the HCP. This may require renovation and/or upgrades of existing facilities.

In comments on the draft EIS, the Umatilla Tribes indicate that the Pacific Salmon Treaty calls for in-kind mitigation for losses of summer Chinook salmon from project passage effects. They state that since summer Chinook salmon naturally and historically outmigrated as subyearlings, yearling fish should not be used for hatchery mitigation. The benefits of the HCP hatchery program to summer Chinook salmon was evaluated in detail in NMFS (2002). Based on this analysis, we conclude that the proposed summer Chinook salmon hatchery program would mitigate for the 7 percent unavoidable losses targeted by the HCP. However, if yearling summer Chinook salmon releases are unsuccessful, the HCP process also allows for a modification of measures.

In the final EIS recommending implementation of the HCP, NMFS stated that the existing hatchery production levels, which were based on initial inundation and ongoing losses from project operations, are "believed to be greater than actual fish passage losses " at Chelan PUD projects (NMFS, 2002). As noted previously, the Commission was a cooperating agency in preparing the final EIS for the HCP, and in its Order Amending the License of the Rocky Reach Project, determined that implementing the HCP measures is in the public interest.

The Umatilla Tribes' recommendation to implement state-of-the-art bioengineering and production methods at project facilities would potentially result in more efficient production, and could increase the number and survival of fish produced to mitigate project losses and enhance existing populations. However, no evidence has been filed with the Commission that shows that Chelan PUD is currently unable to meet its current production obligations. As stated above, in order to meet hatchery production goals required by the HCP, renovation and/or upgrade of existing facilities may be required as recommended by the HCP Hatchery Committee.

**Tributary Conservation Program**

The HCP would provide for enhancement of off-site tributary habitat used by salmon and steelhead within the mid-Columbia River Basin. Under the proposed action, Chelan PUD would annually contribute $229,800 (in 1998 dollars) to a Plan Species Account to mitigate for 2 percent of unavoidable project mortality (2 percent of the no net impact goal). A Tributary Committee composed of HCP signatories would be charged with ensuring that an appropriate number of projects are implemented upstream of the project tailrace. Alternatively, the Tributary Committee could request certain lump sum payments in lieu of annual payments. In addition, Chelan PUD would fund a tributary assessment program (not to exceed $200,000) for the purpose of monitoring and evaluating the performance of projects supported through the Tributary Conservation Plan.

As noted earlier, Interior (BLM, FWS, and NPS), NMFS, WDFW, WDOE, and the Yakama Nation, in their March 2005 letters and Interior in its June 1, 2005, letter to the Commission providing preliminary or final recommendations, terms and conditions, and prescriptions, expressed their general support for continued implementation of the HCP.

*Our Analysis*

Restoration and enhancement of tributary habitat are important components of the effort to increase access and use of habitat for impaired populations of coldwater fish species, including salmon, steelhead, resident trout, and bull trout. Viable habitat restoration projects specified in the HCP include habitat protection, flood plain rehabilitation, channel function improvement, instream flow improvement, passage provision, riparian restoration, and water quality improvement. Improving and enhancing existing habitat conditions for spawning and rearing fish would make more habitat available for spawning and rearing, thereby leading to increased production and survival of natural and hatchery-supplemented populations. According to section 7.7 of the HCP, acquisition of land or interests in land, such as conservation easements or water rights, or interests in water, such as dry year lease options, are a high priority. Additionally, project selection would be based on a unanimous vote by the Tributary Committee appointed by the signatories to the HCP. The Tributary Committee may also include expert non-voting advisors such as land and water conservancy groups.

No specific projects have been identified to date, so we are unable to make conclusions concerning site- or species-specific benefits of the proposed action. Chelan PUD states that re-establishment of shoreline riparian vegetation, flood plain continuity, and water conservation for maintenance of instream flows would be among the likely objectives of tributary habitat projects. These types of actions would improve and/or increase available spawning and rearing habitat for fish in the project area, resulting in potential increases in recruitment to existing populations. Given the collaborative structure of the HCP Tributary Committee, we are confident that the types of projects selected for funding would benefit cold-water fish species that might migrate through the project area. As noted previously, the Commission was a cooperating agency with NMFS in preparing the final EIS for the HCP, and in the Commission's Order Amending the License of the Rocky Reach Project, determined that implementing the HCP measures, including the proposed tributary conservation program, is in the public interest.

#### 3.4.2.2 White Sturgeon Populations

As part of the Settlement Agreement, Chelan PUD proposes to implement the White Sturgeon Plan that contains measures to address project-related effects on white sturgeon. The objectives of the plan are as follows: (1) increase the population of white sturgeon in the reservoir to a level commensurate with available habitat and allowing for

appropriate and reasonable harvest through a supplementation program; (2) determine the effectiveness of the supplementation program; (3) determine the carrying capacity of available habitat in the reservoir; and (4) determine natural reproduction potential in the reservoir, and adjust the supplementation program accordingly.

To achieve the plan goals, Chelan PUD proposes the following measures, which are supported by FWS and WDFW as parties to the Settlement Agreement:

1. develop a brood stock collection plan, and, if feasible, begin brood stock collection in year two of the new license;
2. implement a white sturgeon supplementation program by initially releasing up to 6,500 yearling white sturgeon into the reservoir each year for 3 years, with subsequent annual release levels to be determined by the RR Fish Forum based on monitoring results;
3. in consultation with the RR Fish Forum, by year seven, determine a long-term source of fish to be used for continuing the supplementation program throughout the term of the new license;
4. conduct an initial 3-year index monitoring for juvenile and adult sturgeon in the reservoir to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon;
5. continue index-monitoring every 3 years to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon and to direct the supplementation program strategy;
6. conduct tracking surveys of juvenile white sturgeon to determine emigration rates from the reservoir;
7. compile information on other white sturgeon supplementation programs in the region; and
8. track adult white sturgeon to identify potential spawning locations, or place egg collection mats downstream of Wells dam to evaluate spawning activity and habitat use.

The Umatilla Tribes' 10(a) recommendation 13 calls for Chelan PUD to create, fund, and implement a White Sturgeon Plan to be developed in coordination with and with the approval of a fisheries technical committee. The Umatilla Tribes express the view that Chelan PUD is responsible for contributing to the rebuilding of a pre-project population, with an ultimate goal of a harvestable surplus. More specifically, they call for a plan to work toward the goal of rebuilding white sturgeon populations to levels of "optimal productivity," providing 500 adult white sturgeon for tribal fisheries.

The Tribes request that this plan be developed and implemented in coordination with a regional work group of state, tribal, and federal managers and Chelan PUD representatives to meet project-specific mitigation goals and the overall regional goal of sturgeon recovery (from the Columbia River mouth to Grand Coulee dam and on the Snake River to Hells Canyon dam).

Steps to implement the Tribes' goals are detailed below and organized in separate implementation increments: Tier 1—immediate (years 0-5), Tier 2—short term (years 5–15), Tier 3—re-building (years 15–25), and Tier 4—long-term (years 25+). The tier elements include supplementation measures; baseline stock assessments; annual monitoring and evaluation; hosting and funding annual meetings with state, tribal, and federal fisheries representatives; and other measures.

Tier 1—Immediate (years 0-5) objectives include the following:

1. Development of permanent sturgeon supplementation facilities as called for in the Rocky Reach terms and conditions from WDFW.
2. Baseline stock assessments, spawner surveys, young-of-year surveys, and broodstock tagging.
3. Initial releases of yearling sturgeon, likely from other sources, no less than 6,500 annually, with provisions for additional fish if deemed necessary, with a percentage of them appropriately tagged to study baseline information on entrainment rates, growth, and mortality. All released fish are to be scute marked and PIT-tagged prior to release.
4. Collection of broodstock for future spawning efforts. Broodstock collection efforts to emphasize mid-Columbia reservoirs as first priority. Other locations to be determined by agency and tribal fish managers.
5. Host and fund annual monitoring and evaluation meeting with state, tribal and federal fisheries managers to present information from past year and to confirm upcoming year operations schedule.

Tier 2—Short-term (years 5–15) objectives include the following:

1. Completion of Rocky Reach hatchery facilities
2. Use of Rocky Reach white sturgeon hatchery facilities.
3. Continue stock, young-of-year, and spawning surveys on a 3-year rotation. Information on growth and survival rates to determine annual release numbers to maintain integrity of reservoir ecosystem and sturgeon growth rates.
4. Continue periodic monitoring of entrainment potential, particularly as population increases and/or water conditions vary from the norm.

5. Collect and spawn broodstock annually.
6. Evaluate stock assessment data and growth information to evaluate potential for initial fishery opportunities.
7. Host and fund annual M&E meeting with state, tribal and federal fisheries managers to present information from the past year and to confirm the upcoming year's operations schedule.
8. Cooperatively work with other regional fish managers and PUD staff to coordinate and cooperate regarding sturgeon supplementation, monitoring and evaluation, and other appropriate tasks to as pertinent. For example, coordinate on broodstock collection and spawning activities.

Tier 3—Re-building (years 15–25) objectives include the following:

1. Collect and spawn broodstock annually.
2. Initiate annual spawning and young-of-year surveys to monitor the potential recruitment of now maturing fish from initial releases. Continue periodic monitoring of entrainment potential, particularly as population increases and/or water conditions vary from the norm.
3. Continue stock, young-of-year, and spawning surveys on a 3-year rotation. Information on growth and survival rates to determine annual release numbers to maintain integrity of reservoir ecosystem and sturgeon growth rates.
4. Continued use of hatchery facilities to produce annual broods for release.
5. Implement fisheries program with commensurate monitoring on Rocky Reach Reservoir.
6. Harvest information paired with periodic (3-year rotation) stock
7. Assessments used to maintain appropriate level of broodstock recruitment to insure some level of natural spawning.
8. Cooperatively work with other PUD staff to coordinate and cooperate regarding sturgeon supplementation, monitoring and evaluation, and other appropriate tasks as pertinent. For example, coordination on broodstock collection and spawning activities.
9. Host and fund annual monitoring and evaluation meeting with state, tribal and federal fisheries managers to present information from past year and to confirm upcoming year operations schedule.

Tier 4—Long-Term (years 25+) objectives include the following:

1. Collect and spawn broodstock annually.
2. Continue stock, young-of-year, and spawning surveys on a 3-year rotation. Information on growth and survival rates to determine annual release numbers to maintain integrity of reservoir ecosystem and sturgeon growth rates.
3. Continued use of Rocky Reach hatchery facilities to produce annual broods for release.
4. Implement fisheries program with commensurate monitoring on Rocky Reach Reservoir.
5. Harvest information paired with periodic (3-year rotation) stock assessments used to maintain appropriate level of broodstock recruitment to ensure some level of natural spawning.
6. Continue annual spawning and young-of-year surveys to monitor the potential recruitment of now maturing fish from initial releases. Continue periodic monitoring of entrainment potential, particularly as population increases and/or water conditions vary from norm.
7. Continue to host and fund annual monitoring and evaluation meeting with state, tribal and federal fisheries managers to present information from past year and to confirm upcoming year operations schedule.
8. Cooperatively work with other regional fish managers and PUD staff to coordinate and cooperate regarding sturgeon supplementation, M&E, and other appropriate tasks to as pertinent. For example, coordination on broodstock collection and spawning activities.
9. Host and fund annual monitoring and evaluation meeting with state, tribal and federal fisheries managers to present information from past year and to confirm upcoming year operations schedule.

*Our Analysis*

Development of hydroelectric power generation facilities within the Columbia River Basin has adversely affected white sturgeon. White sturgeon rarely use the fish ladder at the project for upstream or downstream passage, but they do move downstream by passing through the turbines or in spill. White sturgeon have been documented to use fish ladders at lower and middle Columbia River dams for both upstream and downstream passage, but for reasons that are not understood, the use of ladders by white sturgeon is highly variable among dams, even though the ladders are similarly designed (Lepla and Chandler, 2001; Golder, 2003a).

Project effects on white sturgeon spawning and rearing in the project area are currently unknown. Based on studies completed in the reservoir, it is evident that there is some recruitment, but the total number of individuals is low (Golder, 2003a). Results of surveys for white sturgeon conducted in 2001 and 2002 in the project area indicate the population size to range between 50 to 115 fish, with uncertainties in the data projecting a maximum population of no more than 300 fish (Chelan PUD, 2006c). Critical habitats for sturgeon in the project area have yet to be identified, and sturgeon are rarely seen in the fish ladder at the project.

Although recruitment and abundance are low, it is unknown what effect these parameters have on the population, or what population size this reach of the Columbia River is capable of sustaining. In its December 27, 2004, letter containing Chelan PUD's responses to FERC's AIR, Chelan PUD indicated that substantial rearing habitat for sturgeon exists in the project reservoir. However, habitats for white sturgeon spawning have not been identified. However, habitat for white sturgeon spawning in the project area has not been identified.

The current natural recruitment of sturgeon in the reservoir appears to be too low to maintain a healthy population of sturgeon in the project area. The White Sturgeon Plan's measures to increase numbers of juveniles through supplementation of 6,500 juveniles in the first 3 years after the license is issued would potentially lead to an increase in reservoir populations as these juveniles mature. The monitoring and evaluation programs described in the White Sturgeon Plan would provide information that would contribute to the success of the supplementation program and help to evaluate what supplementation levels may be necessary to achieve the plan goals. The tracking surveys proposed in the White Sturgeon Plan would provide information on emigration rates from the reservoir. Tracking adult sturgeon may provide information on habitat utilization and spawning areas in the reservoir.

The Umatilla Tribes' letter describes measures that should be included in the White Sturgeon Plan to address the data uncertainties in a comprehensive manner. Such a White Sturgeon Plan would benefit white sturgeon populations by potentially providing information that would aid in the development of actions that could be used to increase populations in the project area or minimize adverse project effects. Some of the Tribes' recommended measures listed above are specific measures designed to achieve the same objective as Chelan PUD's proposal and WDFW's recommendations.

Construction of a hatchery facility for white sturgeon would provide Chelan PUD with a dedicated source for white sturgeon broodstock, thereby potentially increasing the availability of broodstock for use in the supplementation program. The availability of broodstock is a critical component of the success of the population rebuilding efforts, because it would provide juveniles that would recruit to the population in the reservoir.

Implementation of the Umatilla Tribes' proposed measures would potentially increase existing populations of white sturgeon in the reservoir. The Tribes' Tier 1 measures are similar to the Settlement Agreement's White Sturgeon Plan in that they call for initial supplementation releases of up to 6,500 tagged fish, and describe specific monitoring actions that would provide information on the success of the supplementation program. By monitoring through PIT tagging and scute marking, subsequent growth, entrainment, and mortality studies could help identify factors that influence the survival of the introduced sturgeon. With this information, managers could more effectively tailor the supplementation program to increase the survival of the introduced sturgeon, thereby increasing the survival of hatchery populations in the reservoir over the long term.

Tier 2, 3, and 4 measures would continue to provide managers with information that could be used to better manage hatchery releases, thereby potentially increasing recruitment to the population of sturgeon in the reservoir. A sustainable increase in reservoir populations of white sturgeon could ultimately lead to the implementation of a harvest program on the reservoir stock.

The White Sturgeon Plan's stated objective, and the Umatilla Tribes' recommendation, seek to increase sturgeon abundance in the reservoir to a level commensurate with available habitat and that would allow for white sturgeon harvest. While this may be a reasonable fisheries management goal, it appears to be unrelated to the magnitude of project effects on the resource. With respect to relicensing the Rocky Reach Project, it would be more appropriate to establish goals for the White Sturgeon Plan that include identifying and quantifying the project's effects on the resource while simultaneously developing and implementing measures to mitigate for these effects. Many of the actions contained in the White Sturgeon Plan would be useful in identifying project effects or appropriate mitigation measures; however, the overall goal goes beyond addressing the effects of continued O&M of the Rocky Reach Project on white sturgeon.

#### 3.4.2.3 Pacific Lamprey Populations

As part of the Settlement Agreement, Chelan PUD proposes to implement the Pacific Lamprey Plan with the goals of providing safe, timely, and effective passage for adult and juvenile Pacific lamprey, and implementing protection, mitigation, and enhancement (PME) measures that result in no net impacts to the population.

To achieve the Pacific Lamprey Plan goals, Chelan PUD proposes the following measures, which are also supported by parties to the Settlement Agreement:

1. Continue to provide upstream and downstream passage for Pacific lamprey through the project's upstream fishway and downstream bypass, in accordance with the operation criteria for anadromous salmonids and compatible bull trout migration guidelines;

2. Conduct annual upstream fishway passage counts of adult Pacific lamprey;
3. Complete a literature review for the effectiveness of lamprey passage measures implemented at other hydroelectric projects in the Columbia and Snake rivers;
4. Investigate and implement appropriate and reasonable upstream fishway modifications to provide safe, timely and effective volitional Pacific lamprey passage;
5. Implement a monitoring program, such as through the use of radio telemetry or other appropriate methods, to evaluate fishway modifications;
6. Develop a plan and implement appropriate and reasonable measures to address ongoing project effects on downstream adult passage that are identified through the monitoring program;
7. Once adult upstream passage success has been achieved, conduct radio telemetry monitoring every 10 years to confirm the success of any modifications;
8. Monitor juvenile Pacific lamprey impingement and implement appropriate and reasonable measures to address ongoing project-related effects, if any;
9. Measure the type and magnitude of any ongoing project impacts on the downstream passage of juvenile lamprey, using appropriate and reasonable methodologies
10. Determine juvenile Pacific lamprey presence/absence and relative abundance in the reservoir; and
11. Compile information on Pacific lamprey distribution, population status and trends, as well as juvenile downstream migration timing, to identify and implement appropriate measures to address unavoidable impacts to achieve no net impact.

The Umatilla Tribes' 10(a) recommendation 10 states that Chelan PUD should be required to make structural and operational modifications to the project to improve the downstream passage of lamprey. They recommend that Chelan PUD monitor passing lamprey and evaluate delayed mortality by monitoring lamprey, including locations outside the project boundary (i.e., in tributary streams where spawning and holding occurs). They also recommend that Chelan PUD develop operations and maintenance procedures to avoid lamprey effects from such practices as fishway dewatering.

The Umatilla Tribes' 10(a) recommendation 11 states that regional fisheries managers are currently working to develop downstream passage performance standards for juvenile Pacific lamprey. Once such standards are established, the Tribes indicate that Chelan PUD should be required to meet the standards at the project. For upstream passage of adult lamprey, the Tribes recommend that Chelan PUD meet a quantitative

passage goal of 80 percent passage in a 24-hour period by 2013 and a long-term passage goal of 97 percent to 98 percent by 2020. In addition, the Tribes recommend that Chelan assess indirect morality and injury rates for Pacific lamprey; however, they acknowledge that methods to evaluate juvenile lamprey passage and survival are still under regional development. The Umatilla Tribes state in their letter that they will continue to work with Chelan PUD to identify operational and structural modifications to improve fish passage and reduce lamprey mortality

The Umatilla Tribes' 10(a) recommendation 12 states that Chelan PUD should refine, fund, and implement actions in a Lamprey Passage Plan that would help move the project toward meeting qualitative and quantitative performance goals for juvenile and adult lamprey passage. The plan should ensure safe, timely and effective passage for juvenile and adult lamprey: assess and reduce project mortality from passage and habitat loss: and commit to attaining "sustainable, healthy and harvestable levels" of lampreys through cooperation and participation with regional lamprey recovery efforts. The Tribes state that the goal of the PME measures in the Plan should be no net effect of the project on Pacific lamprey. In working toward the no net effect goal, they indicate that Chelan PUD should (1) ensure safe timely and effective passage for juvenile and adult lamprey, (2) assess and reduce injury and/or mortality on Pacific lamprey populations from passage through the project and to mitigate appropriately for passage and habitat losses so there is no net effect on these populations from the configuration and operation of the project, and (3) commit to assist rebuilding these populations to sustainable, healthy and harvestable levels through cooperation and participation with regional lamprey recovery efforts. Specifically, the Tribes request that Chelan PUD:

- Determine discrete and cumulative impacts of the Rocky Reach Project on lamprey populations,
- Identify species/stocks for lamprey in Project area (this includes determination of anadromous/resident and parasitic/non-parasitic forms),
- Develop structures and project operations at Rocky Reach to facilitate juvenile and adult lamprey safe, timely and effective passage at rates similar to the best found in the basin,
- Ensure that structural and/or operational measures to promote safe and efficient salmon passage do not compromise lamprey passage,
- Investigate opportunities for supplementing lamprey populations through hatchery facilities and programs,
- Determine water quality effects of hydro projects on lamprey populations and implement actions to reduce these effects, and
- Evaluate tributary habitat conditions for potential off-site mitigation that will contribute to survival of spawning adults and rearing juvenile lamprey.

The Tribes recommend that Chelan PUD implement Tier 1 and 2 actions of the Lamprey Passage Plan as noted below and subsequently evaluate upstream passage effectiveness of lamprey at the project. If evaluations indicate that passage effectiveness does not meet the site-specific short term performance goal of 80 percent passage through the dam within a median time of 24 hours, the Tribes recommend that Chelan PUD implement Tier 3. In the Tribes' view, the ultimate objective of the plan should be safe, timely, effective, and volitional lamprey passage at all passage routes.

Chelan PUD would complete all Tier 1 tasks within 2 years of the effective date of the new license in consultation and with approval of the Fisheries Technical Committee. These tasks include modeling and design work, environmental measures, and monitoring and evaluations.

Chelan PUD would complete modeling and conceptual design work for passage structures at the dam to determine the most appropriate designs for improving upstream lamprey passage. These designs should be incorporated into the fish ladder and juvenile salmon bypass system and dam for adult lamprey that fallback over the dam.

Chelan PUD would complete all Tier 1 environmental measures to improve passage conditions for lamprey at the project after developing appropriate plans or designs in consultation with the Fisheries Technical Committee.

1. Based upon information from the existing adult radio-telemetry study and information from Corps' passage work at Bonneville dam, examine and incorporate successful techniques for improving lamprey passage such as, but not limited to, plating over grates, improving orifices for passage, rounding sharp edges, constructing rest areas in front of submerged orifices, reducing diffuser grating spacings, and providing collection devices for adults.
2. Conduct more detailed adult radio telemetry studies to determine where lamprey are moving through the fishway and where they are being lost. Information from the current adult telemetry study indicates that over 90 percent of the adults enter the ladder, but only 55 percent of those that enter the ladder successfully exit the ladder. Ladder entrance conditions such as whether the ladders are blocked with debris shall be evaluated. Chelan PUD shall conduct additional radio telemetry studies after structural modifications to the fishway have been implemented to assess post improvement passage.
3. Conduct a hydraulic study of the fish ladder with specific transects to examine fishway entrance conditions, and examine in detail velocities in different sections of the fishway. Results of the study would be used to implement modifications to the fishway to facilitate lamprey passage.
4. Experiment with project operations such as reducing fishway flows and velocities during nighttime hours when salmon do not pass ladders.

5. Fund and conduct an investigation of lamprey passage barriers with regional experts during the 2005–2006 adult ladder dewatering period.
6. Conduct post-adult telemetry evaluations to determine effects of structural and operational improvements as soon as the improvements are implemented.
7. Develop and implement specific written procedures for protecting and salvaging adult and juvenile lamprey at fish passage facilities during facility dewatering and other relevant times. These will be included in the annual detailed fishery operating plan
8. Contribute funding towards existing research and development for a juvenile lamprey radio-tag that can be used with balloon tag technology.
9. Develop PIT-tag or acoustic tag technology. Evaluate effects of downstream passage routes on juvenile lamprey survival.
10. Contribute funding toward the continuation of physiological and behavioral work.
11. Fund the artificial propagation of juvenile lamprey for use in future passage and survival studies at the project.

Chelan PUD would complete the following Tier 1 monitoring and evaluations at the dam with consultation and approval by the fisheries technical committee and coordinated with regional efforts.

1. Continue to use adult upstream passage count methodology, always working towards improving and standardizing it. Research the use of mark/recapture methods of adults in the tributaries as a tool to obtaining adult abundance and survival estimates.
2. Conduct spawning and/or redd counts.
3. Conduct juvenile and adult surveys in reservoir and tributaries.
4. Develop reliable methods for assessing juvenile relative abundance.
5. Explore the feasibility of conducting downstream juvenile counts.
6. Identify habitat parameters that augment and/or diminish lamprey productivity during juvenile and adult surveys.
7. Identify existing and potential rearing habitat within the reservoir and any other areas ever impacted by the project.
8. Identify existing and potential spawning habitat within the reservoir (if any) and any other areas ever impacted by the project.
9. Identify adult overwintering habitat.

10. If habitat appears to be limiting, Chelan PUD shall explore enhancement measures.
11. Actively participate and assist in funding a regionally supported assessment of juvenile lamprey passage technology.
12. Assess effectiveness of modifications that are made to improve passage.
13. Use active adaptive management processes and decision analyses until goals are achieved. The final Pacific Lamprey Plan should contain a decision tree of actions, dates when actions occur and specific check-ins (i.e., every 3 years to evaluate effectiveness of measures, and every 5 years to evaluate if goals are being met; if not then modify the measures and/or implement new measures to improve project passage, habitat and mitigation).
14. Investigate water quality issues, (e.g., toxin bioaccumulation, temperature effects, TDG) on lamprey. Collaboration with the Irrigation Districts on water quality issues seems reasonable.
15. Continue to use radio-telemetry as appropriate for abundance, passage and movement studies. Build and expand upon existing adult passage research. Conduct radio telemetry studies to determine passage rates and problem passage areas at each mainstem dam and reservoir. Track fish to tributary areas to augment other objectives identified above.
16. Develop engineering designs for fishway modifications to improve lamprey passage.
17. Evaluate the feasibility of a trap and haul program for adult lamprey as a short-term mitigation measure as volition passage is developed through the project.

Chelan PUD would complete all Tier 2 tasks within 5 years of the effective date of the new license. These tasks include environmental measures, and post-modification monitoring and evaluations.

Chelan PUD would complete the following Tier 2 environmental measures after developing appropriate plans or designs in consultation with the fishery technical committee and coordinate with regional efforts.

1. Chelan PUD would, with tools developed in Tier 1, evaluate route specific juvenile lamprey passage and survival through the dam and reservoir. Implement engineering measures to improve lamprey passage through the fishway.
2. Chelan PUD would continue to implement the adult salvage program to mitigate impaired passage. The program should be conducted annually until the Project meets the passage performance goal for the species or until the

fishery technical committee identifies one or more alternative measures that would be better investments of the resources dedicated meeting the passage goal.

3. Chelan PUD would fund tributary habitat measures such as securing habitat reserves or instream work in consultation and with approval of the fisheries technical committee.

Chelan PUD would complete the following Tier 2 monitoring and evaluations in consultation with the fishery technical committee and coordinated with regional efforts.

1. Chelan PUD would evaluate the effectiveness of the lamprey passage improvements, including the controlled flow structure(s). This evaluation should include a determination of passage effectiveness for the entire Project so that lamprey passage performance can be compared to the goal developed in Tier 2.

2. Chelan PUD would monitor and evaluate the effectiveness of the capture-and-haul program.

3. The Fishery Technical Committee would decide which suite of measures is appropriate to meet the passage goal.

If necessary to meet Project performance goals, Chelan PUD would implement Tier 3 within 8 years of the effective date of the new license. This tier includes several potential environmental measures.

If monitoring and evaluations conducted in Tier 2 indicate the upstream and downstream passage of lamprey does not meet the site-specific performance goals, Chelan PUD would implement one or more of the following Tier 3 environmental measures in consultation and with approval of the fisheries technical committee.

1. Install additional and or newly designed lamprey passage devices at the dam
2. Operational changes as determined by the fishery technical committee and next steps taken;
3. Continue comprehensive capture and haul program for lamprey adults.
4. Develop and implement a supplementation program.
5. Continue to fund tributary habitat restoration projects preference and use and restoration projects.

Chelan PUD would develop any necessary Tier 3 monitoring and evaluation plans in consultation with the fishery technical committee.

*Our Analysis*

The effects of project operations on Pacific lamprey populations are currently unknown. The study of Pacific lamprey in the Columbia River Basin is ongoing, and many critical uncertainties exist. Recent research in the lower (Moser et al., 2002a) and mid-Columbia River (Nass et al., 2003) indicates that fish passage facilities often delay or impede adult Pacific lamprey migration. The project can affect upstream migration of lamprey adults by hindering movement through project fishways and structures, and causing injury and mortality from upstream and downstream passage. Upstream migration can be delayed at the project due to the configuration of fishway structures and the swimming methods of adult lamprey. Lamprey critical swimming speeds are below average velocities at the entrances and channels of project fishways (Stevenson et al., 2005), and they may have difficulty negotiating past these areas of high velocity and adhering to passage structures. Impeded adult migration to spawning grounds can cause spawning delays or block access to upstream spawning areas. The importance of blocked passage to mid-Columbia River lamprey is unknown since it is possible that individuals that fail to pass upstream of dams may successfully spawn in downstream areas.

At the completion of their larval stage, Pacific lamprey transform into macropthalmia, undergo a smoltification process, and start migrating downstream to the ocean where they begin their parasitic life form. The downstream movement of macropthalmia may be affected by dams either from passage through turbines or via spill (Long, 1968). Macropthalmia may also become impinged on the face of screen material or other structures that are intended to deflect young salmonids away from turbine intakes (Hammond, 1979). Once impinged, macropthalmia may slide along these structures toward the gatewells.

Fish counting records at the project dam have documented adult Pacific lamprey passage since 1961 (BioAnalysts, 2000b). More recently, Pacific lamprey adult counts at the mid-Columbia River dams have increased, although they are still below most of the high counts recorded in the 1960s, when the range was 1,000 to 17,000.

Benthic invertebrate studies conducted in 2002 resulted in the incidental capture of approximately 5.6 ammocoetes (juvenile lamprey) per square meter in sandy, depositional habitats within the project dam tailrace (Golder, 2003b).

Specific reasons for the fluctuations in Pacific lamprey populations throughout their range in the United States are not fully understood, but have occurred in the same time period as similar declines of Pacific salmon populations. Causes of population decline may include (1) passage problems for adult and juvenile lamprey migrating through and past dams; (2) declining conditions of spawning and rearing habitat in freshwater; (3) a decline of the marine prey base; (4) industrial and agricultural pollution; (5) urbanization; (6) dewatering of streams; and (7) adult losses at sea (Close, 2002; Moser and Close, 2003). Although most of these factors could apply to mid-Columbia

River populations of Pacific lamprey, only those related to upstream and downstream passage and habitat conditions in the reservoir may be affected by operation of the project.

Chelan PUD conducted radio-telemetry studies at Rocky Reach during 2004 to assess impediments to upstream passage. Results showed a Net Ladder Passage Efficiency, (the proportion of fish detected in the tailrace of the dam that exit the upstream fishway, adjusted for downstream passage and re-ascent) to be 47 percent (Chelan PUD, 2005a). A comparison of mean migration rates through nine potential fishway entrances at the project showed the slowest migration rates occurred in the uppermost section of the fishway from the ladder flow regulation diffuser to the ladder exit (0.09 meter/minute compared to 1.03 to 21.09 meters/minute in other portions of the fishway). This section of the fishway contains the diffuser, public viewing windows, a Pickett Barrier, and the fish counting window and station, and Chelan PUD speculates that one or more of these structures may delay migration (Chelan PUD, 2005a).

Acquisition of adult upstream Pacific lamprey passage information (efficiency, timing, routes) past the project dam would be important to gain an understanding of project-related effects. Studies conducted at other Columbia River dams indicate that a high percentage (e.g., 30 percent to 40 percent at Bonneville dam [Moser, et al., 2002b]) of lamprey fail to move upstream past the fishways. Adult Pacific lamprey swim close to the bottom and need to attach to surfaces so they may not be able to effectively negotiate fish ladders originally designed to pass salmonids. Since fish ladders at Columbia River dams are similarly designed (Clay, 1995), it is possible that adult Pacific lamprey migration at the project dam is impeded by features similar to those observed at other facilities (i.e., fish count stations, fishway and spillway entrances, areas with diffusion grating, fishway weirs and orifices, and powerhouses and collection channels). Compilation of existing information on Pacific lamprey in the region for factors that impede upstream passage that are analogous to conditions at the project would enable potentially effective fishway modifications to be designed more efficiently.

Chelan PUD's proposal includes investigating and implementing measures to improve upstream passage in the project dam fishways, with the goal of achieving passage rates similar to the best passage rates found at other projects on the Columbia and Snake rivers. This information together with research compiled from fishway modifications implemented elsewhere on the Columbia River would help in the design and implementation of appropriate fishway modifications to improve the passage efficiency of lamprey through the project. However, requiring Chelan PUD to meet the best passage rates found at other projects on the Columbia and Snake rivers is not a well-defined goal, depends on many factors outside the influence of the project, and may not be reasonable or feasible.

Chelan PUD's proposal to identify and implement measures to address unavoidable impacts to achieve "no net impact" is similar to the Umatilla Tribes'

recommendation that project operations, and PME measures result in "no net effect" of the project on Pacific lamprey. However, quantifying effects from downstream passage through spill or the turbines is not technically feasible at this time, and consequently, assessing what constitutes 'no net impact' is not currently feasible. Additionally, there is no information in the record that demonstrates the project is affecting lamprey other than through effects on upstream passage.

Determining juvenile Pacific lamprey presence/absence and relative abundance in the reservoir would potentially provide information to fisheries managers on lamprey spawning in the reservoir, and on whether project operations are affecting spawning habitat or spawning success. Chelan PUD's proposal to contribute to other local or regional lamprey programs to develop methods for research may help to determine what investigation techniques to employ at the project to determine project effects.

The Umatilla Tribes' recommendations are similar to Chelan's proposal in that they provide site-specific and applicable regional information that would provide a basis for development and implementation of future lamprey protection and enhancement measures. Development of O&M procedures that would avoid effects on lamprey of such practices as fishway dewatering would reduce project-caused mortality. Fishway dewatering for maintenance purposes typically occurs during the winter, when few fish would be expected to use the fishways. During recent years, Chelan PUD found fewer than 20 adult lampreys a year when it dewatered the fishways for winter maintenance (Chelan PUD, 2006d). This indicates that although routine O&M does not appear to represent a major source of lamprey loss, developing procedures that could minimize the losses that do occur would be beneficial.

The Umatilla Tribes' proposed Pacific Lamprey Plan calls for Chelan PUD to investigate and implement reasonable and feasible fishway modifications within five years of the issuance of a new license, which is the same as Chelan PUD's proposal. This would address current passage inefficiencies that have been identified, and the proposed continued monitoring would document the upstream passage effectiveness after any modifications are implemented. Improvements in upstream and downstream lamprey passage at the dam would minimize project impacts and potentially improve survival of lamprey during migrations. Participating in regional research and information exchanges regarding juvenile downstream migration as well as effective fishway modifications would enable Chelan PUD and other members of the RR Fish Forum to evaluate and implement effective improvements to project facilities. Continued monitoring throughout the life of the license, with periodic evaluation and implementation of fishway modifications, would further aid in improving passage performance for lamprey.

Implementation of the HCP could provide additional benefits to Pacific lamprey passing the project and inhabiting tributaries to the Columbia River in the vicinity of the project. Additional benefits to Pacific lamprey could be realized through (1) operation of the juvenile bypass system, which would provide a safe passage route for downstream

migrating macropthalmia; (2) implementation of the Tributary Enhancement Fund, which would provide habitat improvements in local tributaries; and (3) implementation of the Northern pikeminnow predator control program, which would reduce mortality on downstream migrating macropthalmia.

The Umatilla Tribes indicate that regional fisheries managers are developing passage standards for juvenile lamprey and that once these standards are developed, Chelan PUD should be required to meet these standards. Because no passage standards exist at this time, we are unable to determine whether such standards would be attainable or what benefit they would have.

For upstream adult lamprey passage, the Umatilla Tribes recommend that Chelan PUD be required to achieve 80 percent upstream passage with a median passage time of 24 hours by 2013. The Umatilla Tribes recommend that by 2030, Chelan PUD should be required to achieve 97-98 percent upstream passage. Regional fisheries managers are in the process of developing upstream passage standards for adult lamprey and there are no widely accepted upstream passage standards for Pacific lamprey at this time. The Tribes state that their recommended passage standards are reasonable and justified and they provided information suggesting 80 percent passage success has been achieved at other projects. Data collected by Chelan PUD at the Rocky Reach Project indicate that current passage rates are between 50 and 60 percent and Chelan PUD has proposed measures to increase those percentages. However, we have no information to indicate that 80 percent passage success is attainable at the Rocky Reach Project or that 98 percent upstream passage is attainable at Rocky Reach or any other project. Additionally, we have no information to indicate that adult lamprey failing to pass the Rocky Reach Project cannot successfully reproduce in areas downstream of the project. Lastly, it is not apparent that the recommended passage levels for the Rocky Reach project are necessary to maintain or recover the Columbia River lamprey population.

The Umatilla Tribes recommend that all Tier 1–3 actions be implemented in consultation with a fisheries technical committee. We view this recommendation to be comparable to the consultation with the RR Fish Forum specified in Chelan PUD's proposal and find that it would have a comparable effect on lamprey management. Cooperatively sharing information among agencies has the potential to result in more informed management decisions, thereby benefiting lamprey populations in the reservoir.

The Umatilla Tribes call for all Tier 1 tasks listed above to be implemented within 2 years of the effective date of the new license, and in consultation with and with the approval of a fisheries technical committee. This includes modeling and design work for passage structures at the dam to determine the most appropriate designs for improving upstream lamprey passage. Information resulting from this work, if used to implement improvements to fishway passage success for lamprey, would benefit lamprey populations by identifying and addressing impediments to passage caused by project facilities and operations. We note, however, that the responsibility for approving

measures called for under a Commission license lies with the Commission, and not other parties.

The Umatilla Tribes recommend 11 Tier 1 environmental measures that call for Chelan PUD to complete a variety of studies at the project, implement fishway modifications, fund physiological and behavioral studies, and fund artificial propagation of juvenile lamprey for use in passage studies. Completing passage studies at the project would aid managers in identifying project structural and operational changes that could be implemented to facilitate lamprey passage at the project. Funding radio-tag, PIT tag, or acoustic tag technology and physiological and behavioral studies for lamprey would aid in research, but it is unclear how funding such research would benefit lamprey populations affected by project operations and facilities.

Eighteen measures are listed in the Umatilla Tribes' Tier 1 monitoring and evaluations above, some of which are duplicates of Tier 1 environmental measures (12, 13, 17). Measures designed to improve upstream and downstream passage counts and success (1, 6, 13, 16, 18) would give managers more reliable information that could be used to address potential impacts to lamprey at the dam. Measures 2-5 and 15 would help to provide information on lamprey abundance and habitat use in the project area. This information could be used to guide potential habitat improvements that could be made to enhance lamprey populations in the reservoir. Measures 9-11 are investments in technology or habitat studies that would not specifically benefit lamprey within the project area and would not help identify or mitigate ongoing project effects. Measure 14 is a process for guiding decisions. Information from measure 18, evaluation of feasibility of trap and haul, would provide data on an alternative method to successfully pass lamprey through the project dam.

The Umatilla Tribes recommend that Chelan PUD complete all Tier 2 tasks within 5 years and Tier 3 measures within 8 years of the effective date of a new license. These tasks include both environmental measures and post-modification monitoring and evaluations that would build on Tier 1 measures. These measures would provide ongoing information that could be used to decrease project impacts and improve populations of lamprey in the project area. Implementing the Tribes' Tier 3 measures for installing additional or newly designed lamprey passage facilities at the project would mitigate project impacts to passage if other measures implemented in Tiers 1 and 2 were deemed insufficient during consultation with management agencies and the Tribes.

#### 3.4.2.4 Fish Spawning and Rearing Habitat

**Anadromous Fish**

Compensation for losses of mainstem as well as tributary spawning habitat due to inundation by the project reservoir has been established in agreements dating to the construction of the Rocky Reach dam. As part of these agreements, Chelan PUD, tribes,

and fishery agencies agreed upon an artificial production program to mitigate all spawning and rearing effects on spring Chinook salmon and steelhead due to construction and operation of the project (FERC, 1995; Chelan PUD, 1961, 1963a). According to the agreements, the loss of spawning and rearing habitat has been fully mitigated by hatchery production. This program is continuing under the Commission-approved HCP for anadromous fish. The Hatchery Program and Tributary Conservation Program components of the HCP were described earlier in this document.

**Resident Fish**

Initial project construction raised concerns regarding the potential for loss of fishing opportunities (specifically whitefish) in the project area due to passage and habitat issues. Agreements between Chelan PUD and WDFW (formerly the Washington Department of Game) were established in 1963 to mitigate for project impacts on recreational fishing opportunities. The agreement includes a provision for stocking rainbow trout in local area lakes. The provisions of these agreements are still in effect, and Chelan PUD (2004a) indicates that they are considered successful.

Under the terms of the Settlement Agreement, Chelan PUD proposes to implement the Resident Fish Plan. As a party to the Settlement Agreement, WDFW and FWS concur with the proposal. The goal of the Resident Fish Plan is to protect and enhance resident fish and habitat in the project reservoir, and to enhance recreational fishing opportunities.

The Resident Fish Plan calls for Chelan PUD to continue producing 30,000 pounds of rainbow trout, or other species as agreed to by the RR Fish Forum, for stocking in local area water bodies in Chelan and Douglas counties. It also includes a measure for Chelan PUD to provide funds to evaluate creating an additional fishing opportunity by introducing a new species to the project reservoir. Another element of the plan is for Chelan PUD to implement resident fish enhancement measures in consultation with the RR Fish Forum. The first priority would be to use resident fish enhancement funds in the Lake Chelan Basin. However, through recommendations by the RR Fish Forum, funding could be used within the Rocky Reach Project boundary or in tributaries to the reservoir. Projects that would be considered for funding are:

1. Habitat enhancement on Twentyfive Mile Creek;
2. Culvert modification on Twentyfive Mile Creek to improve upstream fish passage;
3. Installation of remote-site egg incubators on Lake Chelan tributaries;
4. Blocking off the entrance to preclude fish access to the existing degraded Twentyfive Mile Creek spawning channel, and re-visiting Twentyfive Mile Creek spawning channel reconfiguration in the future;

5. Lake Chelan tributary habitat enhancements;
6. Fishing pier acquisition/construction/enhancement in Lake Chelan (located in the lower (Wapato) Basin with suitable public access); and
7. Other projects as recommended by the RR Fish Forum and the Lake Chelan Fish Forum, pending the results of a food web model study to be performed for Lake Chelan.

Chelan PUD also proposes to conduct a 1-year comprehensive evaluation of resident fish abundance and species composition in the project reservoir, focusing on predatory fish species. If the comprehensive evaluation shows that the predatory fish population adversely affects the achievement of HCP Plan Species survival standards in the reservoir, Chelan PUD would consult with the HCP Coordinating Committee to develop and implement predator control measures as necessary to achieve such standards. Following implementation of any such predator control measures in the reservoir, Chelan PUD would conduct an additional one-year follow-up comprehensive evaluation to determine the efficacy of predator control measures undertaken in the reservoir. If it is determined, based on the comprehensive evaluation, that a predatory fish problem does not exist in the reservoir for the HCP Plan Species, Chelan PUD would conduct three 1-year surveys to monitor any changes in abundance or species composition in the resident fish populations in the reservoir. The timing and methodologies for the monitoring surveys would be developed by Chelan PUD in consultation with the RR Fish Forum.

*Our Analysis*

The Chelan PUD proposal to commit to funding WDFW stocking programs is intended to allow WDFW to exercise a least-cost method of obtaining high quality fish, and would include raising or producing fish for planting in local area water bodies. The settlement parties support this proposal. This proposal is intended to enhance fishing opportunities in the local area.

Under this proposal, Chelan PUD would provide funds to WDFW to raise fish at WDFW facilities. In comments on the draft EIS, WDFW indicated that because of potential effects of hatchery fish on threatened and endangered fish species, the hatchery fish would not be stocked in the project area and would instead be stocked in various water bodies throughout Chelan and Douglas counties. Therefore, under this proposal, fish would be reared at non-project facilities and stocked outside of project area which would contribute to recreational fishing activities in Chelan and Douglas counties, but would not benefit project resources or provide recreation opportunities in the project area.

Chelan PUD's proposal provides a list of potential resident fish measures that could be funded, ranging from habitat enhancement activities to funding food-web model studies. Habitat improvements and culvert modifications at Twentyfive Mile Creek, and

Lake Chelan tributary enhancements, would potentially provide more suitable spawning habitat for resident fish in Lake Chelan. Installation of remote site incubators could improve the recruitment of salmonid fry over natural conditions. Increasing fishing pier availability for the public can improve the opportunity for recreational fishing for non-boaters.

The PDEA did not identify any effects on resident fish (Chelan PUD, 2004a) and no other impacts have been identified in the record. According to the Resident Fish Plan, the specific habitat improvement projects would be determined in consultation with the RR Fish Forum and would be intended to provide fishing opportunities for anglers in the Lake Chelan Project area, Rocky Reach Project area, or in tributaries to the Rocky Reach Project. The list of potential habitat improvement projects included in the Resident Fish Plan suggests that these measures would either directly enhance fish habitat and fish numbers or provide fishery managers with information useful in managing local recreational fisheries. However, because no specific location for implementing the resident fish habitat enhancement measures has been selected, we cannot determine the effect of this proposal on Rocky Reach Project resources.

As part of the Resident Fish Plan, Chelan PUD proposes to investigate the introduction of a new species for recreational fisheries in the project reservoir. This measure would provide information to fisheries managers and could lead to development of new fishing opportunities in the project area. However, introducing a new species to the project reservoir could adversely affect threatened and endangered fish species and it is not clear that such a measure is necessary or appropriate.

Conducting a comprehensive evaluation of the effects of predatory resident fish species on HCP Plan Species could be useful in identifying effective ways to increase reservoir survival of juvenile salmon and steelhead. However, if the comprehensive evaluation does not reveal any significant link between predatory fish and juvenile salmon and steelhead survival, Chelan would conduct three 1-year surveys to monitor changes in abundance or species composition of reservoir resident fish populations. It is not clear why the information from these latter surveys is needed or how it would be used. There is no information on the record to suggest that ongoing operations or programs affect resident fish, nor is there information about how data from these surveys would be used to benefit fish in the project area.

#### 3.4.2.5 Predation

The project dam has altered the fluvial dynamics of the reservoir and has increased habitat for both native and non-native predatory fish species. There are approximately 41 species of fish in the project area; about half of them are piscivorous. Of the piscivores, northern pikeminnow, walleye, smallmouth bass, and white sturgeon may affect the survival of juvenile anadromous fish in the project area through predation. Walleye,

smallmouth bass, and white sturgeon are not abundant in the project area (Burley and Poe, 1994; BioAnalysts, 2000a) and, therefore, do not represent an important source of mortality for juvenile anadromous fish. WDFW stated in its comments on the draft EIS that the size of the walleye population in the Rocky Reach reservoir is significantly under-represented by fish presence surveys conducted to date. However, WDFW did not provide any evidence to support this statement or to indicate that walleye may be affecting populations of native fish or anadromous salmonids in the reservoir.

As a provision of the HCP, Chelan PUD would continue to conduct a predator control program to reduce predation-related mortality of juvenile salmon and steelhead. The program would contribute to the HCP's 93 percent survival goal for juvenile fish passing the project. Chelan PUD would conduct control efforts for both northern pikeminnow and piscivorous bird populations for the protection of juvenile Plan Species. Northern pikeminnnow would be primarily controlled using hook and line angling at the dams and in project reservoirs. Longlines and trapping could also be used. Piscivorous bird populations, including Caspian terns, double-crested cormorants, and various gull species would be hazed, using such techniques as wire arrays in the tailrace, propane cannons, various pyrotechnics, and lethal control when necessary. This program is supported by parties to the HCP and participants of the Natural Resources Working Group.

*Our Analysis*

The nature of fish passage facilities tends to cause numbers of migrating fish to concentrate near the dam. This can facilitate foraging by predatory fish as well as avian predators. Northern pikeminnow, in particular, tend to concentrate in tailrace areas downstream of mainstem dams during the juvenile salmonid migration period. They hold in relatively slow-moving water areas (less than about 3 feet per second) near passage routes, where they prey upon the migrating salmonid smolts. In addition, avian predators pose a predation problem by disrupting and feeding on young fish in rearing and holding habitats.

Chelan PUD has implemented a predator abatement program for northern pikeminnow as a means of increasing the survival of juvenile anadromous fish that migrate through the project reservoir and pass the dam. Chelan PUD indicated that this program has proven to be successful in reducing the number of large (greater than 10 inches in length) northern pikeminnow that are known to consume outmigrating smolts. In 2003, 23,700 pikeminnow were removed from the Rocky Reach and Rock Island hydroelectric project reservoirs. Nearly 80 percent of the pikeminnow caught were less than 10 inches in length, indicating that the program is reducing the population of older, larger pikeminnows. The HCP provides for continuation of this program.

In 2002, Chelan PUD contracted with the University of Washington and WDFW to determine what effect avian predators were having on the outmigrating salmonid population. The product of this 3-year study will be an adaptive management program that would allow Chelan PUD to meet the HCP goals without having a negative effect on the local piscivorous bird populations (Chelan PUD, 2003b).

The predator control provisions of the HCP would reduce the numbers of predatory northern pikeminnow in the reservoir, resulting in a decrease in predation on juvenile anadromous fish, thereby increasing smolt survival and adult returns to the project area. Avian control programs would also increase smolt survival and ultimately help increase survival to adults.

#### 3.4.2.6 Pool Fluctuations

Project-related fluctuations in both surface water elevation and water velocity in the Rocky Reach pool have the potential to affect migration, spawning, rearing, and stranding of fish within the reservoir, as well as riparian zone structure and reservoir habitat. Chelan PUD proposes to avoid such effects by continuing to operate the project under the Hourly Coordination Agreement, to which it is a signatory party, which establishes operating protocols that facilitate maintaining mid-Columbia reservoirs at or near full pool levels. This agreement is described in more detail in section 3.4.2.1, *Water Use and Quantity*. Chelan PUD also proposes to continue operating the project under the Hanford Reach Agreement.

The Umatilla Tribes recommend that Chelan PUD adhere to Hourly Coordination operational protocols developed for the Hanford Reach adult fall Chinook salmon spawning period and the Hanford Reach juvenile fall Chinook salmon susceptibility period (approximately March through early May) each year.

*Our Analysis*

Currently, the project operates in the top 1 foot of reservoir storage 73 percent of the time and within the top 2 feet 98 percent of the time. BioAnalysts (2000c) reported on an investigation into the potential effects of Rocky Reach pool fluctuations on fisheries resources. The investigation included an assessment of effects on ESA-listed anadromous fish populations, as well as the riparian habitat bordering the pool. BioAnalysts' study found no incidents of fish stranding since May 1988. The Rocky Reach forebay water level is very stable (within elevation 705 to 707 feet) and the forebay water level changes slowly because the forebay surface area is large compared to the hydraulic capacity of the powerhouse. These operational characteristics help avoid fish stranding.

No adverse effects on fish due to pool fluctuations have been identified as a result of project operations, and we conclude that no additional environmental measures are necessary beyond continued operation under the protocols established under the Hourly Coordination Agreement.

#### 3.4.2.7 Other Fisheries Issues

**Management/Oversight of Plans**

Under the terms of the Settlement Agreement, Chelan PUD proposes that the Natural Resources Working Group would continue to function as the RR Fish Forum following the effective date of a new license and any subsequent annual licenses. The RR Fish Forum would be responsible for meeting to share information, coordinate efforts, and make recommendations regarding the implementation of the Bull Trout Plan, Pacific Lamprey Plan, Resident Fish Plan, and White Sturgeon Plan. The RR Fish Forum would be a recommending body only. The HCP Coordinating Committee would have management and oversight of measures relating to the HCP Plan Species. As a party to the Settlement Agreement, WDFW concurs with Chelan PUD's proposal.

The Umatilla Tribes recommend that Chelan PUD ensure that decisions are made through adaptive management, are consensus-based, and subject to appropriate dispute resolution procedures. The tribes call for Chelan PUD to establish one, truly comprehensive fisheries and aquatics committee (Fisheries Technical Committee) that would implement adaptive management measures for Pacific lamprey, sturgeon, Chinook salmon, steelhead, coho salmon, and sockeye salmon.

The Umatilla Tribes recommend that Chelan PUD develop a detailed fishery operations plan for the operation of the project to meet performance goals and objectives for salmon.

In addition, the Umatilla Tribes recommend that Chelan PUD establish hatchery and habitat management plans and expedite implementation of actions in these plans in coordination with and with the approval of the Fisheries Technical Committee. The Umatilla Tribes state that these plans should contain state-of-the-art bioengineering and other applicable methods and standards.

*Our Analysis*

The HCP Coordinating Committee has been established to oversee all aspects of the standards, methods, and implementation of the HCP by various means, including establishing methods to determine if survival standards are being achieved, determining if the signatories are carrying out their responsibilities, determining if no net impact is achieved, approving study plans and reviewing study results, making adjustments to the

passage survival plan, resolving disputes, and adjusting schedules and dates for performance.

The settlement parties have worked collaboratively to develop four management plans for HCP non-Plan Species. Chelan PUD's proposal would maintain the same process of technical review of various fisheries issues currently served by the Natural Resources Working Group, though the group would be renamed the RR Fish Forum.

Establishment of the RR Fish Forum, together with the HCP Coordinating Committee, would satisfy the Umatilla Tribes' recommendation.

**Aquatic Invasive Species**

Eurasian watermilfoil is present in project waters, and Chelan PUD currently harvests the aquatic weed at the project's recreational facility public access points. Under Chelan PUD's proposal, Chelan PUD would continue this effort. Zebra mussels do not currently occur in project waters. Chelan PUD has an ongoing program that includes plankton tow net sampling to monitor for the presence of zebra mussels on project structures. The PUD has also scheduled the use of mussel traps in project waters.

As reflected in the Settlement Agreement, Chelan PUD proposes to develop and begin implementation of an aquatic invasive species monitoring and control plan coordinated with WDOE's Freshwater Aquatic Weed Control Program to monitor for the presence of new aquatic invasive species at or near project facilities within one year of the effective date of a new license, in consultation with the RR Fish Forum. They propose that the plan and implementation include the following components: signage at boat launches and distribution of educational materials and boater questionnaires to voluntary participants at Rocky Reach reservoir boat launch sites during the peak boating season (May 1 to October 30 each year) to increase boater awareness of the issue; development of methods and a schedule of prevention, monitoring and control measures regarding the presence and movement of aquatic invasive species at or near project facilities; and an annual report of monitoring and educational activities conducted in the preceding year. WDFW, as a signatory to the Settlement Agreement, supports this proposal.

*Our Analysis*

Aquatic invasive species are often spread by recreational watercraft, and these species can pose a threat to native aquatic species. Eurasian watermilfoil is already present in project waters, although zebra mussels do not currently exist west of the Missouri River system. One way to reduce the spread of existing aquatic invasive weeds and to minimize the risk of zebra mussels expanding into the project area is to develop a prevention program aimed at educating boaters on how they can contribute to achieving those goals. The aquatic invasive species prevention program proposed by Chelan PUD

does not identify particular invasive SOCs, but could, if successful, provide a benefit to native aquatic species by: (1) promoting boater awareness and understanding of the general problem of aquatic invasive species, (2) providing for boat inspections to limit the spread of aquatic invasive species from one water system to another, (3) helping reduce the spread of aquatic invasive weeds, and (4) providing a means of rapid response for any new aquatic invasive species that could enter into the project waters and pose a threat to native species.

Chelan PUD's proposal to develop and implement an aquatic invasive species monitoring and control plan as described would facilitate the coordination of their actions with state activities and programs, potentially increasing their effectiveness, and would help Chelan PUD coordinate its actions with federal agencies that administer regional programs to monitor for invasive species.

### 3.4.3 Cumulative Effects

Of the measures proposed within this section, measures for anadromous fish including the Hanford Reach Agreement and HCP, the White Sturgeon Plan, and the Pacific Lamprey Plan are expected to contribute to cumulative effects on fisheries resources.

#### 3.4.3.1 Anadromous Salmonids

Flow releases from the project have the potential to affect fish habitat found in waters downstream of the project. The Hanford Reach Agreement replaces the June 16, 1988, Vernita Bar Agreement to protect and enhance fall Chinook salmon on Vernita Bar during the spawning, pre-hatch, post-hatch, and emergence periods. The agreement provides for minimum flows and regulation of flow fluctuations in the Hanford Reach to reduce the cumulative effects of hydropower operations on fall Chinook salmon fry during the rearing period. The Hanford Reach Agreement establishes reservoir operating procedures that would be followed by Chelan PUD and Douglas PUD during the rearing period to assist Grant PUD in reducing flow fluctuations in the Hanford Reach to minimize effects on fall Chinook salmon, thereby reducing the cumulative effect on this species within the Columbia River Basin.

The Commission was a cooperating agency in the NMFS' final EIS for the HCP (NMFS, 2002) that analyzed environmental measures specified in the HCP, and cited that analysis in its Order Amending the License of the Rocky Reach Project. The HCP addresses a wide range of issues affecting salmon populations in the project area and the basin. Implementation of the HCP, in addition to federal, tribal, state and local salmonid recovery programs, is expected to increase wild fish populations in the Columbia River. Other environmental effects of the HCP and Columbia River Basin recovery programs are expected to include an increase in native riparian vegetation, an increase in wildlife

dependent on riparian habitat, a decrease in predators of salmonids (piscivorous fish and birds), habitat protection and enhancement, an increase in employment associated with habitat restoration and commercial and recreational fishing, more natural aesthetic settings in salmonid streams, an increase in passive recreational opportunities (such as hiking and boating), and increased protection of Native American cultural resources, including salmon. The HCP would reduce direct and indirect project-related effects on Plan Species, thereby reducing the cumulative effects on these species within the Columbia River Basin.

#### 3.4.3.2 White Sturgeon

Development of hydroelectric power generation facilities within the Columbia River Basin has adversely affected white sturgeon. White sturgeon rarely uses the fish ladder at the project for upstream or downstream passage, but they do move downstream by passing through the turbines or in spill. The project dam would continue to present an upstream barrier to white sturgeon, as would other projects on the Columbia River.

Chelan PUD's proposal includes measures to mitigate this adverse effect. Implementation of the measures contained in the plan would increase the population of white sturgeon to a sustainable level, to be determined by the monitoring and evaluation, and includes the flexibility to adjust the program over the term of the new license as new information is gathered.

#### 3.4.3.3 Pacific Lamprey

The number of adult Pacific lamprey returning to the Upper Columbia River appears to have declined over the past 40 years. These declines have been attributed to a variety of factors, including degraded habitats, past fisheries management practices, water pollution, dam passage problems, ocean conditions, and food availability. Adult lamprey uses the fish ladder at the project for upstream passage to spawning grounds. Juveniles migrate downstream to the ocean and pass through the juvenile bypass system, through the turbines, or in spill. Specific mortality rates for lamprey from Columbia River projects are not yet known. However, it is likely that some delays occur within the fish ladders and that some mortality occurs during downstream movements.

Chelan PUD proposes to investigate and implement feasible adult fishway modifications to mitigate this adverse effect on passage. Implementation of these measures would improve lamprey passage through the fish ladder.

### 3.4.4 Unavoidable Adverse Impacts

Continued operation of the Rocky Reach dam facilities will result in unavoidable losses to anadromous and resident fish species in the reservoir through turbine mortality,

upstream and downstream fish passage delays, and adverse effects on critical habitats. Measures contained in the HCP and the four proposed fish management plans are designed to minimize harm to fish species, to mitigate for fish losses, and to enhance the potential for species survival through the project.

## 3.5 TERRESTRIAL RESOURCES

### 3.5.1 Affected Environment

#### 3.5.1.1 General Description of Terrestrial Resources

Located in the rain shadow of the Cascade Range, the mid-Columbia region is classified as arid to semi-arid and experiences dry summers with warm to hot temperatures and relatively cold winters. Continental-type climate conditions prevail, with some marine influences. Most of the Columbia River Basin receives less than 20 inches of precipitation annually, with much of this precipitation occurring in winter. Deep snow can accumulate on the mountainous areas, where water is held as natural storage until spring runoff.

Existing botanical resources consists mainly of shrub-steppe communities on upland habitats adjoining the project. Riparian and wetland plant communities have developed on the shoreline of the project reservoir, which inundated similar communities when the project was constructed in 1957. There are additional areas of riparian and wetland vegetation along tributary streams and rivers. In addition, there are some sparsely vegetated habitats with unique soil types including gravelly or sandy soils, shallow and/or stony sites, and sand dunes near the Columbia River (Franklin and Dyrness, 1973).

Disturbed/developed/modified cover types make up approximately 57 percent of the project area (DES, 2000). Orchards occupy the largest cover-type area (25.2 percent), followed by shrub-steppe (22.3 percent) and residential/industrial (15.6 percent) cover types. Collectively, riparian and shoreline wetland habitats constitute a small portion of all habitats in the area (9.2 percent). From 1991 to 1999, the residential/industrial cover type increased more than any other (approximately 230 acres), followed by the recreational cover type (increase of approximately 59 acres).

#### 3.5.1.2 Botanical Resources

**Upland Vegetation**

Botanical investigations in the project area (Caplow, 1990)[26] identified undeveloped areas of shrub-steppe vegetation dominated by big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* species [spp.]), bitterbrush (*Purshia tridentata*), bluebunch wheatgrass (*Pseudoroegneria spicata*), arrowleaf balsamroot (*Balsamorhiza sagitatta*), and numerous non-native weed species such as cheat grass (*Bromus tectorum*), bulbous bluegrass (*Poa bulbosa*), knapweeds (*Centaurea* spp.), Russian thistle (*Salsola kali*), and western tansy-mustard (*Descurainia pinnata*).

The shrub-steppe cover type is the predominant native terrestrial habitat in the study area (22.3 percent), but this cover type decreased more than any other cover type from 1991 to 1999 (approximately 204 acres) (DES, 2000). Most of this change was associated with new residential development and the expansion of existing orchards. Much of the remaining shrub-steppe cover type consists of small patches fragmented by orchards, residential developments, recreational facilities, and roads. Only north of Beebe Bridge is there a large unbroken expanse of shrub-steppe habitat. Wildlife species associated with shrub-steppe habitats in Washington are diverse and include several species that are considered obligate to this unique habitat (Dobler et al., 1996). Eleven of the 40 rare, threatened, and endangered (RTE) wildlife species potentially occurring within the vicinity of the project are closely associated with shrub-steppe habitats.

**Wetland and Riparian Vegetation**

*Riparian and Shoreline Wetlands*

Riparian and shoreline wetland habitats observed in the study area are small, isolated, and distinctly linear (DES, 2000). Expansion of the riparian vegetation in the project area is restricted by the arid conditions at higher elevations, rip-rapped embankments, and agricultural development. At lower elevations in undeveloped areas, shrub and forest riparian zones are dominated by species such as white alder (*Alnus rhombifolia*), water birch (*Betula occidentalis*), black cottonwood (*Populus balsamifera* spp. *trichocarpa*), willows (*Salix* spp.), and quaking aspen (*Populus tremuloides*). Common shrub species include wood rose (*Rosa woodsii*), redtwig dogwood (*Cornus sericea*), and snowberry (*Symphoricarpos alba*). Common herbaceous species include stinging nettle (*Urtica dioica*) and reed canarygrass (*Phalaris arundinacea*).

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[26] The project area covered by Caplow (1990) includes both lands within the project boundary and areas outside the project boundary that are likely to be affected by project operations.

Riparian and shoreline wetland habitats constitute a small portion of all habitats in the area (9.2 percent), but contribute disproportionately to the biodiversity of the region. Approximately 85 percent of Washington's wildlife species use riparian habitats at some time during their life cycle (Knutson and Naef, 1997). Some of the reasons why riparian and wetland habitats are so important to wildlife include: (1) the presence of water for drinking, bathing, or reproduction (amphibians); (2) high vegetative biomass; (3) high structural diversity; (4) the presence of edge habitats; (5) the presence of cool, shaded and humid microclimates; and (6) readily usable corridors for migration and travel (Thomas, 1979). Riparian habitats within arid or semi-arid environments are particularly distinctive and support species assemblages that could not occur otherwise.

The RTE Wildlife and Cover-type Mapping Study (DES, 2000) shows relatively small changes in riparian habitat over the past decade compared to mapping conducted by Ebasco Environmental in 1990 (EBASCO, 1991). Riparian cover types decreased by approximately 20 acres (5.6 percent) within the study area from 1991 to 1999, although the majority of this change was due to a reclassification of lawns within the Riparian Grassland type to Residential/Industrial. Riparian Deciduous Tree cover-types decreased by approximately 25 acres and Riparian Shrub cover-types increased by approximately 31 acres; therefore, the combined area of those cover types is generally unchanged. Differences in field interpretation could account for this difference. This finding suggests that riparian habitats within the study area are stable and have adapted to the water-level fluctuations associated with project operation. Irrigation runoff from adjacent orchards may influence some riparian habitats within the study area. This supplemental groundwater may promote development of riparian vegetation in areas that would otherwise be too dry. Furthermore, some existing riparian vegetation may be more lush because of this supplemental water source than it would be under natural conditions.

*Submerged Wetlands*

Chelan PUD's aquatic habitat mapping study (DES, 2001a) estimated the total acreage of aquatic macrophyte beds in the project reservoir to be about 386 acres in 1999. Submerged aquatic vegetation and submerged terrestrial grasses were the second most abundant aquatic cover type available in the project reservoir. Boulders formed the most abundant cover type.

Earlier wetland mapping efforts (Chelan PUD, 1991) also found wetland habitats to be widespread within the project area and consisting primarily of submerged aquatic vegetation beds and patches of emergent wetlands. These habitats are typically located in protected coves or in shallow areas where sediment has accumulated. They are also often found in isolated depressions associated with the railroad and the highways that parallel much of both sides of the river (Chelan PUD, 1991). Dominant native plant species of wetland habitat types within the project area include slender-leaved pondweed

(*Potamogeton filiformis*), common waterweed (*Elodea canadensis*), common cattail (*Typha latifolia*), and tule (*Scirpus validus*).

**Noxious Weeds**

A number of non-aquatic weeds classified as Class B designate and Class C non-aquatic noxious weeds for Chelan County[27] are also known to exist within the project area (Chapter 16-750 WAC). These include purple loosestrife (*Lythrum salicaria*), several species of diffuse knapweed (*Centaurea diffusa*), Russian knapweed (*Acroptilon repens*), perennial pepperweed (*Lepidium latifolium*), Dalmatian toadflax (*Linaria dalmatica*), yellow starthistle (*Centaurea solstitialis*), common mullein (*Verbascum thapsus*), camelthorn (*Alhagi maurorum*), Canada thistle (*Cirsium arvense*), common St. John's-wort (*Hypericum perforatum*), and hoarycress (whitetop) (*Cardaria draba*).

Chelan PUD continues to implement an annual purple loosestrife control program that was initiated in 1994. Purple loosestrife first began to appear in the Rock Island and Rocky Reach Project reservoirs in the early 1990s. Chelan PUD conducted a survey in 1993 to map purple loosestrife locations along both project reservoirs. The survey identified 110 locations with purple loosestrife. In the same year, Chelan PUD recognized purple loosestrife as a noxious weed and potential threat to wildlife habitat. As part of the control program, professional applicators are contracted to apply the herbicide Rodeo. There has been some decrease in the amount of purple loosestrife as a result of these annual efforts. However, purple loosestrife remains present along the reservoir shorelines.

**Rare Plant Species**

During a rare plant survey from 1999 to 2000 (Calypso Consulting, 2000), botanists located 14 populations of 6 rare plant species in the project area that are state-listed species: porcupine sedge, giant helleborine, adder's-tongue, little bluestem, blue-eyed grass, and Ute ladies'-tresses (table 10). One of these, the Ute ladies'-tresses, is also federally listed as a threatened species and is discussed in section 5.3.5, *Threatened and Endangered Species*.

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[27] Class B designated noxious weeds are those that have become established in some parts of Washington but are of limited distribution or not present in other regions of the state. In regions where a Class B noxious weed is unrecorded or of limited distribution, prevention of seed production is required. In these areas, the weed is a "Class B designate," meaning it is designated for control by state law. Class C noxious weeds are those already widely established in Washington or of special interest to the state's agricultural industry. Placement on the state noxious weed list allows counties to enforce control if locally desired.

Table 10. Rare plant populations at the Rocky Reach Project area, 1999–2000. (Source: Calypso Consulting, 2000)

| Common Name | Scientific Name | Status | Number of Populations Observed during RTE Wildlife Study |
|---|---|---|---|
| Ute ladies'-tresses | *Spiranthes diluvialis* | State/federal threatened | 3 |
| Porcupine sedge | *Carex hystericina* | State sensitive | 4 |
| Giant helleborine | *Epipactis gigantea* | State sensitive | 4 |
| Adder's-tongue | *Ophioglossum pusillum* | State threatened | 1 |
| Little bluestem | *Schizachyrium scoparium* | State threatened | 1 |
| Blue eyed grass | *Sisyrinchium montanum* | State threatened | 1 |

Each plant taxon of interest is described and summarized below. The rare plant survey included all lands within the project boundary and immediately adjacent lands likely to be affected by project operations; however, it did not differentiate whether populations were within or just outside of the project boundary. The study area for rare plant species extends from the tailrace of Rocky Reach dam (RM 473.5) upstream to the tailrace of Wells dam (RM 516.5). The project boundary varies in elevation along the reservoir and corresponds to the water elevation associated with the probable maximum flood.

*Giant Helleborine and Porcupine Sedge*

The 1999–2000 survey located four populations of giant helleborine within the project area. Two populations are associated with lakes, one is associated with a slough, and the remaining population includes all giant helleborine plants found directly along the Columbia River. The three lake- and slough-associated populations are limited in size. The river population includes, and greatly expands upon, the nine occurrences located during a previous rare plant survey conducted in 1990 for a proposed pool raise. That study area included all land subject to inundation or vegetation change as a result of the proposed pool raise. In 1990, these nine giant helleborine occurrences ranged in size from 9 to more than 250 stems, with an estimated total of 700 stems (Calypso Consulting, 1990). Currently, the river population consists of approximately 60 subpopulations and many thousands of stems.

The 1999–2000 survey also located four populations of porcupine sedge within the project area. All four populations of porcupine sedge were found growing among populations of giant helleborine. In 1990, no populations of porcupine sedge were located.

*Adder's Tongue*

Adder's-tongue is known to occur at 12 sites in scattered counties in Washington (Washington Natural Heritage Program, 2000). During the 1999–2000 survey, one adder's-tongue population with approximately 150 plants was found on Chelan PUD-owned land in a moist, herbaceous meadow adjacent to a small pond near the Columbia River. The pond is not directly connected hydrologically to the Columbia River via surface water (Calypso Consulting, 2000). However, there is probably a groundwater connection through the gravelly substrate between the pond and the river.

*Little Bluestem*

One population of little bluestem was found during the 1999–2000 survey (Calypso Consulting, 2000); it is the second population to be located in the state of Washington, where it is listed as threatened.

*Blue-Eyed grass*

One small population of approximately 50 blue-eyed grass plants was located in the project area, just above the high water level of the Columbia River (Calypso Consulting, 2000). This is the first known population of this taxon in the state of Washington. The plants were discovered growing in a mossy, vernally moist seep on the side of a hill in a silt loam substrate. This is the only known habitat of this sort on the Rocky Reach reservoir. This species is listed as threatened in the state of Washington.

#### 3.5.1.3 Wildlife Resources

**Mammals**

Mule deer (*Odocoileus virginianus*), bighorn sheep (*Ovis canadensis*), cougar (*Felis concolor*), bobcat (*Lynx rufus*), and coyotes (*Canis latrans*) inhabit the mid-Columbia region. These species are present near the project reservoir, and have been recorded occasionally within the project boundary. WDFW manages big game winter areas adjacent to the west shore of the downstream half of the project reservoir; a deer fence, State Highway 97A, and a railroad separate the state management area lands from the project reservoir and habitats immediately adjacent to the shoreline.

In the mid-1960s, Chelan PUD provided funds to the Washington Department of Game (now WDFW) for the purchase of 20,397 acres of land along the Columbia River between Swakane Canyon and Chelan Butte. These lands, the Swakane, Entiat, and Chelan Butte WAs (figure 2), collectively known as the Chelan Wildlife Area, were purchased to mitigate the loss of the wildlife habitat that was inundated by the Rocky Reach and Lake Chelan Projects. The lands that were purchased provide important mule deer winter range within Chelan County. These lands are primarily composed of shrub-steppe habitat at the lower and intermediate elevations on exposed south-facing slopes. Some lands at the highest elevations are predominantly forested with alpine meadow and barren rocky areas (Myers, 2003). WDFW manages these lands.

Small mammals that use areas along the project shoreline include a variety of bat species; badgers (*Taxidea taxus*); striped skunks (*Mephitis mephitis*); a large variety of moles, voles, mice, and shrews; long-tailed weasels (*Mustela frenata*); mink (*M. vison*); raccoons (*Procyon lotar*); porcupines (*Erethizon dorsatum*); river otters (*Lutra canadensis*); beaver (*Castor canadensis*); and muskrats (*Ondatra zibethicus*). Shrub-steppe shorelines provide habitat for Great Basin pocket mice (*Perognathus parvus*), deer mice (*Peromyscus maniculatus*), and western harvest mice (*Reithrodontomys megalotis*), while talus slopes are used by yellow-bellied marmots (*Marmota flaviventris*), bushy-tailed woodrats (*Neotoma cinerea*), and Nuttall's cottontails (*Sylvilagus nuttalli*). Riparian cottonwood, ponderosa pine, and willow areas provide forage and cover for a variety of species.

**Avian Species**

There is a diverse array of avian habitat within the project area and surrounding vicinity. For example, belted kingfishers (*Ceryle alcyon*) use willows and cottonwoods as hunting perches. Large cottonwoods and ponderosa pine provide perch and nest sites for raptors and woodpeckers. Riparian and wetland vegetation provide nest, forage, and cover habitat for songbirds. Fruit orchards are used by a variety of birds, especially mourning doves (*Zenaida macroura*). Shorebirds include killdeer (*Charadrius vociferus*), spotted sandpipers (*Actitis macularia*), terns (*Sterna* spp.), herons, and gulls.

The project reservoir provides limited habitat for breeding waterfowl. Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), and common mergansers (*Mergus merganser*) are probably the most common breeding waterfowl, although backwater areas probably also support a few nesting pairs of pied-billed grebes (*Podilymbus podiceps*) and coots (*Fulica atra*). Winter use of the reservoir by waterfowl and other waterbirds is significant. Approximately 16,000 to 17,000 birds winter on the reservoir each year (Fielder, 1991), with 40 percent being coots.

Raptors that nest in the vicinity of the project reservoir include red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), ravens (*Corvus corax*), great horned owls (*Bubo virginianus*), osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus*

*leucocephalus*), and western screech-owls (*Otus kennicottii*). Cliffs and large cottonwoods and ponderosa pines provide raptor nesting sites. Artificial nesting platforms established by Chelan PUD also are used by some species, and nest boxes maintained by Chelan PUD and WDFW are used by kestrels.

**Reptiles and Amphibians**

Amphibians likely to be present in project area wetlands include Pacific tree frogs (*Hyla regilla*), tiger salamanders (*Ambystoma tigrinum*), long-toed salamanders (*Ambystoma macrodactylum*), Columbia spotted frogs (*Rana luteiventris*), western toads (*Bufo boreas*), great basin spadefoots (*Scaphiopus intermontanus*), and bullfrogs (*Rana catesbiana*). Shallow backwater areas and temporary pools provide habitat for these species.

Reptiles present in the project area include painted turtles (*Chrysemys picta*), western rattlesnakes (*Crotalus viridis*), gopher snakes (*Pituophis catenifer*), western fence lizards (*Sceloporus occidentalis*), western skinks (*Eumeces skiltonianus*), rubber boas (*Charina bottae*), and western terrestrial and common garter snakes (*Thamnophis* spp.). Some of these species are closely associated with wetlands (e.g., painted turtles) while others are more common along rocky and talus shorelines (e.g., rubber boas).

**Rare Wildlife Species**

Chelan PUD conducted a survey for RTE wildlife in the project area in 2000 (DES, 2000). The study area for the wildlife survey consisted of lands within the project boundary and areas likely to be affected by project operations. The study area extends from the tailrace of the project (RM 473.5) upstream to the tailrace of the Wells Project dam (RM 516.5). The width of the rare wildlife species study area varies by location but generally lies between the major roadways on either side of the Columbia River.

State and federally listed wildlife species that are known to, or potentially, occur within the study area are listed in table 10, along with an indication of whether they were observed during the RTE wildlife study. Potential occurrence for each species was determined from confirmed records and known distribution and habitat requirements. The Washington Gap Analysis Project and Chelan PUD records were the primary sources used to develop this list (DES, 2000).

Eleven state and/or federally listed species were documented during the RTE Wildlife Study (DES, 2000) in the project study area. These species, as well as monitor[28] and candidate species, are listed in table 11.

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[28] State Monitor species are not considered state Species of Concern , but are monitored for status and distribution. They are managed by WDFW, as needed, to prevent them from becoming endangered, threatened, or sensitive.

Table 11. State and federally listed and monitored wildlife species known to occur or that may occur in the Rocky Reach Project area. (Source: DES, 2000)

| Common Name | Scientific Name | Status | Known to occur in the project area |
|---|---|---|---|
| Bald eagle | *Haliaeetus leucocephalus* | State/Federal Threatened | Yes[a] |
| Pygmy rabbit | *Brachylagus idahoensis* | State/Federal Endangered | No |
| Common loon | *Gavia immer* | State Candidate | Yes[a] |
| Great blue heron | *Ardea herodias* | State Monitor | Yes[a] |
| Osprey | *Pandion haliaetus* | State Monitor | Yes[a] |
| Northern goshawk | *Accipiter gentilis* | State Candidate, Federal SOC | Yes |
| Swainson's hawk | *Buteo swainsoni* | State Monitor | Yes |
| Golden eagle | *Aquila chrysaetos* | State Candidate | Yes[a] |
| Peregrine falcon | *Falco peregrinus* | State Endangered, Federal SOC | Yes |
| Prairie falcon | *Falco mexicanus* | State Monitor | No |
| Burrowing owl | *Speotyto cunicularia* | State Candidate, Federal SOC | Yes |
| Sage grouse | *Centrocercus urophasianus* | State Threatened, Federal SOC | No |
| Sharp-tailed grouse | *Tympanuchus phasianellus* | State Threatened, Federal SOC | No |
| Lewis' woodpecker | *Melanerpes lewis* | State Candidate | Yes |
| White-headed woodpecker | *Picoides albolarvatus* | State Candidate | Yes |
| Pileated woodpecker | *Dryocopus pileatus* | State Candidate | No |
| Olive-sided flycatcher | *Contopus borealis* | Federal SOC | Yes |
| Yellow-billed cuckoo | *Coccyzus americanus* | Federal Candidate | No |
| Willow flycatcher | *Empidonax traillii* | Federal SOC | Yes |
| Loggerhead shrike | *Lanius ludovicianus* | State Candidate, Federal SOC | Yes[a] |
| Sage thrasher | *Oreoscoptes montanus* | State Candidate | Yes |
| Sage sparrow | *Amphispiza belli* | State Candidate | No |
| Merriam's shrew | *Sorex merriami* | State Candidate | No |

| Common Name | Scientific Name | Status | Known to occur in the project area |
|---|---|---|---|
| Small-footed myotis | *Myotis ciliolabrum* | State Monitor, Federal SOC | Yes[a] |
| Little brown myotis | *Myotis lucifugus* | State Monitor, Federal SOC | Yes[a] |
| Yuma myotis | *Myotis yumanensis* | State Monitor, Federal SOC | Yes[a] |
| Big brown bat | *Eptesicus fuscus* | State Monitor | No |
| Pallid bat | *Antrozous pallidus* | State Monitor | No |
| Townsend's big-eared bat | *Corynorhinus townsendii* | State Candidate, Federal SOC | No |
| Western gray squirrel | *Sciurus griseus* | State Threatened, Federal SOC | Yes |
| Sagebrush vole | *Lemmiscus curtatus* | State Monitor | No |
| California bighorn sheep | *Ovis canadensis* | Federal SOC | Yes |
| Sagebrush lizard | *Sceloporus graciosus* | Federal SOC | Yes[a] |
| Night snake | *Hypsiglena torquata* | State Candidate | No |
| Western toad | *Bufo boreas* | State Candidate/ Federal SOC | Yes[a] |

Note: SOC – species of concern

[a] Observed during the RTE Wildlife Study (DES, 2000).

### 3.5.2 Environmental Effects

Chelan PUD proposes (Settlement Agreement Article 7) to fund implementation of the Wildlife Plan (Chelan PUD, 2006e) developed in consultation with the NSWG during pre-filing consultation and revised several times before reaching its final version in the Settlement Agreement. The objectives of the Wildlife Plan are to: (1) restore, maintain, or improve the Chelan Wildlife Area; (2) restore, maintain, improve, or increase habitat for key indicator wildlife species; and (3) implement the "Ute Ladies'-tresses (*Spiranthes diluvialis*) Along Rocky Reach Reservoir Management Plan." To attain these objectives, Chelan PUD would: (1) fund measures that would restore, maintain, and improve habitats on WDFW's Chelan Wildlife Area and on adjoining state and federal (Forest Service and BLM) lands, referred to as the Rocky Reach Wildlife Area; (2) provide a conservation easement to preserve riparian habitats associated with Chelan PUD's Sun Cove property; (3) fund a noxious weed control program; (4) continue to conduct wildlife surveys; and (5) implement measures to protect Ute's ladies-tresses,

including controlling noxious weeds at colony sites, monitoring colonies, and obtaining a conservation easement for one site.

Interior and WDFW recommend that the Commission adopt the terms of the Settlement Agreement. The Forest Service recommends, pursuant to FPA Section 10(a), that within 2 years of license issuance, Chelan PUD, in consultation with and subject to approval by the Forest Service and other state and federal agencies and Indian tribes, implement the September 23, 2005, version of the Wildlife Plan (Chelan PUD, 2005b). With respect to habitat restoration, the September 23, 2005, version calls for the same funding amounts and restoration measures as the February 3, 2006 version included in the Settlement Agreement.

#### 3.5.2.1 Restoration of Habitats on the Chelan Wildlife Area and Adjoining Federal Lands

Chelan PUD explains in the offer of settlement that the signatory parties were unable to identify any lands within the project boundary that would be suitable for implementing environmental measures designed for protecting, mitigating, and enhancing wildlife. Therefore, the signatories decided to focus management actions to benefit key indicator wildlife species on the Chelan and Rocky Reach Wildlife Areas. Key indicator wildlife species include: mule deer and bighorn sheep; rare, threatened, endangered, and sensitive species; SOCs; or priority species.

Chelan PUD proposes to make funding, in varying amounts and timing, available to WDFW to restore, maintain, or improve lands in the Chelan Wildlife Area. Chelan PUD proposes to provide this funding as follows:

1. Within 180 days of the effective date of the new license, and by January 31 of each subsequent year of the new license, Chelan PUD would make available to WDFW $74,000 to restore, maintain, or improve WDFW lands within the Chelan WMA.
2. Within 180 days of the effective date of the new license, Chelan PUD would make available to WDFW an amount not to exceed $286,000 to restore 1,300 to 1,400 acres in the Chelan Wildlife Area previously under cultivation or in need of restoration to self-maintaining shrub-steppe habitat vegetated by bunchgrasses and shrubs such as snowy eriogonum, lupine, balsamroot, big sage, bitterbrush, serviceberry, and elderberry;
3. Within 180 days of the effective date of the new license, and by January 31 of subsequent years two through six of the new license, Chelan PUD would make available $67,000 to WDFW for the habitat restoration of agricultural lands in the Chelan Wildlife Area; and

4. Between years 10 and 50[29] of the term of a new license, Chelan PUD would make available to WDFW an amount not to exceed $457,000 to restore, maintain, or improve the Chelan Wildlife Area.

Chelan PUD also proposes to provide additional funding for habitat restoration on federal lands within the Rocky Reach Wildlife Area. Chelan PUD proposes to make available to BLM $20,000 annually and up to $20,000 annually on a 50/50 matching basis, and to provide to the Forest Service $5,000 annually and up to $5,000 annually on a 50/50 matching basis, for the term of the new license and any subsequent annual licenses, to restore, maintain, or improve BLM and Forest Service lands, respectively, within the Rocky Reach Wildlife Area. This funding could be used for native shrub-steppe habitat rehabilitation, noxious weed control, prescribed burning, native forb replanting, water development projects, and similar projects.

Under the applicant's proposal, wildlife management activities would occur on three areas of land: (1) Chelan PUD lands, (2) the Chelan Wildlife Area; and (3) Rocky Reach Wildlife Area lands. Lands within the Swakane, Entiat, and Chelan Butte Wildlife Areas are collectively referred to as the Chelan Wildlife Area and include state land managed by WDFW and the Washington Department of Natural Resources (WDNR). The Rocky Reach Wildlife Area is defined in the management plan as "public lands in Chelan County and Douglas County within approximately a 6-mile corridor of the Rocky Reach Reservoir including those of the Forest Service, BLM, and FWS lands adjacent to their hatchery."

Additionally, Chelan PUD proposes to form a RR Wildlife Forum to provide recommendations to the relevant management agencies about the direction of the Wildlife Plan and the best use of the funds to meet short- and long-term goals of the agencies.

*Our Analysis*

Habitats within the Chelan and Rocky Reach Wildlife Area s are upland shrub steppe habitats and associated riparian drainages, located well above the project boundary for the most part but also extending down to the project reservoir. Chelan PUD lands enclosed within the project boundary are predominately limited to the high-water line along the project reservoir and consist of a narrow band of riparian habitat.

The project operates in a manner that provides fairly stable water levels, resulting in a narrow, stable, and well-developed riparian corridor. There is no information in the record indicating that project O&M is adversely affecting upland habitats. However, there is some information suggesting that mule deer seeking and using low elevation

[29] Chelan PUD proposes a 50-year license term; however, the Commission would determine the term of any new license.

shrub steepe habitat and riparian habitat adjacent to the project reservoir may be adversely affected by project-related recreation disturbance, particularly during severe winters.

The upland habitats that would be subject to the management plan consists of state lands purchased with funds provided by the Chelan PUD to mitigate the loss of land inundated by the original construction of the Rocky Reach and Lake Chelan Projects and federal lands that are managed in coordination with the Chelan Wildlife Area to maximize wildlife benefits. A major focus of the wildlife measures outlined in the management plan is restoring native shrub steppe habitat to improve mule deer winter survival, although other wildlife such as sage grouse would also benefit from a properly functioning shrub steppe ecosystem.

WDFW, in its October 28, 2005, comments on the draft EIS, states that in this region the success of wintering mule deer can hinge on minimizing energy expenditures. WDFW believes that the project reservoir represents an impediment to mule deer needing to access winter habitat across the river in Douglas County. According to WDFW, mule deer now have to expend more energy to cross the Columbia River to get to winter forage because project construction doubled the width of the river and reduced river current. In its May 24, 2006, letter, WDFW states that during severe winters mule deer are driven to milder microclimates in the valley bottom near flowing streams. WDFW says this exposes mule deer to human disturbance and vehicular collisions as they attempt to locate these habitats along the project shoreline. Finally, WDFW says that remaining riparian and low elevation shrub-steppe habitat immediately adjacent to the reservoir is of limited value because of noise and disturbance associated with motorized watercraft recreation and agriculture and urban development, which can be indirectly attributed to the presence of the project.

However, while it is not unreasonable to assume that mule deer historically crossed the Columbia River in the project area, that they are now impeded from crossing the project reservoir, or that the project resulted in increased energy expenditures of mule deer, there is no information in the record to support these assumptions. Mule deer studies conducted between 2000 and 2002 (Myers, 2003)[30] located mule deer outfitted with radio collars a total of 1,342 times in both winter and summer seasons. No deer were found in Douglas County or attempting to cross the river; although a few were located near the project reservoir on the Chelan County side. The lack of sightings in Douglas County may be attributed to low snow fall and higher than normal winter temperatures, as well as access limitations associated with residential and agricultural development, a state highway, and a railroad. During the summer months when water-based recreation levels are greatest, deer are located mostly in habitat above 3,904 feet in elevation (Myers, 2003). Thus, motorized watercraft likely disturb few individuals

[30] Chelan PUD funded the mule deer studies to provide baseline information on winter habitat use to determine the most effective way of enhancing mule deer habitat.

during the summer. During the critical winter periods, there is less water-based recreation, and it is likely limited to activities such as duck hunting and some snowmobiling. During critical winter periods, any such disturbance could significantly drain energy reserves of wintering mule deer and other wildlife.

Regardless, as WDFW acknowledges, the Chelan Wildlife Area and adjoining federal lands are now managed to provide mule deer habitat needs for thermal and hiding cover and that mule deer use of the riparian habitat along the reservoir within the project boundary is very limited. Lands within the project boundary represent a very small component of the habitat base for mule deer and other wildlife in the project area. Furthermore, WDFW states that it wishes to discourage big game from crossing the highway to get to the river.

The mule deer studies (Myers, 2003) determined that the primary cause of mule deer population decline in recent years is severe winters and loss of winter habitat and healthy forage due to fires in 1988 and 1994. Bitterbrush, the preferred mule deer winter forage species, was dramatically reduced by the fires. The majority of the shrub-steppe habitat that is important to wintering mule deer is located in the Chelan Wildlife Area, which is outside of the project boundary.

A number of cumulative factors are placing greater importance on remaining shrub-steppe habitats within the Chelan and Rocky Reach Wildlife Areas. Human activities such as residential development and agriculture have resulted in a highly fragmented landscape with relatively few large tracts of native vegetation (DES, 2000). WDFW reports that about 100 parcels of land out of nearly 400 parcels with frontage on the project reservoir have residences on them and conversion of habitats to residential/industrial uses has increased in total area by 231 acres (66 percent). Some of this development may be attributed to indirect cumulative effects associated with the project, including a rapidly increasing population growth in Chelan and Douglas counties, and the popularity of building along the reservoir because of the attraction of flat water for recreation. The remaining small areas of native habitat may be either too isolated or insufficient in size to support healthy wildlife populations. Other human activities that have negatively affected wildlife habitat in the area include land fill, trash dumping, off-road vehicle use, and uncontrolled camping, all of which is occurring outside the project boundary.

The lands within the Chelan Wildlife Area are not currently functioning at the level that was present at the time of their purchase, due to factors unrelated to continued project operations. Myers (2003) found that enhancing mule deer winter ranges in Chelan County would require the restoration of bitterbrush stands. Chelan PUD has apparently voluntarily provided some funding for wildlife habitat improvements, but WDFW has not had sufficient funding to restore and manage lands within the Chelan Wildlife Area to desired levels. Additional funding would permit habitat improvements that would preserve ecosystem functions and increase the level of habitat currently

available. Converting 1,400 acres of lands under cultivation to native shrub-steppe habitats would benefit mule deer populations and other wildlife dependant on shrub-steppe habitats by providing higher quality habitats. Coordinating restoration activities on adjoining federal land would maximize benefits to wildlife. Without continued maintenance (for example, prescribed burns and noxious weed control), established native vegetation would become senescent and habitat attributes would decline, as has the existing native shrub steppe habitats on the wildlife area and in the region.

In addition to shrub steppe habitat restoration, the Wildlife Plan identifies a number of other potential activities and projects that could be undertaken to benefit wildlife. These include establishing wildlife plantings in Swakane Canyon, planting trees and shrubs to develop riparian strips and shorelines, installing erosion control structures in selected canyons, installing water guzzlers and other wildlife watering basins, and improving and developing irrigations systems. All of these habitat measures would benefit a variety of wildlife, including mule deer. These improvements could help delay winter migration of mule deer to lower elevations, reducing their exposure to recreational disturbance.

Neither the settlement parties nor the Wildlife Plan explain the allocation of funds, provide a basis for the funding levels, describe in detail where the habitat improvement actions would take place, or provide a schedule for conducting management activities. Instead, the applicant and the settlement parties intend to coordinate annually to define appropriate actions and make recommendations regarding implementation of the plan. WDFW states that Chelan PUD would have oversight of all measures implemented under the plan and that any entity implementing any measures would be accountable to Chelan PUD to ensure the actions are consistent with any license issued. That accountability would be attained through an annual report to be filed with Chelan PUD by January 31 of each year detailing the work that has been completed in the previous year and the work planned for the subsequent year. Chelan PUD would provide reimbursement only for actions that were consistent with the license. Because of the lack of specificity in the plan and provisions for Commission approval, it would be difficult for the Commission to ensure compliance with the plan and ensure that the measures being implemented are benefiting project resources.

While the habitat improvement measures described above would directly benefit wildlife (from butterflies to mule deer ) by helping to meet their life history requisites, several of the actions proposed in the Wildlife Plan go beyond restoration of native shrub steppe habitat to include actions that are typically the responsibility of the land managing agency, such as law enforcement, public education, public use management (road access control) to ensure compatibility with wildlife management objectives, and the introduction of native species.

#### 3.5.2.2 Wildlife Surveys

In coordination with the RR Wildlife Forum, Chelan PUD proposes to continue to conduct habitat improvement projects and/or wildlife surveys similar to those conducted during the term of the original FERC license. The cost of these activities would not exceed $10,500 or equivalent staff-days per year during the term of a new license and any subsequent annual licenses. The stated intent of this funding is to survey and monitor threatened, endangered, and sensitive species on a periodic schedule as directed by the RR Wildlife Forum. Surveys would be conducted annually and would address priority species. Survey techniques and schedule would be developed in coordination with the RR Wildlife Forum. Chelan PUD also proposes to provide annual wildlife survey reports to the RR Wildlife Forum. WDFW recommends that the Commission include this provision in the license without material modification.

*Our Analysis*

Chelan PUD has conducted bald eagle overwinter abundance surveys on the project reservoir since 1982 and Canada goose nesting surveys since 1983. Continuing these monitoring efforts would provide data useful to managing geese and monitoring the recovery of bald eagles. However, the Chelan PUD proposal would increase the amount of funding, open the effort to rare species, and allow funds to be used for habitat improvement projects. The wildlife surveys proposed by Chelan PUD would have the potential to provide site-specific information that could be used to benefit wildlife by identifying areas and/or species most in need of wildlife protection or management. The greater level of funding and broader range of surveyed species proposed by Chelan PUD could provide valuable rare species information that could be used to benefit a broader range of species than existing surveys. However, in its present ambiguous form, staff cannot fully evaluate the benefits, adequacy of the funding levels, or need for the additional habitat measures or alternative surveys included in the Settlement Agreement and Wildlife Plan.

#### 3.5.2.3 Sun Cove Riparian Habitat Maintenance

In the Settlement Agreement, Chelan PUD proposes to enter into a contract with the Chelan-Douglas Land Trust, or other appropriate entity, to pursue and make available funding to acquire a conservation easement and to limit access to the reservoir on Chelan PUD-owned property near Sun Cove for protection of the shoreline riparian area. The easement would also allow the remaining portions of the properties to be managed or sold by Chelan PUD at its discretion. The easement would run the length of the riverward portion of the property (approximately 3,500 feet along the shoreline) and extend inland 50 feet from the ordinary high water line. The easement would also provide two 100-foot-long access corridors along the riverward portion of the Chelan PUD property at locations to be approved by WDFW, to provide community access to the river for the

benefit of future land owners, including boat launching and moorage facilities. Chelan PUD's October 28, 2005, and June 6, 2006, responses to the draft EIS state that the upland habitats have limited wildlife value and that the Sun Cove properties' primary habitat value is the riparian habitat. WDFW concurs with Chelan PUD's proposal.

*Our Analysis*

Sun Cove riparian and shrub-steppe habitats are located on the east bank of the project reservoir from RM 491.6 to 492.1 and from RM 492.4 to 492.9, respectively (DES, 2000). The Sun Cove property consists of about 164 acres of shrub-steppe and riparian habitats that are owned by Chelan PUD. These lands are outside, but adjacent to, the project boundary, with the exception of a narrow strip of land within the high-water mark that is within the project boundary.

The riparian habitat is relatively undisturbed because there is limited public access to the area. The shrub-steppe habitat has evidence of recent disturbance from ATV use along a trail within the site. Chelan PUD currently posts ATV restrictions on this trail. The nearby Sun Cove residential development is also encroaching on this area. Development, agriculture, and a highway fragment this habitat from other wildlife habitat, limiting its value to mule deer, grouse, and other wildlife species. Other than the indirect effects of dispersed recreation use of the sites, there are no project-related effects to the Sun Cove properties.

As noted earlier, high quality riparian habitat is limited in the project area. Given its proximity to the project reservoir, establishing and protecting a riparian buffer would protect valuable riparian habitat along the reservoir edge from encroaching development.

#### 3.5.2.4 Noxious Weeds

Chelan PUD proposes to provide $10,000 in funding annually, for the term of the new license and any subsequent annual licenses, for implementation of an integrated noxious weed control program in the Rocky Reach Wildlife Area. The program would be implemented by Chelan PUD personnel or other qualified personnel selected by the RR Wildlife Forum and would include noxious weed species defined by the Washington Natural Heritage Program, Washington State Weed Board, or other entity recommended by the RR Wildlife Forum. The program would not include aquatic weeds, which we address in section 3.4.2.7, *Other Fisheries Issues*. This program would be established through inter-agency cooperation and coordination with the intention of developing an area-wide noxious weed control strategy. In the PDEA, Chelan PUD indicated an intention to continue its current noxious weed program for purple loosestrife, which includes professional application of herbicides and bio-control methods. Although not mentioned in the Settlement Agreement, we assume that Chelan PUD still proposes to continue controlling purple loosestrife in this manner. In the Settlement Agreement,

Chelan PUD has proposed additional noxious weed control funding for protection of Ute ladies'-tresses or other rare species on public lands adjacent to the reservoir. Ute ladies'-tresses is a federally listed species and is discussed in section 3.6.2.5. As parties to the Settlement Agreement, Interior and WDFW support Chelan PUD's proposal.

*Our Analysis*

Weed invasion correlated with grazing, fire, fire suppression, water fluctuation, and development is extensive in the project area. The water fluctuation zone along the reservoir, where the water level fluctuates daily during the growing season, is dominated by weeds that thrive in this regime. Many of these weeds compete with native and rare plant species (Calypso Consulting, 2000). The more disturbance an area gets, the greater the probability that noxious weeds will become established and out-compete native species. Sources of disturbance include agricultural, residential, and commercial development; land clearing; grazing; and water-level manipulation. Daily reservoir water level fluctuations are controlled by Wells dam upstream and Rocky Reach dam downstream. Fluctuations in the upriver portion of the reservoir are mainly influenced by water releases from Wells dam, while the middle and lower portions of the reservoir are mainly influenced by water storage by the Rocky Reach dam.

The rare plant survey (Calypso Consulting, 2000) found that all six species of rare plants found in the project area (porcupine sedge, giant helleborine, adder's tongue, little bluestem, blue-eyed grass, and the federally listed threatened Ute ladies'-tresses) are in danger of being out-competed by various species of noxious weeds. All of these species are located in areas that are hydraulically connected to the project and therefore could be affected by project operations. Potential effects on the federally listed Ute ladies'-tresses are discussed in section 3.6.2.5.

Porcupine sedge and giant helleborine populations have expanded in the past 10 years. They occur within the lower and middle portions of the reservoir where the water level is more stable than upstream and there is a slow current. Because these conditions are favorable to these species, they would be expected to continue to expand under proposed project conditions. Possible project-related effects on these species include recreation activities, maintenance, and competition from noxious weeds. Both species are in danger of being out-competed by yellow flag and purple loosestrife. The largest subpopulation of giant helleborine in the project area is located near a very large stand of purple loosestrife that could threaten a portion of this subpopulation.

The noxious weed and rare species measures proposed by Chelan PUD would provide a mechanism to reduce, control, and monitor noxious weeds on Chelan PUD and adjoining public lands. The proposed integrated noxious weed control program would be developed through interagency coordination, which would support a wider reaching plan than the current program that targets only purple loosestrife. Because noxious weeds are

likely to pose the biggest threat to rare species in the project area, management and control of these weeds both within and near the project boundary would result in the protection and enhancement of current and potential rare plant habitat inside the project boundary.

However, neither the Settlement Agreement nor the Wildlife Plan clearly define the types of measures that would be implemented, where they would be implemented, or when they would be defined and implemented. The Settlement Agreement and Wildlife Plan also do not include any justification of the funding levels. Comments provided by WDFW (May 24, 2006) and Chelan PUD (June 6, 2006) indicate that the funds also would be used to control noxious weeds in the Chelan and Rocky Reach Wildlife Areas, particularly following management activities. Such actions would help ensure that native vegetation plantings successfully take hold and that management actions continue to provide wildlife benefits. As noted above, certain aspects of project operation (reservoir fluctuation and maintenance operations that result in soil disturbance) can contribute to the spread of noxious weeds. Efforts to minimize and control the spread of noxious weeds from project-related activities as part of an integrated noxious weed control program would benefit wildlife and be consistent with national and local control efforts.

Additional funding for noxious weed control is proposed with a focus on Ute ladies'-tresses protection. The additional noxious weed control would also benefit other rare species that coexist with the Ute ladies'-tresses, such as giant helleborine and adder's tongue.

#### 3.5.2.5 Effects of Recreation on Wildlife Habitat

In the Settlement Agreement, Chelan PUD proposes a number of measures related to recreation development, such as renovations at Lincoln Rock and Daroga state parks, a paved one-mile trail linking Lincoln Rock State Park to a fish bypass viewing station, and the revitalization of Entiat Park, as outlined in the Recreation Resource Management Plan. These measures are discussed in greater detail in section 3.8.2 *Recreation Resources, Environmental Effects*. With respect to wildlife, Chelan PUD proposes in the Recreation Plan to conduct a Recreation Use Assessment during the term of the new license. A component of this study is to include "analysis of wildlife impacts resulting from recreation use of the reservoir." This analysis would be done in coordination with the RR Wildlife Forum. The RR Wildlife Forum would also coordinate with the RR Recreation Forum when habitat restoration, maintenance, and improvement projects are implemented in order to provide for compatible public use.

*Our Analysis*

Recreation development has the potential to displace or disrupt wildlife habitat. Chelan PUD proposes to consider both public use and wildlife effects through the course

of their recreation management planning and site development. As a result, any adverse effects on wildlife from recreational site development or use should be minimal.

### 3.5.3 Unavoidable Adverse Impacts

None.

## 3.6 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES AND ESSENTIAL FISH HABITAT

### 3.6.1 Affected Environment

Three federally listed threatened or endangered fish species are known to occur in the project area. These are the bull trout, Upper Columbia River steelhead, and Upper Columbia River spring-run Chinook salmon. According to the FWS, six federally listed threatened or endangered wildlife species (gray wolf, Canada lynx, northern spotted owl, grizzly bear, pygmy rabbit, and bald eagle) and three listed plant species (showy stickseed, Wenatchee Mountains checker-mallow, and Ute ladies'-tresses) may occur in the vicinity of the project area (letter from Mark G. Miller, Project Leader, Central Washington Field Office, FWS, to Gregg Carrington, Licensing Director, Chelan PUD, dated October 28, 2004).

#### 3.6.1.1 Upper Columbia River Spring-run Chinook Salmon

NMFS listed the Upper Columbia River spring-run Chinook salmon ESU as endangered under the ESA on March 24, 1999 (64 FR 14307). Critical habitat for this species, effective January 2, 2006, was designated on September 2, 2005 (70 CFR 52630–52858). We address the species biology in section 3.4.1.4, *Anadromous Fish Species.*

#### 3.6.1.2 Upper Columbia River Steelhead

NMFS listed the Upper Columbia River steelhead as endangered on August 18, 1997 (62 FR 43937). Critical habitat for this species, effective January 2, 2006, was designated on September 2, 2005 (70 CFR 52630–52858). Notice of final listing determination was issued on January 6, 2006 (71 FR 834). We address the species biology in section 3.4.1.4, *Anadromous Fish Species.*

#### 3.6.1.3 Bull Trout

The Columbia River bull trout populations were listed as threatened under ESA in June 1998 (63 FR 31647). Critical habitat for this species was designated on September 26, 2005 (70 CFR 56212) and the mainstem Columbia River and tributaries in the project

area were excluded from the final designations. We address the species biology in section 3.4.1.4, *Anadromous Fish Species.*

#### 3.6.1.4 Gray Wolf

The federally listed threatened gray wolf (*Canis lupis*) was historically well distributed throughout Washington before European settlers arrived. Since 1990, biologists have seen three separate groups of adults and pups in the North Cascades (NPS, 1998). Wolves may occasionally be present in the mountains of the Wenatchee-Okanogan National Forest that includes the drainages of the Wenatchee, Entiat, Methow, and Okanogan rivers. However, wolves are not currently present in the lower elevations near the project.

#### 3.6.1.5 Canada Lynx

The federally listed threatened Canada lynx (*Lynx canadensis*) inhabit forests and wet bogs in the United States and Canada (WDFW, 2001). They are found in high-elevation forests of north central and northeast Washington, including Chelan, Okanogan, Ferry, Stevens, and Pend Oreille counties but may be extirpated from the southern Cascade mountains (WDFW, 2001). Transient lynx may occasionally be found west of the Cascade crest, probably during years of low prey availability east of the Cascades.

In the Cascade mountains, lynx live in the lodgepole pine and Engelmann spruce-subalpine fir forests of the high mountains. Older, mature, forests with downed trees and windfalls provide cover for denning sites, escape, and protection from severe weather. These habitats are not found in the lower elevation shrub-step-habitats associated with the project. The Canada lynx does not currently occur in the project area.

#### 3.6.1.6 Northern Spotted Owl

The federally listed threatened northern spotted owl *(Strix occidentalis caurina*) is found in old-growth forests and occasionally in younger conifer forest in the Cascade, Sierra Nevada, and coastal mountains of British Columbia, Washington, Oregon, and northern California. The range of the spotted owl habitat on the Wenatchee and Okanogan National Forests has been described as being in old-growth and late successional conifer forest below the 5,000-foot elevation. Some of the 53 units totaling 2.2 million acres of critical habitat in Washington are included in the Wenatchee, Entiat, and Methow river drainages (personal communication, B. Gains, Forest Service Biologist, Wenatchee, WA, as cited Chelan PUD, 2004a). Owls nest in the Wenatchee and Okanogan National Forests (Smith et al., 1997) and a northern spotted owl activity center is documented on the northwest side of the Wenatchee River about 1 mile from the Chiwawa fish facility, a Rock Island Project satellite fish rearing facility. The project is not within known northern spotted owl habitat.

#### 3.6.1.7 Grizzly Bear

The historic range of grizzly bears (*Ursus acrtos horribilis*) once covered over a third of what is now the continental United States. It is federally listed as threatened in the lower 48 states, where it survives only in parts of the Rocky Mountains and northern Cascades. The North Cascades Grizzly Bear Recovery Area includes all of the North Cascades National Park, most of the Mount Baker-Snoqualmie National Forest, and all of the Wenatchee and Okanogan National Forest lands to the north of I-90. The recovery area extends roughly from I-90 to the Canadian border and east to the Columbia and Okanogan rivers on the east side of the Cascade Mountains. The North Cascades Grizzly Bear Recovery Area includes portions of Chelan and Okanogan counties but does not border the Columbia River or the project reservoir shoreline. The Wenatchee, Entiat, and Methow rivers and tributaries of the Okanogan River extend into the North Cascades Grizzly Bear Recovery Area. The grizzly bear does not occur currently in the project area.

#### 3.6.1.8 Pygmy Rabbit

The federally listed endangered pygmy rabbit (*Brachylagus idahoensis*) is the smallest native rabbit in North America. Its distribution is scattered in the sagebrush-dominated shrub steppe areas of the Great Basin. This includes portions of Oregon, California, Nevada, Utah, Idaho, Montana, Wyoming, and Washington. Washington populations are discontinuous from the rest of the species' range and are genetically distinct from other populations. The known range of the Washington pygmy rabbit formerly occupied sagebrush habitat in five counties: Benton, Adams, Grant, Lincoln, and Douglas (WDFW, 1995). Pygmy rabbits are usually found in areas of dense sagebrush cover with relatively deep, loose soils. They dig their burrows underneath sagebrush bushes and depend almost exclusively on sagebrush for food during the winter. From spring through fall, they also eat native bunch grasses and forbs.

Pygmy rabbits are not found in the project area. The only known population in Washington and the last known location inhabited by pygmy rabbits in the state was in Douglas County at Sagebrush Flat on land owned by WDFW. Sagebrush Flat is in the south-central part of Douglas County, approximately 28 air miles from Rock Island dam There are no documented historic occurrences of the pygmy rabbit within six miles of the Rocky Reach reservoir.

#### 3.6.1.9 Bald Eagle

The federally listed threatened bald eagle (*Haliaeetus leucocephalus*) tends to select perch sites that offer an open-limbed structure, allowing good visibility and unobstructed flight (Stalmaster and Newman, 1979; Fielder and Starkey, 1986). In its December 27, 2004, letter, Chelan PUD indicates that the diurnal perches along Rocky

Reach reservoir preferred by bald eagles include cottonwood trees, ponderosa pine trees, and snags (44 percent, 25 percent, and 11 percent of 2,114 perch use observations, respectively). There is a potential night roost identified within one-half mile of Rocky Reach dam in Douglas fir trees growing on the north facing rock cliffs. This site has the habitat and topographic characteristics that may lend it to being a bald eagle communal night roost. However, no eagle presence has been documented to date at this site and Chelan PUD in its October 28, 2005, response to the draft EIS reports that the Washington Natural Heritage Program has removed the potential night roost from its list of potential roost sites. Also in its December 27, 2004, letter, Chelan PUD reports that one small communal night roost was suspected in a canyon north of Ribbon Cliff along the reservoir, but that became a nest site in approximately 1998 After the nesting pair started to nest at that site, eagles did not seem to use the site as a communal roost.

There are four known bald eagle nests in Chelan County. One nest site is north of Ribbon Cliff approximately one-quarter mile from the river in a canyon perpendicular to the river. A second nest is at the northwest end of Lake Wenatchee. A third, new, nest has been reported along the Icicle River approximately one-half mile upstream from its confluence with the Wenatchee River. The fourth bald eagle nest in Chelan County is located at the head of Lake Chelan. There are no known bald eagle nests in Douglas County near the project area.

Taylor (1989) reported that 1 to 7 bald eagles wintered along the Wenatchee River between 1982 and 1989. In its December 27, 2004, letter, Chelan PUD reports that several bald eagles use the lower portion of the Entiat River during winter. These eagles likely feed on resident fish in the rivers and deer carrion on surrounding hills. Salmon and steelhead are relatively unimportant in the diets of bald eagles wintering along Rocky Reach reservoir or the Wenatchee and Entiat rivers because most of the eagles do not arrive before November and by then, spawned out carcasses are no longer available to the eagles.

Most of the bald eagles that winter along Rocky Reach reservoir nest in Alaska and northwestern Canada (Stinson, 2001 as cited in Chelan PUD's December 27, 2004 AIR response). Waterfowl, especially American coots, provide most of the winter diet of bald eagles along the mid-Columbia River (Fielder, 1982). To a lesser extent, wintering bald eagles also feed on resident fish in the Rocky Reach reservoir and tributary streams during winter. During severe winters, eagles supplement their diet with winter-killed deer carrion along the hillsides overlooking Rocky Reach reservoir (Fielder, 2000).

#### 3.6.1.10 Showy Stickseed

Showy stickseed (*Hackelia venusta*) is listed as endangered by FWS and the state of Washington. It is locally endemic in the Wenatchee Mountains in the eastern Cascades physiographic province of Chelan County, Washington. Showy stickseed is an

upland plant that occurs in dry, loose soils and crevices on granite or talus slopes that range from 25 to 75 degrees. It generally occurs at elevations of 1,500 to 2,500 feet. According to Chelan PUD's December 27, 2004, letter, there is only one known population of this plant, occurring on less than 2.4 acres of land on the lower slopes of Tumwater Canyon on federal land. Rare plant surveys along the Rocky Reach shorelines did not locate this plant (Calypso Consulting, 2000; Caplow, 1990).

#### 3.6.1.11 Wenatchee Mountains Checker-Mallow

Wenatchee Mountains checker-mallow (*Sidalcea oregano var.* calva) is listed as endangered by FWS and the state of Washington. It occurs within tributary basins of the Wenatchee River at elevations ranging from 1,900 to 3,200 feet. This plant is most abundant in moist meadows that have surface water or saturated upper soil profiles extending into early summer. Suitable meadows vary in size from 0.5 acre to greater than 100 acres. In its December 27, 2004, letter, Chelan PUD indicates that this plant is also found in somewhat open coniferous stands dominated by Douglas fir and ponderosa pine and along edges of shrub and hardwood thickets. The historical range of this species covered an area of approximately 11 by 3 miles, extending south to southeast from Leavenworth in Chelan County, Washington, generally in the vicinity of the Camas Meadows and Camas Creek, east of Peshastin Creek (Washington Natural Heritage Program, 1998). Rare plant surveys along the Rocky Reach shorelines did not locate this plant (Calypso Consulting, 2000; Caplow, 1990).

#### 3.6.1.12 Ute Ladies'-tresses

Ute ladies'-tresses, a federally listed threatened species, is an attractive, perennial, white-flowered member of the orchid family. It is known to occur in Utah, Colorado, Wyoming, Nebraska, Montana, and Idaho, as well as Washington. The preferred habitat of Ute ladies'-tresses is low-elevation wetland and riparian areas, including spring habitats, mesic to wet meadows, river meanders, and floodplains. Ute ladies'-tresses seem to require "permanent sub-irrigation," indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season and into the late summer or early autumn (FWS, 1995). Ute ladies'-tresses occur primarily in areas where the vegetation is relatively open and not overly dense or overgrown (FWS, 1995). Populations tend to decline if trees and shrubs invade the habitat where they reside (FWS, 1995).

Three Ute ladies'-tresses populations were found during surveys conducted in 1999–2000 (Calypso Consulting, 2000). The 1999–2000 surveys included all lands within the project boundary and immediately adjacent lands likely to be affected by project operations. All of the populations that were identified within the project area were located in wooded or wet-meadow wetlands. In 2005, BLM located a fourth

population on BLM land outside the project boundary in a narrow band above the high-water line and below drier, sandier soil.

The habitat requirements and life history features of this federally listed species make it vulnerable to the combined effects of land conversion, changes in hydrology, invasions of weedy species, loss of pollinators, and diminishing potential habitat. It is not known if the populations of Ute ladies'-tresses that have been identified within the project area are increasing, decreasing, or remaining constant.

### 3.6.2 Environmental Effects

Because of the lack of suitable habitat and their absence from the project area, relicensing the project will not affect gray wolf, Canada lynx, northern spotted owl, grizzly bear, pygmy rabbit, showy stickseed, or Wenatchee Mountains checker-mallow. These species are not discussed further.

#### 3.6.2.1 Upper Columbia River Spring-run Chinook Salmon

For our analysis of effects on Upper Columbia River spring-run Chinook salmon, please see section 3.4.2.1, *Actions Covered by the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan.*

In the final EIS for the HCP, NMFS and FERC concluded that, based on their analysis for ESA-listed Upper Columbia River spring-run Chinook salmon, implementing the HCPs should provide survival levels that are greater than those actually measured in recent years at the project, and therefore implementing the HCPs would substantially increase survival rates of Upper Columbia River spring-run Chinook salmon through the project (NMFS, 2002).

In its biological opinion for the HCP, issued August 12, 2003, NMFS found that under the HCP, there will continue to be adverse impacts to species considered under its biological opinion. These impacts include continuing mortality of juveniles passing the project and are related to both the existence of the project and project operations, which NMFS concluded cannot be separated. NMFS also noted that the levels of juvenile and adult mortality associated with the HCP represent an improvement over the project-caused mortality that occurred historically and contributed to the current species status. Although some short-term negative impacts may result from HCP tributary enhancement projects, these activities are also likely to benefit all Permit Species, to an as yet unknown extent, throughout the term of the ITP (NMFS, 2003) by protecting or enhancing tributary habitat in which these fish spawn and rear.

After reviewing the current status of Upper Columbia River spring-run Chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS' biological opinion concluded that implementation of the

HCP for Rocky Reach is not likely to jeopardize the continued existence of Upper Columbia River spring-run Chinook salmon (NMFS, 2003).

In its September 25, 2003, biological opinion, NMFS indicated that reinitiation of ESA consultation would be necessary if: (1) any action is modified in a way that causes an adverse effect on the species that is new or significantly different from those analyzed in connection with the HCP; (2) new information or project monitoring reveals adverse effects of the action in a way not previously considered or that involves additional take not analyzed in connection with the original HCP; or (3) a new species is listed or critical habitat is designated that may be affected by the action.

In a letter issued on September 7, 2005, we indicated that our analysis, presented in the draft EIS, did not identify any adverse effects of relicensing the project that would be new or significantly different from those already analyzed in connection with the HCP. We also stated that we are not aware of any new information or project monitoring that would reveal adverse effects not previously considered and that no new species had been listed subsequent to completion of consultation on the HCP.

In the September 7, 2005, letter, we indicated that effective January 2, 2006, new critical habitat for Upper Columbia River spring-run Chinook salmon was designated (70 CFR 52630–52858). Designated critical habitat for Upper Columbia River spring-run Chinook salmon that could be affected by relicensing the project includes the mainstem Columbia River in the project area and the mouths of the Entiat and Chelan Rivers. The primary constituent element of these designated critical habitats is to serve as a freshwater migration corridor. In the September 7, 2005, letter, we concluded that relicensing the project as proposed in the draft EIS (and now the final EIS) would not likely adversely affect any designated critical habitat for Upper Columbia River spring-run Chinook salmon.

Based on this determination, we indicated to NMFS that we did not believe there was any need to reinitiate formal consultation on Upper Columbia River spring-run Chinook salmon or their designated critical habitat and we requested a response within 30 days. On July 17, 2006, NMFS filed a letter with the Commission stating it did not agree with our determination and stating its intention to provide the Commission with its biological opinion no later than 135 days after the issuance of its letter.

#### 3.6.2.2 Upper Columbia River Steelhead

For our analysis of effects on Upper Columbia River summer steelhead, please see section 3.4.2.1, *Actions Covered by the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan.*

In the final EIS for the HCP, NMFS and FERC concluded that, based on their analysis for ESA-listed Upper Columbia River steelhead, implementing the HCPs should

provide survival levels that are greater than those actually measured in recent years at the project, and therefore implementing the HCPs would substantially increase survival rates of Upper Columbia River steelhead through the project (NMFS, 2002).

In its biological opinion for the HCP, issued August 12, 2003, NMFS found that under the HCP, there will continue to be adverse impacts to species considered under its biological opinion. These impacts include continuing mortality of juveniles passing the project and are related to both the existence of the project and project operations, which NMFS concluded cannot be separated. NMFS also noted that the levels of juvenile and adult mortality associated with the HCP represent an improvement over the project-caused mortality that occurred historically and contributed to the current species status. Although some short-term negative impacts may result from HCP tributary enhancement projects, these activities are also likely to benefit all Permit Species, to an as yet unknown extent, throughout the term of the ITP (NMFS, 2003) by protecting or enhancing tributary habitat in which these fish spawn and rear.

After reviewing the current status of Upper Columbia River summer steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS' biological opinion concluded that implementation of the HCP for Rocky Reach is not likely to jeopardize the continued existence of Upper Columbia River summer steelhead (NMFS, 2003).

In its September 25, 2003, biological opinion, NMFS indicated that reinitiation of ESA consultation would be necessary if: (1) any action is modified in a way that causes an adverse effect on the species that is new or significantly different from those analyzed in connection with the HCP; (2) new information or project monitoring reveals adverse effects of the action in a way not previously considered or that involves additional take not analyzed in connection with the original HCP; or (3) a new species is listed or critical habitat is designated that may be affected by the action.

In a letter issued on September 7, 2005, we indicated that our analysis, presented in the draft EIS, did not identify any adverse effects of relicensing the project that would be new or significantly different from those already analyzed in connection with the HCP. We also stated that we are not aware of any new information or project monitoring that would reveal adverse effects not previously considered and that no new species had been listed subsequent to completion of consultation on the HCP.

In the September 7, 2005, letter, we indicated that on September 2, 2005, new critical habitat for Upper Columbia River steelhead was designated (70 CFR 52630–52858). Designated critical habitat for Upper Columbia River steelhead that could be affected by relicensing the project includes the mainstem Columbia River in the project area and the mouth of the Entiat River. The primary constituent element of these designated critical habitats is to serve as a freshwater migration corridor. In the September 7, 2005, letter, we concluded that relicensing the project as proposed in the

draft EIS (and now the final EIS) would not likely adversely affect any designated critical habitat for Upper Columbia River steelhead.

Based on this determination, we indicated to NMFS that we did not believe there was any need to reinitiate formal consultation on Upper Columbia River steelhead or their designated critical habitat and we requested a response within 30 days. On July 17, 2006, NMFS filed a letter with the Commission stating it did not agree with our determination and stating its intention to provide the Commission with its biological opinion no later than 135 days after the issuance of its letter.

#### 3.6.2.3 Bull Trout

The FWS 2000 biological opinion on the effects to listed species from operation of the FCRPS (FWS, 2000) concludes that run-of-river dams in the system directly affect bull trout populations. Upon reviewing the effects outlined in the FWS biological opinion, the NSWG identified the following issues of concern regarding bull trout populations in the project area:

- Project effects on upstream and downstream movement of bull trout; and
- Project effects on mainstem habitat.

Key findings of bull trout studies initiated by Chelan PUD in 2001 and other information gathered at the project are presented in the Bull Trout Plan (Chelan PUD, 2006f). Results of the study indicated the following project effects on bull trout, as presented in the Bull Trout Plan (Chelan PUD, 2006f).

**Project Effects on Movement**

The radio telemetry study identified no apparent adverse effects on movement or survival of tagged bull trout (BioAnalysts, 2002, 2004). Downstream passage routes available to bull trout include (1) passage over spillways during spill periods (generally between April 20 and August 15); (2) the juvenile fish bypass system, composed of one surface collector entrance (6-kcfs flow) and screened turbine units number 1 and 2 (generally operated April 1 to August 31); (3) one adult fish ladder; and (4) turbine units 3 through 11. Upstream passage is provided by a single fish ladder with three separate entrances in the tailrace, and a single exit in the forebay (see Chelan PUD, 2005f, appendix A, for fishway operations and maintenance).

**Project Effects on Habitat**

On May 12, 2004, the FWS filed with the Commission a biological opinion for bull trout as part of the license amendment application for the HCP (FWS, 2004b). The biological opinion states that Chelan PUD must monitor take of bull trout that is directly related to project operations. The biological opinion contains terms and conditions for

monitoring and minimizing incidental take of bull trout at the project, specifies minimization measures, and requires the PUD to develop a Bull Trout Management Plan to be filed with the Commission. On February 28, 2005, Chelan PUD filed a draft Bull Trout Management Plan under Article 411 of the existing license for the project, and FERC approved the Plan on April 19, 2005. The draft plan described measures Chelan PUD would implement under the current license as amended by the HCP, and also identified proposed environmental measures to be implemented under the new license. Measures in the draft plan included further discussion of proposed environmental measures as well as actions to monitor and minimize any incidental take consistent with Section 7 of the ESA.

In the Settlement Agreement, Chelan PUD proposes to implement a Bull Trout Plan that is slightly modified from the FERC-approved plan under Article 411 of the existing license, since some monitoring and interim measures of the FERC-approved plan have been completed or are currently in progress. As parties to the Settlement Agreement, WDFW and FWS concur with Chelan PUD's proposal. Elements of the proposed environmental measures in the Settlement Agreement are described below.

Chelan PUD would continue operating the upstream fishway and downstream bypass to pass adult and sub-adult bull trout, and would continue to conduct video monitoring in the upstream fishway to provide information on size, age, and condition of bull trout using the fishway.

Chelan PUD would identify any ongoing adverse project impacts on adult and subadult bull trout passage. Using radio telemetry, Chelan PUD would monitor adult upstream and downstream passage through the dam and reservoir, and implement appropriate measures to monitor any incidental take of bull trout. They would continue such monitoring for a one-year period in year 10 of the new license, and every 10 years thereafter to determine Chelan PUD's compliance with the project's incidental take allowances for adult and sub-adult bull trout. In year 10 of the new license, and every 10 years thereafter, upon recommendation of the RR Fish Forum, Chelan PUD would monitor sub-adult bull trout at the dam.

Chelan PUD proposes to investigate reservoir stranding of bull trout by investigating Rocky Reach inflow patterns, reservoir elevations, and backwater curves for three years to determine if bull trout are becoming stranded or entrapped during low flow events. If potential stranding areas were identified, then further sampling would occur to determine if incidental take is occurring, and if so, Chelan PUD would consult with the FWS and RR Fish Forum to develop a plan to minimize such take.

In consultation with FWS and the RR Fish Forum, Chelan PUD would implement appropriate and reasonable measures to modify the upstream fishway and downstream bypass if adverse impacts on bull trout were identified.

In the final Bull Trout Plan described in the Settlement Agreement, Chelan PUD proposes to participate in developing the FWS Bull Trout Recovery Plan, and would implement, as appropriate, measures identified in the plan. Chelan PUD also proposes to participate in information exchanges to explore methods to monitor upstream and downstream movement of bull trout. Chelan PUD also proposes to consider the feasibility of distributing large woody debris collected at the dam to project tributaries for projects funded by the Tributary Conservation Plan of the HCP Agreement. Finally, the Settlement Agreement's Bull Trout Plan also contains a provision that Chelan PUD fund the collection of bull trout tissue samples for genetic analysis.

In letters to the Commission from Interior, NMFS, WDFW, WDOE, Forest Service and the Yakama Nation (dated March 14, 2005, March 8, 2005, March 11, 2005, March 14, 2005 and March 14, 2005, respectively), the parties expressed their support for the continuation of HCP implementation. The Bull Trout Management Plan is a component of the HCP, as required by the FWS biological opinion.

*Our Analysis*

Monitoring measures contained in the final Bull Trout Plan would provide information on bull trout life history and migration, as well as the potential for incidental take from stranding through the project. Information that is gathered could be used to mitigate potential adverse project effects and would also aid in the recovery of bull trout populations in the region. The Bull Trout Plan outlines how Chelan PUD would implement measures to investigate and address project impacts to bull trout. The Settlement Agreement's Bull Trout Plan would effectively minimize and mitigate for project impacts to bull trout populations.

Chelan PUD's draft Bull Trout Plan was approved by the Commission on April 19, 2005. The draft Bull Trout Plan was intended to satisfy the requirements of the FWS' HCP biological opinion issued on May 12, 2004 and to be consistent with the FWS Bull Trout Recovery Plan. The Bull Trout Plan contains measures to be implemented under the current license (primarily monitoring), as well as measures proposed for the new license. Although there are some differences between the previously approved Bull Trout Plan and the version included with the Settlement Agreement, none of the changes would substantially change the potential effects on bull trout.

Implementation of the HCP measures discussed above would benefit bull trout by improving survival of adults and sub-adults by providing a safe passage route (the juvenile bypass system) through the project, providing tributary habitat enhancement, thereby increasing stream productivity, and by implementing the hatchery plan, which would increase the density of historically important prey items for bull trout.

Monitoring measures contained in the Bull Trout Plan would provide useful information on bull trout life history and migration through the project. Information

gathered can be used to mitigate potential effects and would also aid in the recovery of bull trout populations in the region. Additionally, the Bull Trout Plan outlines detailed descriptions of how the licensee would implement measures to address project impacts to bull trout. The Bull Trout Plan as described in Article 411 of the existing license for the project, and as the Commission approved the plan on April 19, 2005, effectively minimizes and mitigates for project impacts to bull trout populations.

The measures proposed in the Bull Trout Plan address the terms and conditions of the incidental take statement included in the FWS' HCP biological opinion issued on May 12, 2005. In the biological opinion, the FWS concluded that implementation of the HCP with the associated terms and conditions would not be likely to jeopardize the continued existence of the Columbia River distinct population segment of bull trout and would not be likely to destroy or adversely modify proposed critical habitat for bull trout.

In its May 12, 2004, biological opinion, the FWS indicated that reinitiation of ESA consultation would be necessary if: (1) the amount or extent of incidental take allowed by the biological opinion 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 the biological 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 the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action.

In a letter issued on September 7, 2005, we indicated that we have no information to indicate that the amount or extent of incidental take specified in FWS's May 12, 2004, biological opinion has been exceeded. Additionally, we indicated that we are not aware of any new information that would identify effects on bull trout or critical habitat that were not previously considered in the opinion. Finally, we indicated that while no new species have been listed subsequent to completion of consultation on the HCP, new critical habitat was designated on October 6, 2004 (69 FR 59995). However, since the final rule designating critical habitat for bull trout excluded the mainstem Columbia River and all waters impounded behind dams (reservoirs and pools), we concluded that relicensing the project would not affect designated critical habitat for bull trout.

Based on these determinations, we indicated to FWS that we did not believe it was necessary to reinitiate formal consultation on bull trout and we requested a response within 30 days.

FWS filed a letter with the Commission on October 17, 2005, indicating it does not concur with the ESA determinations (no species were specified) contained in the Commission's September 7, 2005, letter, and indicating that FWS was initiating formal consultation. In a letter dated March 9, 2006, FWS indicated that a Settlement Agreement was forthcoming and the timeline for completing the biological opinion was moot. FWS recommended that the Commission reinitiate consultation based on the final

EIS. In a May 3, 2006, letter, we indicated that our recommended action (proposed action for ESA consultation) was unchanged and we requested that FWS complete the consultation initiated by the October 17, 2005, letter.

#### 3.6.2.4 Bald Eagle

Chelan PUD proposes to continue to conduct wildlife surveys similar to those conducted during the original FERC license and/or habitat improvement projects at a cost not to exceed $10,500 or equivalent staff-days per year during the term of the new license and any subsequent annual licenses. Currently, bald eagle overwinter abundance surveys are conducted by Chelan PUD on the reservoir. However, as proposed in the Settlement Agreement and the Wildlife Plan, the funds could be used to monitor or conduct habitat improvement projects to benefit other threatened, endangered or sensitive species. The specific measures would be determined in coordination with the RR Wildlife Forum. The Wildlife Plan, as proposed in the Settlement Agreement and supported by WDFW and FWS, also provides for coordination between the RR Wildlife Forum and the RR Recreation Forum during planning and implementation of recreational activities to consider public use while considering wildlife and terrestrial issues.

*Our Analysis*

The Wildlife Plan, as proposed by Chelan PUD in the Settlement Agreement, includes measures that could benefit bald eagles, such as riparian tree plantings and bald eagle and raptor perching habitat within the Rocky Reach Wildlife Area. None of the four bald eagle nests located in Chelan County are on project land and would not be affected by project operation. However, bald eagles do use the project area for perching and feeding, especially during the winter. Bald eagle use in the project area is influenced by several factors, including available perch sites, food availability, and various levels of human disturbance (Fielder and Starkey, 1986, 1987; Fielder, 1992). The preferred perch trees, cottonwood and ponderosa pine, are live trees located on or near the reservoir shoreline; however, they are not within the water or in the reservoir inundation zone. Thus, they would not be affected by project operations.

Waterfowl, especially American coots, are the predominant winter prey of bald eagles along the mid-Columbia River. The reservoir is used extensively by waterfowl in the winter, with approximately 16,000 to 17,000 birds wintering each year. Coots make up 40 percent of these birds. In the downstream part of the reservoir, where waterfowl are most abundant, the impoundment from Rocky Reach dam reduces river current and maintains a relatively stable water level. These conditions result in suitable waterfowl habitat, thereby maintaining an abundant prey base for wintering eagles. Fish enhancement measures described in section 3.4.2, *Environmental Effects on Fisheries Resources,* would also benefit bald eagles by enhancing their prey base.

Although project-related recreation could create human disturbance that negatively affects bald eagles, Chelan PUD's proposed RR Wildlife Forum coordination with the RR Recreation Forum would attempt to minimize public disturbance of wildlife habitats. Continuation of bald eagle surveys proposed by Chelan PUD would help ensure that any adverse effects to bald eagle populations in the winter would be identified promptly and would provide data useful to the continual recovery of the species. Chelan PUD proposes that additional funds be allocated for wildlife surveys, but also recommend expanding the surveys to other rare species. Therefore, we cannot determine how the level of effort devoted to bald eagle surveys under Chelan PUD's proposal compares to the existing survey effort or ensure that the surveys or habitat improvements for bald eagles would be provided each year.

Overall, Chelan PUD's proposal would have a beneficial effect on bald eagles and their habitat.

#### 3.6.2.5 Ute Ladies'-tresses

One of the objectives of the Wildlife Plan proposed by Chelan PUD as part of the Settlement Agreement is to implement the "Ute Ladies'-tresses (*Spiranthes diluvialis*) Along Rocky Reach reservoir Management Plan". This plan contains several measures for the protection and enhancement of Ute ladies'-tresses and its habitat. Chelan PUD, in coordination with the RR Wildlife Forum, would make $5,000 available annually, for the term of any new license issued and any subsequent annual licenses, for implementation of noxious weed control focusing specifically on areas where Ute ladies'-tresses occur on public lands adjacent to the project reservoir. Noxious weed control would be implemented by qualified personnel selected by the RR Wildlife Forum, for the term of the new license or any subsequent annual licenses. Chelan PUD would also make available $3,000 annually for implementation of an annual Ute ladies'-tresses monitoring program to document population health within the project boundary. Chelan PUD also proposes to enter into a contract with the Chelan-Douglas Land Trust, or other appropriate entity, to pursue acquisition of a conservation easement on a parcel of private land to protect an identified Ute ladies'-tresses site, at a cost not to exceed $160,000. As parties to the Settlement Agreement, FWS, BLM, and WDFW support Chelan PUD's proposal.

*Our Analysis*

It is not known whether this species is decreasing or increasing in population size within the project area. Prior to the discovery of the four populations discussed in section 3.6.1.12, there was only one other population known to exist in Washington. These populations are found in the upper reaches of the reservoir that are more riverine in nature, with less influence from impoundment from Rocky Reach dam. The riparian floodplain communities where these populations are located are, therefore, not affected

so much by water storage at Rocky Reach dam, but by water releases from the upriver Wells dam. Daily water level fluctuations as a result of these water releases create conditions that are favorable to the invasion of noxious weeds. Noxious weeds appear to pose the greatest threat to the Ute ladies'-tresses because they can take over the habitat. Ute ladies'-tresses cannot compete with aggressive species that form dense monocultures such as reed canarygrass or Canada thistle (FWS, 1995).

Timing and duration of inundation may also affect flowering and seed-set. The degree to which such factors are affecting the viability of Ute ladies'-tresses at the project is unknown. Monitoring the populations would help identify trends in colony establishment and growth and what factors may be influencing that growth.

The noxious weed control measures and Ute ladies'-tresses monitoring proposed by Chelan PUD and recommended by Interior would provide some level of protection for Ute ladies'-tresses populations on public land. By attempting to control the invasion of noxious weeds, the proposal would reduce the biggest threat to the populations. Annual monitoring would regularly document population health, allowing weed control efforts to be focused on the areas most in need. Because one of the populations is on private land, it would not be subject to the Chelan PUD management and protection measures. However, Chelan PUD proposes to pursue a conservation easement on that private property in order to extend the proposed protection measures to all four of the identified Ute ladies'-tresses populations. These protection measures would result in increased protection of Ute ladies'-tresses and its habitat and should benefit the species. We find that relicensing the project may affect, but would not be likely to adversely affect, the Ute ladies'-tresses.

### 3.6.3 Unavoidable Adverse Impacts

None.

## 3.7 CULTURAL RESOURCES

### 3.7.1 Affected Environment

#### 3.7.1.1 Definition of Cultural Resources, Historic Properties, and Area of Potential Effects

**Section 106 of the National Historic Preservation Act**

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (Section 106), requires the Commission to evaluate potential effects on properties listed or eligible for listing in the National Register of Historic Places (National Register) prior to an undertaking. An undertaking means a project, activity, or

program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including, among other things, processes requiring a federal permit, license, or approval. In this case, the undertaking is the proposed issuance of a new license for the project. Potential effects associated with this undertaking include project-related effects associated with the day-to-day O&M of the project after issuance of a new license.

Historic properties are cultural resources listed or eligible for listing in the National Register. Historic properties represent things, structures, places, or archeological sites that can be either Native American or European-American in origin. In most cases, cultural resources less than 50 years old are not considered eligible for the National Register. Cultural resources also have to have enough internal contextual integrity to be considered historic properties. For example, dilapidated structures or heavily disturbed archeological sites may not have enough contextual integrity to be considered eligible.

Section 106 also requires that the Commission seek concurrence with the State Historic Preservation Officer (SHPO) on any finding involving effects or no effects on historic properties, and allow the Advisory Council on Historic Preservation an opportunity to comment on any finding of effects on historic properties. If Native American properties have been identified, Section 106 also requires that the Commission consult with interested Native American tribes that might attach religious or cultural significance to such properties.

**Area of Potential Effects**

Pursuant to Section 106, the Commission must take into account whether any historic property could be affected by a proposed new license within the project's APE. The APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. In this case, the APE for the project includes lands within the FERC project boundary as it is delineated in the current FERC license, plus lands outside the project boundary where project operations may affect the character or use of historic properties and/or TCPs. The FERC project boundary for the project is defined by elevation contours that represent the surface area of the reservoir likely to be covered by water during a maximum flood year, ranging from 711 feet above msl at the dam to 734 feet above msl approximately 43 miles upriver at the end of the reservoir, downstream of the Wells Project dam.

#### 3.7.1.2 Culture Historic Context

**Rocky Reach Aboriginal Occupations**

The project lies within the Columbia River Plateau Culture Area, in which native peoples evolved a distinctive way of life characterized by settlement along rivers,

exploitation of a wide range of food sources (game, fish, and plants), extensive cross-utilization of resources among various groups, extensive intermarriage among groups, and extension of trade links. Archaeologists working in this area over many decades have proposed a variety of cultural chronologies to describe and date the evolution of aboriginal cultures that go back to approximately 11,000 Before Present (B.P.). For approximately 3,000 years (11,000 to 7000 B.P.), the human population was relatively small and thinly scattered, with a mobile lifestyle that made use of both upland and riverine environments. Initially heavily dependent upon large game for subsistence, native peoples gradually began to incorporate fish, as well as roots and vegetables, into their diets. From about 7000 to 3900 B.P., there was an increase in the native population of the Rocky Reach area. The groups became less mobile, seasonally re-occupying selected locales, and exploiting anadromous fish to a greater extent. They also evolved more permanent habitation in the form of semi-subterranean pit houses used primarily during the winter. This general trend continued, with the period from around 3900 to 270 B.P. characterized by concentration of settlements to the north and south of the Rocky Reach area, construction of communal longhouses, less focus on hunting in favor of reliance on fish, roots, and vegetable resources. The appearance of the horse on the Columbia River Plateau around 1730 did not measurably alter subsistence or cultural patterns, but did make it possible for native peoples to range at greater distance.

**Historic Period**

At the time of the Lewis and Clark Expedition (1805), the native populations in the Rocky Reach area included the Salish-speaking Wenatchee, Entiat, Chelan, Methow, and Columbia Indians. They lived in locally autonomous villages, sometimes grouping to form bands under a central chieftainship. Each band had a permanent winter village situated along a principal water source, with principal subsistence focused on hunting, fishing, and the gathering of plant resources. Within a few decades, diseases brought by European-American explorers and fur traders had greatly diminished these native populations, a decline that was further accelerated by the large immigrations into Washington during the 1840s.

The Colville Indian Reservation was created by executive order in 1872; originally intended to be occupied by the Okanagan, Sanpoil, Nespelum, Colville, Lake, Pend d'Orielles, Spokane, and Methow tribes. In 1879 and 1880, tracts of land, called the Columbia Reservation, were set aside for the Sinkayuse-Columbia, Chelan, Entiat, and Wenatchee Indian tribes. In 1883, tribal leaders for the Columbia, Chelan, Entiat, and Wenatchee tribes agreed to relocate to the Colville Reservation. However, a number of tribal members elected to remain in their ancestral homeland, and the government parceled out 37 allotments to Indian families. The tribes did not relinquish their rights through any of these events.

The Yakama Nation was "created" by combining members of the Yakama, Palouse, Wenatchee, Wenatshapam, and a number of other lower Columbia River groups,

including speakers of not only Salish but also Chinook and Sahaptin. In 1855, the Yakama Nation entered into a treaty with the U.S. government in which the tribes and bands ceded "the lands and country occupied and claimed by them" in exchange for a defined reservation as well as the right to fish, hunt, and gather plant resources in "usual and accustomed places."

Although some mining occurred in the Rocky Reach area in the 1850s, white settlers did not appear in numbers until the 1880s, when passage of the General Allotment, or Dawes, Act of 1887 allotted specific lands to individual Native Americans, leaving the remainder of reservation lands open to legal claim by railroad interests, mining companies, and others. White agrarian settlement focused on diversified farming and livestock, gradually increasing production of a variety of fruits, including apples, peaches, pears, plums, figs, and grapes. Towns emerged as the focal points of economic activity, among them Entiat, Orondo, and Chelan Falls.

#### 3.7.1.3 Cultural Resources Identified within the APE

Archaeological research in the project vicinity can be dated back to rock art investigations by Cain in 1945 at Orondo Rockshelter. Since that time, numerous archaeological investigations have been conducted in association with the project. The first survey of the project dam and reservoir was conducted by Washington State University in 1954 (Daugherty, 1956). Washington State University did further investigations in 1959 and 1981–82, including a survey of five proposed recreation sites along the reservoir (Gunkel, 1961; Schalk and Mierendorf, 1983).

In 1990, Eastern Washington University undertook a resurvey for Chelan PUD. This survey concentrated on the northern end of the reservoir, which had received less attention from previous investigators (Galm, 1990; Boreson, 1992).

In 2001, Western Shore Heritage Services, Inc., (WSHS) conducted another survey of the project area for Chelan PUD to check the locations of the 76 previously recorded sites. The archaeologists confirmed that 12 of the previously recorded sites were beneath the waters of the reservoir behind the Rocky Reach dam, 4 sites were found to have been destroyed by recent events unrelated to project operations, and 10 sites could not be relocated. Access for survey was denied by private landowners for about 2.2 miles of shoreline, where seven sites had been previously recorded. WSHS also checked eight areas that Eastern Washington University characterized as being archaeologically sensitive and found one isolated find and one new site. Testing was conducted at four previously recorded sites and the one newly recorded site (Hartmann and Schumacher, 2002, as cited in Chelan PUD, 2004a).

Of the 44 sites that were confirmed to exist in the 2001 survey, the Cultural Resources Working Group identified 10 as potentially eligible for the National Register.

Three are lithic scatters, six are prehistoric camps, and the remaining site is a prehistoric camp with a burial component.

TCPs are cultural resources identified by Indian or other traditional groups. TCPs can be archeological sites or other special activity areas that often lack artifacts or other obvious signs of human occupation. TCPs in general reflect places used traditionally for generations within a tribal community, and can be eligible for the National Register—if they have been continuously used for more than 50 years.

As part of the Washington State University cultural resources survey report produced in 1983 for Chelan PUD, Allan Smith prepared an ethnohistoric study of native peoples who formerly occupied or used the project area (Smith, 1983a,b). TCPs studies were also completed on behalf of the Yakama Nation (Griffin, 2002) and Colville Confederated Tribes as part of the relicensing processes for both the Lake Chelan and Rocky Reach Projects. These studies identified ethnohistoric village or camp sites and native place names in the vicinity of the project area, as well as sites associated with oral legends, vision quest activities, and human burials.

The initial project facilities were built between 1956 and 1961 and are under 50 years of age. They have not been evaluated for eligibility for inclusion in the National Register.

### 3.7.2 Environmental Effects

Effects on cultural resources within the APE can result from project-related activities such as reservoir operations, modifications to project facilities, or other project-related ground-disturbing activities. Effects can also result from other forces such as wind and water erosion, vandalism, and private and commercial development. The type and level of effects on cultural resources can vary widely, depending upon the setting, size, and visibility of the resource, as well as whether there is public knowledge about the location of the resource.

The conditions of most historic-period archaeological sites appear little changed from the time they were recorded. Conditions of prehistoric sites, however, are variable. Although the conditions of some of the sites appeared similar to conditions seen when they were originally recorded, erosion appears to have adversely affected several other sites. Some bank slumping has occurred in the northern end of the reservoir since the 1990 archaeological surveys in that area.

Chelan PUD and the Cultural Resources Working Group have drafted a Historic Properties and Cultural Resources Management Plan (Cultural Plan) that outlines measures for avoiding, reducing, or mitigating effects on National Register-eligible or potentially eligible cultural resources within the APE over the term of any new license issued. Chelan PUD proposes to finalize this plan and implement it in consultation with

the agencies and tribes. Key elements of Chelan PUD's Cultural Plan, as set forth in the Settlement Agreement (Chelan PUD, 2006g) and supported by BLM as a party to the Agreement, include:

- Formation of a RR Cultural Forum, composed of representatives from the Colville Tribes, Yakama Nation, Bureau of Indian Affairs (BIA), SHPO, BLM, Forest Service, and Chelan PUD to facilitate consultation with agencies and tribes and to ensure that all aspects of work on cultural resources are conducted in accordance with the Cultural Plan..
- Appointment of a Cultural Resources Coordinator, who would be the primary point of contact for all cultural resource tasks undertaken by Chelan PUD.
- Development and implementation of treatment plans in consultation with the RR Cultural Forum for currently identified, eligible archaeological sites within 1 year of license issuance, and development and implementation of treatment plans for other eligible resources as they may be identified over the term of the license.
- Implementation of an archaeological monitoring program to maintain current information about site conditions. The program would be designed to update site information on a regular basis using a rotation system that prioritizes sites on the basis of current assessments of project effects. Annual monitoring would be conducted at those sites subject to the most severe and sustained project effects, as well as any sites documented as containing burials. Chelan PUD's archaeological sites and resources monitoring plan (an appendix to the Cultural Plan in the Settlement Agreement) lists 16 sites warranting first priority for annual monitoring, including 7 archaeological sites that are located in BLM-mapped erosion sites. Eligible or potentially eligible sites that Chelan PUD's archaeological surveys determined were not being threatened by project operations would be monitored every five years. Sites that are currently evaluated as ineligible would be revisited every 15 years. The monitoring priorities would be reviewed annually by the RR Cultural Forum.
- Development of a stand-alone document for management of TCPs. Chelan PUD's treatment plans for identified TCPs within the APE that are affected by project operations would be based on recommendations from the interested tribes and the land management agency responsible for the property on which the TCPs are located.
- Preparation of a curation plan within 3 years of the effective date of the new license to preserve the project's archaeological materials and provide documentation according to the guidelines of 36 CFR 79.

- Development of an integrated cultural resource information management system incorporating data from Chelan PUD's Lake Chelan Project, the Rocky Reach Project, and the Rock Island Project.
- Development and implementation of an interpretive plan and educational program focusing on cultural resources.

*Our Analysis*

The NHPA (16 U.S.C. 470 et seq.) (as amended) requires federal agencies to manage cultural resources under their jurisdiction and authorizes the Secretary of the Interior to maintain a National Register. The law also provides for the creation of SHPOs to facilitate the implementation of federal cultural resource policy at the state level, and for the responsible federal agency (i.e., agency official) to consult with Native American tribes who attach religious or cultural importance to cultural resources under their jurisdiction. Section 106 of the NHPA requires federal agencies to take into account the effect of any proposed undertaking on properties listed in or eligible for listing in the National Register. If the agency official determines that the undertaking may have adverse effects on properties listed in or eligible for listing in the National Register, the agency official must afford an opportunity for the ACHP to comment on the undertaking. The relicensing of the project is considered an undertaking and the Commission acts as the agency official.

Finalization and implementation of Chelan PUD's Cultural Plan in consultation with the SHPO, Colville Confederated Tribes, Yakama Nation, BLM, BIA, and Forest Service, would ensure that adverse effects on historic properties arising from project operations or project-related activities over the term of the new license would be avoided or satisfactorily resolved. The Cultural Plan would include specific measures to resolve any potential adverse effects arising from license requirements.

Lands within the APE were ceded to the U.S. government in the mid-1850s under treaties with Indian groups. These lands within the APE fall within areas ceded by the Yakima Treaty of 1855.

Indian tribes hold certain rights and privileges reserved under treaty, statute, and executive order. Courts have recognized the origins of certain treaty rights as being "reserved" by tribes from land cessions made by tribes to the United States, rather than as rights "granted" to tribes by the United States. Indian reserved rights continue to be exercised by tribes and their members today under tribal regulation, and remain enforceable under the supremacy clause of the Constitution until extinguished by express Congressional action.

The concept of a federal trust responsibility comes from early Supreme Court decisions that sought to interpret Indian treaties and to determine the relationship among

Indian tribes, Indian property rights, and the federal government. These early cases determined that Indian tribes occupy a unique position as "domestic dependent nations"; that is, they are sovereign entities with authority to prohibit state intrusions but with a "ward-guardian" relationship with the federal government. The tribes trusted the federal government to fill its promises, and the government has thereby incurred a duty to protect the best interests of the tribes.

Implementation of the Cultural Plan would ensure that treaty and trust rights of the tribes for the protection of valued cultural resources are respected through the term of the new license, along with continued consultation occurring among the tribes, PUD, BLM, SHPO, BIA, and other interested parties, along with oversight from Commission staff.

Pursuant to the NHPA and to protect historic properties, we would craft and execute a Programmatic Agreement (PA) to implement the Cultural Plan as a condition of any new license for this project. The PA would be executed between FERC and the SHPO, with Chelan PUD, Yakama Nation, Colville Confederated Tribes, BLM, BIA, and Forest Service invited to sign the PA as concurring parties. With execution and implementation of the PA and the Cultural Plan, we would anticipate that any adverse effects on cultural resources from project operations would be appropriately resolved.

### 3.7.3 Unavoidable Adverse Impacts

None.

## 3.8 RECREATION RESOURCES

### 3.8.1 Affected Environment

#### 3.8.1.1 Regional Recreational Opportunities

Recreational resources in the mid-Columbia River region are extensive and include public and private parks, wilderness areas, preserves, and multi-use lands. Recreational use is primarily associated with water-based activities within the region. Four tributary rivers to the Columbia River, including the Okanogan, Methow, Entiat and Wenatchee rivers, are popular for kayaking, rafting, other boating, fishing, and swimming. Visitors also use the tributaries for other outdoor activities that are enhanced by public access to rivers and lakes, such as sightseeing, camping, hiking, horseback riding, motorcycle riding, mountain bike riding, snowmobiling, cross-country skiing, bird watching, hunting, and other outdoor activities. Washington fishing regulations allow for some recreational fishing in the tributaries, except on the lower Entiat River.

In addition to the four tributaries, the reservoirs on the mainstem Columbia River formed by the Wells, Rocky Reach, and Rock Island projects, as well as numerous public

parks in the project area, provide popular sites for boating, camping, swimming, hiking, fishing, and field sports.

The Columbia River forms the county line between Chelan and Douglas counties, bisecting the project. Chelan County on the west side of the Columbia River includes large areas of public lands with forests, mountains, rivers, and lakes that provide extensive and dispersed recreational opportunities. Public lands include the Wenatchee National Forest, North Cascades National Park, and Lake Chelan National Recreation Area, as well as several designated wilderness areas and other lands managed by BLM, WDFW, and WDNR. These lands provide extensive trail-related recreational opportunities and provide public access for hiking, horseback riding, mountain biking, and off-road vehicles. Chelan County also has numerous lakes and rivers, including Lake Chelan and the Wenatchee and Entiat rivers, which are popular for kayaking and whitewater rafting, as well as for picnicking and sightseeing. Lake Wenatchee and Confluence State Park are popular locations for swimming and boating. The Peshastin Pinnacles State Park provides extensive recreational opportunities, including rock climbing and hiking to elevated view points above the Wenatchee River valley. Ohme Gardens, just outside Wenatchee, provides public access to nine acres of alpine gardens built on a rocky bluff overlooking the Wenatchee River valley and Columbia River.

In Douglas County, located on the east side of the Columbia River, most of the public recreational areas, including camping and day-use facilities, are adjacent to the Columbia River.

#### 3.8.1.2 Recreation Facilities and Opportunities Associated with the Project

There are seven public recreational sites within the project boundary, shown in figure 2 and described in table 12. Chelan PUD built these parks, or portions of these parks, under its original license. Three parks are owned and operated by Chelan PUD, including the Rocky Reach Visitor Center and Park, Chelan Falls/Powerhouse Park, and Beebe Bridge Park. Chelan PUD built and owns two parks, the Lincoln Rock State Park and Daroga State Park, which are currently operated and maintained by Washington State Parks through an agreement with the State of Washington. Chelan PUD built Orondo Park and retains ownership of a small portion of the park. Douglas County Port, which owns most of Orondo Park, currently operates and maintains the site. Chelan PUD built and owns most of Entiat Park. The city of Entiat owns a small portion of the park, which it intends to exchange with the PUD as described in section 3.8.2.2 below. Chelan PUD and the city of Entiat share O&M costs for Entiat Park through a partnership agreement.

A variety of recreational services are available at the seven facilities, including RV and tent camp sites, restrooms with showers, RV sewage dump stations, boat launches and docks, picnic shelters with power, amphitheaters, landscaping and lawns, swimming beaches, athletic fields, and concession buildings.

Table 12. Existing recreational facilities within the Rocky Reach project boundary. (Source: Chelan PUD, 2004a)

| Site | Acres | Camping | Picnic and Day-Use Facilities | Boating Facilities | Swimming Beach | Trails/ Walkways | Interpre-tation Facilities | Barrier-free Facilities |
|---|---|---|---|---|---|---|---|---|
| Rocky Reach Hydroelectric Project Dam and Visitor Center | 38 | No | 20 picnic tables, 2 shelters, formal gardens, visitor center, museum, playground equipment, 2 horseshoe pits, 3 restrooms, 241 parking spaces | No | No | 0.45 mile | Yes | Yes |
| Lincoln Rock State Park | 65 | 94 RV/tent spaces RV dump | 166 picnic tables, 3 shelters, amphitheater, playground equipment, baseball field, volleyball courts, 2 tennis courts, 2 basketball courts, 3 horseshoe pits, 1 open court area, concession building, 6 restrooms/ 44 toilets/12 showers, 148 day-use parking spaces | 3 launch lanes, 6 tie-up docks, 102 boat trailer parking spaces | 175 linear feet | 0.94 mile | No | Yes |
| Orondo River Park | 5 | 14 RV/tent sites, grassy area with 10–15 tents | 14 picnic tables, 1 shelter, 1 volleyball court, 1 horseshoe pit, 1 restroom/4 toilets/4 showers, 22 day-use parking spaces | 1 launch lane, 3 tie-up docks, marina, overnight moorage, 14 boat trailer parking spaces | 225 linear feet | No | No | Yes |
| Entiat Park | 40 | 31 RV sites, 50 tent sites allowed (1991) in day-use area reduced to 25 tents allowed in 2001 | 108 picnic tables, 1 shelter, playground equipment, 2 horseshoe pits, restrooms/12 toilets/4 showers, 43 day-use parking spaces | 1 launch lane, 2 tie-up docks, 17 boat trailer parking spaces | 250 linear feet | No | Museum | Yes |
| Daroga State Park | 140 | 28 RV/tent campsites + 17 boat/walk-in tent sites 2 group camping areas (total | 75 picnic tables, 3 shelters, playground equipment, 1 baseball field1 soccer field, tennis courts, 2 basketball courts, 1 open court area, restrooms/38 toilets/12 showers, 114 day-use parking spaces | 2 launch lanes, 3 tie-up docks, 76 boat trailer parking spaces | 475 linear feet | 2.5 miles | No | Yes |

| Site | Acres | Camping | Picnic and Day-Use Facilities | Boating Facilities | Swimming Beach | Trails/ Walkways | Interpre-tation Facilities | Barrier-free Facilities |
|---|---|---|---|---|---|---|---|---|
| | | capacity 100 people) RV dump station | | | | | | |
| Chelan Falls and Powerhouse Parks | 53 | No | 11 picnic tables + 16 in 2 shelters, playground equipment, 2 softball fields, 1 soccer field, 2 volleyball courts, 1 tennis court, 1 basketball court, 2 horseshoe pits, 2 open court areas, 3 restrooms/24 toilets/4 showers, 178 parking spaces | 2 launch lanes, 2 tie up docks, 25 boat trailer parking spaces | 375 linear feet | 0.2 mile | No | Yes |
| Beebe Bridge Park | 56 | 46 RV/tent sites | 14 picnic tables + 14 in 1 shelter, playground equipment, 1 baseball field, 1 soccer field, 1 volleyball court, 2 tennis courts, 1 open court area, 3 restrooms/24 toilets/6 showers, 196 day-use parking spaces | 2 launch lanes, 3 tie up docks, 16 boat trailer parking spaces | 475 linear feet | 0.6 mile | No | Yes |

In addition to the seven project recreational sites, Douglas County PUD operates and maintains a boat launch at the tailrace of Wells dam. This boat launch provides access to the Rocky Reach reservoir, but is located within the Wells Project boundary and is not considered further in this environmental review.

#### 3.8.1.3 Recreational Use of the Project

Chelan PUD prepared estimates of existing recreational use from field data collected in the peak summer season (May 30 to September 9, 1999) and the off-season (September 10 to October 31, 1999, and April 1 to May 26, 2000). Chelan PUD did not collect data during winter months because of the low usage of recreational facilities. Chelan PUD supplemented its field data with historical recreational visitor use statistics (1995–2000) that were collected by Washington State Parks, the Port of Douglas County, the city of Entiat, and other recreation facility managers in the area.

Table 13 summarizes estimated average daily use by recreational site and season and estimated visitor use by recreational activity. Lincoln Rock State Park receives the greatest average number of visitors, followed by the project dam day-use area, Daroga State Park, Beebe Bridge Park, and Entiat Park. Chelan Falls/Powerhouse parks and Orondo River Park generally received the lowest amount of use. Summer months received more than twice as many visitors per day at recreational sites in the study area than the fall months, and the fall months received more use than the spring months. For all seasons, average weekend use was about one and one-half times greater than weekday use. The project's seven recreational sites are used by an average of about 3,500 people per day during the peak season, an average of about 1,500 people per day during the fall, and an average of approximately 1,135 people per day in the spring.

Project facilities are of local and statewide significance, providing water access, camping and picnicking facilities, and athletic fields to residents from local towns and cities and visitors from the Puget Sound Basin metropolitan area. Coastal visitors are drawn to eastern Washington by the warm and dry weather patterns. Chelan PUD found that during peak season, more than 60 percent of visitors were from the Puget Sound Basin metropolitan area and 21 percent were from Chelan and Douglas counties. Approximately 40 percent of fall-season visitors were from the Puget Sound Basin metropolitan area and 25 percent of park visitors were from the two local counties. Approximately 40 percent of spring-season visitors were from the Puget Sound Basin metropolitan area, while 31 percent of spring visitors were from Chelan and Douglas counties.

Table 14 summarizes the estimated average number of people per day that participate in recreational activities at seven public recreational sites within the project boundary. During the peak season, camping, picnicking, boating, and walking were the most popular recreational uses.

Table 13. Estimated average daily use of Rocky Reach Project recreation sites.[a]

| Site | Peak Season (1999) May 30–September 9 Average # People/Day | | | Fall (1999) September 10–October 31 Average # People/Day | | | Spring (2000) April 1–May 26 Average # People/Day | | | Overall Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| | Avg. Peak | Weekday | Weekend[b] | Avg. Peak | Weekday | Weekend[b] | Avg. Peak | Weekday | Weekend[b] | |
| **Rocky Reach Dam Recreation Facilities and Visitor Center (day-use)** | 568 | 530 | 660 | 331 | 305 | 390 | 359 | 335 | 425 | |
| Subtotal: | 568 | 530 | 660 | 331 | 305 | 390 | 359 | 335 | 425 | 3,903 |
| **Lincoln Rock State Park** | | | | | | | | | | |
| Camping/overnight | 337 | 285 | 455 | 215 | 185 | 285 | 124 | 100 | 170 | |
| Boating | 89 | 72 | 132 | 15 | 0 | 54 | 7 | 0 | 24 | |
| Non-boating day-use | 552 | 458 | 773 | 256 | 255 | 256 | 172 | 165 | 196 | |
| Subtotal | 978 | 815 | 1360 | 486 | 440 | 595 | 303 | 265 | 390 | 5,632 |
| **Orondo River Park** | | | | | | | | | | |
| Camping/overnight | 63 | 50 | 90 | 8 | 5 | 15 | 14 | 10 | 20 | |
| Boating | 20 | 19 | 25 | 2 | 0 | 12 | 0 | 0 | 0 | |
| Non-boating day-use | 131 | 101 | 205 | 23 | 10 | 53 | 17 | 15 | 30 | |
| Subtotal | 214 | 170 | 320 | 33 | 15 | 80 | 31 | 25 | 50 | 938 |
| **Entiat Park** | | | | | | | | | | |
| Camping/overnight[c] | RV 59 Tent 56 | RV 43 Tent 42 | RV 92 Tent 88 | All 40 | All 25 | All 80 | All 2 | All 0 | All 5 | |
| Boating | 55 | 42 | 90 | 4 | 0 | 12 | 3 | 0 | 12 | |
| Non-boating day-use | 244 | 183 | 390 | 107 | 80 | 163 | 50 | 10 | 153 | |
| Subtotal | 414 | 310 | 660 | 151 | 105 | 255 | 55 | 10 | 170 | 2,130 |
| **Daroga State Park** | | | | | | | | | | |
| Camping/overnight (group) | 69 | 55 | 97 | 12 | 0 | 38 | 0 | 0 | 0 | |
| Camping/overnight (other) | 120 | 97 | 175 | 58 | 40 | 95 | 34 | 25 | 49 | |
| Boating | 60 | 54 | 78 | 8 | 6 | 15 | 2 | 0 | 6 | |
| Non-boating day-use | 285 | 256 | 352 | 83 | 69 | 110 | 101 | 85 | 149 | |
| Subtotal | 534 | 462 | 702 | 161 | 115 | 258 | 137 | 110 | 204 | 2,683 |

| Site | Peak Season (1999) May 30–September 9 Average # People/Day | | | Fall (1999) September 10–October 31 Average # People/Day | | | Spring (2000) April 1–May 26 Average # People/Day | | | Overall Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| | Avg. Peak | Weekday | Weekend[b] | Avg. Peak | Weekday | Weekend[b] | Avg. Peak | Weekday | Weekend[b] | |
| **Chelan Falls/Powerhouse Parks** | | | | | | | | | | |
| Boating | 6 | 5 | 8 | 0 | 0 | 0 | 1 | 0 | 2 | |
| Non-boating day-use | 281 | 250 | 352 | 115 | 100 | 145 | 122 | 115 | 148 | |
| Subtotal: | 287 | 255 | 360 | 115 | 100 | 145 | 123 | 115 | 150 | 1,650 |
| **Beebe Bridge Park** | | | | | | | | | | |
| Camping/overnight | 159 | 135 | 210 | 38 | 25 | 75 | 12 | 8 | 20 | |
| Boating | 68 | 60 | 90 | 5 | 0 | 21 | 1 | 0 | 2 | |
| Non-boating day-use | 275 | 220 | 405 | 181 | 180 | 179 | 114 | 110 | 128 | |
| | 502 | 415 | 705 | 224 | 205 | 275 | 127 | 118 | 150 | 2,721 |
| TOTAL | 3,497 | 2,957 | 4,767 | 1,501 | 1,285 | 1,998 | 1,135 | 978 | 1,539 | 19,657 |

[a] Refer to Recreation Use Assessment Report (DES and Howe Consulting, Inc., 2001a).

[b] Weekend refers to Friday and Saturday nights for camping/overnight and Saturday and Sunday for day-use.

[c] Differentiation between RV and tent camping at Entiat Park during peak season is based on onsite surveys. No data are available to separate fall- and spring- season RV and tent camping

Table 14. Estimated average daily use by activity of Rocky Reach Project recreation sites.

| | Peak season (1999) May 30–September 9 Average # People/Day | | | Fall (1999) September 10–October 31 Average # People/Day | | | Spring (2000) April 1–May 26 Average # People/Day | | |
|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **All Days[a]** | **Weekday** | **Weekend** | **All Days[a]** | **Weekday** | **Weekend** | **All Days[a]** | **Weekday** | **Weekend** |
| Camping | 863 | 707 | 1207 | 371 | 280 | 588 | 186 | 143 | 264 |
| Boating | 298 | 252 | 423 | 34 | 6 | 114 | 14 | 0 | 46 |
| Visiting dam/visitor center | 245 | 220 | 302 | 231 | 214 | 273 | 180 | 161 | 234 |
| Shore Fishing | 2 | 3 | 1 | 0 | 0 | 0 | 3 | 2 | 6 |
| Visiting beach/sunbathing | 117 | 90 | 176 | 0 | 0 | 0 | 23 | 10 | 50 |
| Swimming/wading | 99 | 67 | 174 | 0 | 0 | 0 | 10 | 4 | 20 |
| Nature study/photography | 3 | 4 | 0 | 0 | 0 | 0 | 14 | 24 | 0 |
| Hang gliding | 8 | 4 | 14 | 0 | 0 | 0 | 8 | 0 | 16 |
| Walking | 336 | 338 | 330 | 227 | 259 | 162 | 117 | 97 | 159 |
| Skating | 5 | 2 | 10 | 0 | 0 | 0 | 14 | 17 | 10 |
| Jogging | 50 | 58 | 34 | 0 | 0 | 0 | 0 | 0 | 0 |
| Picnicking | 598 | 450 | 945 | 183 | 131 | 260 | 261 | 160 | 498 |
| Off-road vehicle riding | 0 | 0 | 0 | 11 | 15 | 6 | 0 | 0 | 0 |
| Bicycling on-road | 8 | 8 | 7 | 5 | 2 | 8 | 29 | 17 | 40 |
| Bicycling off-road | 98 | 94 | 108 | 40 | 34 | 56 | 0 | 0 | 0 |
| Sightseeing | 185 | 180 | 200 | 30 | 8 | 76 | 13 | 6 | 20 |
| Using playgrounds | 210 | 225 | 175 | 13 | 0 | 44 | 50 | 82 | 30 |
| Group activity | 213 | 127 | 415 | 0 | 0 | 0 | 84 | 84 | 83 |
| Total | 3497 | 2957 | 4767 | 1501 | 1285 | 1998 | 1135 | 978 | 1539 |

[a] Based on 1999/2000 data collection and field monitoring; refer to Recreation Use Assessment Report (DES and Howe Consulting, Inc., 2001a).

### Fishing

Chelan PUD documented angling activity specific to the project reservoir in the 1999/2000 Recreational Use Assessment Study Report (DES and Howe Consulting, Inc., 2001a). During the period covered by the study, Chelan PUD found that most angling activity occurred during late summer, when the summer/fall Chinook salmon fishing was open on the Columbia River (opened August 10 and closed October 21). During other parts of the year, anglers primarily target walleye and smallmouth bass, although a large percentage of anglers also were seeking northern pikeminnow as part of a predator control effort. The study reported an average of five anglers per day along undeveloped shorelines during peak-season weekends, and no anglers during peak-season weekdays.

Chelan PUD allows public access to the tailrace for salmon fishing in the late fall and early winter when the fishery is open. After construction of the juvenile fish bypass system began in 2002, Chelan PUD complied with FERC dam safety requirements by prohibiting fishing and boat access within 400 feet of the downstream end of the outfall pipe. This safety and security measure eliminated access to the popular sport-fishing site downstream of the spillway and along the east bank downstream of the project dam. Those fishing for salmon must now move farther down the riverbank, which is open to salmon fishing in the fall and winter. An additional fishing access site has been made available in the project forebay, reached on foot through Lincoln Rock State Park on the Douglas County (east) side of the river.

### Watercraft Use

Chelan PUD's monitoring in 1999 and 2000 indicates that peak weekend watercraft use on the reservoir is below the maximum capacity standards recommended by the State Organization for Boating Access (SOBA). The SOBA recommends a maximum boat density of 33 acres per boat on a typical 8,000-acre lake, and Chelan PUD observed an average of 101.5 acres per boat during the average peak-season weekend. Chelan PUD estimates that future peak-season watercraft use would grow to an average of approximately 57 boats on weekdays and 137 boats on weekend days. The projected average watercraft use on the project reservoir would equal approximately 21 and 50 percent use of the SOBA-recommended maximum capacity for weekdays and weekends, respectively. Boat counts made during the July 4 weekend, however, exceeded SOBA's recommended standards on the project reservoir in the reach between Daroga State Park and Beebe Bridge.

During the 1999 peak season, motorboats made up nearly 70 percent of the watercraft use, personal watercraft (jet-skis) made up 29 percent, non-motorboats made up 1 percent, and airplanes and windsurfers made up less than 1 percent of the watercraft use. During the 1999 fall season, all watercraft observed were motorboats. During the 2000 spring season, 80 percent were motorboats, 14 percent were jet-skis, and 6 percent were non-motorized craft.

#### Dispersed Use

Recreational uses of dispersed use areas include landing small boats, fishing, and swimming. Chelan PUD observed the greatest number of dispersed recreational users along undeveloped shorelines during peak-season weekends, with an average of 65 people per day. An average of 34 people per day was observed along undeveloped shorelines on peak-season weekdays, and little to no activity was observed along undeveloped shorelines during the off-season. Chelan PUD observed most dispersed shoreline use at a beach on Chelan PUD-owned Turtle Rock Island, Chelan PUD- and BLM-owned undeveloped shorelines between Daroga State Park and Beebe Bridge, and on private lands. Chelan PUD observed a few people on the Entiat River sandbar and undeveloped shoreline areas owned by Chelan PUD and managed by WDFW between Beebe Bridge and the Wells Project.

#### Estimated Use Compared to Estimated Physical Capacity at Existing Developed Sites

In its 1999–2000 monitoring, Chelan PUD found that visitor use at the primary recreational sites was generally well below capacity on peak-season weekdays and during fall and spring seasons. During average peak-season weekends, however, Lincoln Rock State Park campground was near 100 percent of its capacity, Beebe Bridge campground was over 90 percent of its capacity, and Daroga State Park was over 80 percent of its capacity. The capacity of the Entiat Park day-use area was exceeded during peak season weekends because of the number of tent campsites allowed in the day-use area. The estimated number of visitors participating in day-use activities exceeded the parking capacity at Orondo River Park during peak-season weekends. Peak-season visitor use was generally below estimated site capacities at other sites except on some holidays and exceptionally busy weekends.

### 3.8.1.4 Recreational Needs Assessment of the Project Area

The Interagency Committee for Outdoor Recreation (IAC) is responsible for assisting local, state, and federal agencies in planning, acquiring, and developing recreational resources. The IAC published the Washington State Comprehensive Outdoor Recreation Plan (SCORP) 2002–2007 in October 2002 (IAC, 2002). The SCORP contains information related to a participant survey, *An Assessment of Outdoor Recreational in Washington State*, to inform decision-makers about issues and opportunities associated with outdoor recreation.

Results from the assessment indicate that there is a need for additional lands and facilities to support almost all outdoor recreational categories, including additional provisions for walking, sightseeing, and bicycling. The assessment anticipates growth in nature photography, especially wildlife photography, and a decline in hunting and fishing.

In the assessment, IAC identifies a need to find acceptable means to pay for recreational facility maintenance and operation costs on public lands, including the need for improved on-the-ground management presence. There is also a need for improved data on public recreational behavior and preferences, as well as an inventory of available facilities, in order to ensure that public resources are more effectively used in meeting public needs.

The Douglas County Recreational and Open Space Plan (Douglas County Parks and Recreation, 2000) identifies objectives for the development of parks and recreational and open space systems within the county over a 20-year period. Included in the list of proposals is the development of almost 100 miles of multi-use trails south of the project area. The proposals also include an extension of the trail system north to Lincoln Rock State Park, where a trailhead would be developed.

The Master Plan for Entiat Park (DOH Associates, 1992) lists goals related to the park, including provisions for future expansion of a trail system that would include a new trailhead at the southern end of the park. These trails would provide access to other lands along the Entiat River to the west.

Chelan PUD's Rocky Reach Recreation Inventory (DES and Howe Consulting, Inc., 2001b) identified goals developed by the Washington State Parks for a trail extending from Lincoln Rock State Park to the Wenatchee Loop Trail system. The inventory also identified the potential for a trail connecting Chelan Falls Park and Powerhouse Park.

Chelan PUD found that visitors are generally satisfied with the recreational sites in the project area. During onsite interviews, visitors were asked to rate the site they were visiting on a scale of 1 to 10, with 10 being the most satisfied. All seven of the recreational sites were given very high ratings, with five of the parks given average ratings of 9 or above. Orondo River Park and Entiat Park were just below 9, with ratings of 8.7 and 8.5, respectively. The PDEA provides additional information about this topic (Chelan PUD, 2004a).

During onsite interviews, Chelan PUD asked visitors to choose from a list of items that could make the site better. Of items that were on the list, cleaner facilities and more docks received the most responses. Comments that were reported most frequently under "something else" included more, cleaner, better maintained, closer, and free bathrooms/showers; more and taller trees; more sewer hookups, and power, water, and facilities; more privacy, larger campsites, and more camp sites; more moorage, dock repairs, and both sides of some docks open; more, less, and repositioned sprinklers; more dumpsters, garbage cans, and recycling bins; better beaches and swimming areas and less seaweed; fewer geese and less smell; concession stands and a convenience store; fewer bees; admittance of dogs; and more telephones.

### 3.8.2 Environmental Effects

#### 3.8.2.1 Recreation Plan

Early in the relicensing process, Chelan PUD convened the Social Sciences Working Group[31] to develop, conduct, and review project-related recreational studies. The primary recreational issues identified by the Social Sciences Working Group included continued O&M of existing recreational facilities, the expansion/revitalization of some existing park facilities, the creation/extension of multi-use trails, the need for future evaluation of recreational use and needs, and a funding mechanism for implementing proposed PME measures.

To address the recreational issues identified by the Social Sciences Working Group, Chelan PUD proposes to implement the Recreation Plan, which was developed by Chelan PUD and the Social Sciences Working Group and was filed as part of the Settlement Agreement (Chelan PUD, 2006h). Specific elements of the plan, such as site improvements and recreational use monitoring, are addressed in section 3.8.2.2 through section 3.8.2.5 below. WDFW, BLM, Washington State Parks and other agencies, as parties to the Settlement Agreement, concur with Chelan's proposal.

The Forest Service recommends that Chelan PUD: (1) address development, funding and implementation of a comprehensive Information and Education (I&E) package to be used to complement efforts underway locally; (2) address appropriate types and levels of information available to the public about the recreation facilities and opportunities at or near the Project; and (3) implement the Recreation Resource Management Plan (RRMP) proposed in the June 30, 2004, *Preliminary Draft Environmental Assessment,* which includes a provision for a Recreation Enhancement Fund.

*Our Analysis*

Chelan PUD currently manages recreational facilities under a Recreation Resources Plan submitted by Chelan PUD to the Commission in 1976. Chelan PUD, in consultation with the Social Sciences Working Group, proposes to develop a new Recreation Plan pursuant to the Settlement Agreement. The recreation enhancement fund was designed to be a flexible method for stakeholders to address recreation resources within the river basin. A cumulative beneficial effects on recreation resources within the

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[33] The Social Sciences Working Group consists of the Forest Service, NPS, WDOE, WDFW, IAC, Washington State Parks, BLM, Entiat Focus Group, Entiat School District, Boat Club of Wenatchee, Columbia Breaks Fire Interpretive Center, Entiat Valley Chamber of Commerce, Trout Unlimited, City of Entiat, landowners along the project boundary, and Chelan PUD.

river basin could occur, with the enhancement fund complementing the public access and recreation facilities included in Chelan PUD's proposal. Currently, recreational use of project lands occurs at the primary public recreational sites within the project boundary, and the proposed measures discussed in section 3.8.2.2 are designed to address current and reasonably foreseeable future project-related recreational demand at those sites. Further, the recreation-use data collected as part of the FERC Form 80 filing would identify future project-related recreational needs. Because the geographic scope of the recommended fund extends beyond the project boundary and there is no indication of displaced recreational effects from the project to these non-project lands, we do not fund a nexus between project operations and the areas outside the existing project boundary that would be addressed by the Recreation Enhancement Fund.

Overall, the plan would guide management of recreational resources and provide a framework for the licensee's implementation of the site improvements and management measures included in the plan, as discussed in more detail in sections 3.8.2.2 through 3.8.2.5 below.

#### 3.8.2.2 Recreational Facility Measures

As part of the Recreation Plan, Chelan PUD proposes the facility improvements summarized in table 15. These proposed enhancements would be located within the project boundary.

A resident of Entiat commented that more recreational facilities, particularly for children, are needed (letter from M. Peterson, Resident, Entiat, WA, to the Commission, filed March 11, 2005). She recommends that Chelan PUD develop and install a new sports field and track on school property, and add a sports field, swimming area, benches, and skateboard park at Entiat Park.

*Our Analysis*

Existing recreational facilities within the project boundary include seven park facilities that occupy nearly 400 acres of land along the reservoir and provide public access to project lands and waters. The infrastructure at many of the existing recreational facilities is degraded from deferred maintenance, and some of the facilities are not able to support the level of use during peak-use periods. Although most recreational visitors interviewed in 1999 and 2000 expressed a high level of satisfaction with the condition of the sites, they also noted their desire for improvements, including cleaner facilities, better maintained restrooms, dock repairs, and additional recycling and garbage containers. In addition, federal, state, and local recreational studies, including the Washington SCORP and the recreational studies conducted through the relicensing process, indicated a general need for trails, boating access, natural areas, and ball fields.

Table 15. Proposed recreational facility improvement measures. (Source: Chelan PUD, 2006h)

| Project | Description | Implementation Schedule |
|---|---|---|
| Operate and maintain recreational sites within the project boundary. | Continue ongoing O&M and capital improvements and enhancements for Rocky Reach Park and Visitor Center, Entiat Park, Beebe Bridge Park, Chelan Falls/ Powerhouse Park, Daroga State Park, and Lincoln Rock State Park. Continue O&M of the portion of Orondo Park that Chelan PUD owns. | Ongoing operations and maintenance for existing facilities at the Rocky Reach reservoir would occur throughout the life of the new license. |
| Renovate and enhance Lincoln Rock and Daroga State Parks | Implement the renovation and enhancement of Lincoln Rock State Park and Daroga State Park to include feasibility, finalization of design, development of a schedule, and determination of costs based on conceptual plans outlined in the Settlement Agreement. Provide for major renovation of, and minor improvements to, existing facilities and enhancements at the parks, which could include, but are not limited to, group camping (an area of the park set aside for groups to camp together in tents, RVs) and convenience camping (small cabins with windows, a door, sleeping bunks, and electricity, but no water or sewer). Washington State Parks would be responsible for the cabins. | Phased, beginning within 1 year of the effective date of new license issuance. |
| Develop a trail link from Lincoln Rock State Park | In partnership with Washington State Parks on Chelan PUD lands, develop a 1-mile-long trail from Lincoln Rock State Park to a fish bypass viewing station located approximately 300 feet downstream of the Rocky Reach dam. The trail would be constructed on Chelan PUD-owned lands. | Within 180 days of new license issuance or after notification from Washington State Parks that it has completed its planning and permitting process, whichever comes later. |
| Add irrigation system at Orondo Park | Design and construct an upgraded irrigation system at Orondo Park. | Within 180 days of new license issuance. |
| Revitalize Entiat Park | Finalize and implement the Entiat Park Revitalization Plan. | Phased, with development beginning within 1 year of new license issuance. |

| Project | Description | Implementation Schedule |
|---|---|---|
| | Upgrade Entiat wastewater treatment plant. | The schedule is not specified in the Settlement Agreement. |
| | Lease or purchase shoreline land owned by Chelan PUD (9.23 acres) to the City of Entiat. | The schedule is not specified in the Settlement Agreement. |
| | Design and construct Entiatqua Trail (an interpretive/nature trail at the confluence of the Entiat and Columbia Rivers). | The schedule is not specified in the Settlement Agreement. |

Chelan PUD's proposed measures at existing facilities, as discussed in the Recreation Plan, address many of these needs.[32] The proposed enhancement measures at existing recreational facilities would improve the quality of recreational resources by: ensuring that the sites continue to provide public access; modernizing the site layout; adding new recreational facilities; and providing barrier-free facilities, where appropriate. These measures would help ensure that public access meets recreational demands for the term of the new license, improve the aesthetic quality and the physical condition of project-related recreational facilities, and reduce recreation-related adverse effects on environmental resources.

Chelan PUD states that Entiat Park upgrades would be based on community input. As identified in the Entiat Park Revitalization Plan (Chelan PUD, 2006h), proposed measures would include the following: (1) Entiat Park upgrades; (2) wastewater treatment plant upgrades; (3) design and construction of a trail linking Entiat Park to the Entiat River Outdoor Learning Center (Entiatqua) at the confluence of the Entiat and Columbia rivers; and (4) lease 9.32 acres of shoreline land owned by Chelan PUD to the City of Entiat with an option to purchase such land in 2012.

We find that these proposed measures at Entiat Park would: (1) address the recreational use capacity issues; (2) satisfy certain goals and objectives identified in the SCORP and in local plans, including the need for trails; and (3) contribute to a beneficial effect on the recreation resources at the park.

With respect to the comment concerning the need for additional recreational resources for children in Entiat, Chelan PUD's proposed measure to upgrade Entiat Park would provide new recreational opportunities and address recreational needs for children and other residents of Entiat.

#### 3.8.2.3 Recreation Resources Monitoring and Evaluation Program

As part of the Settlement Agreement, Chelan PUD proposes to prepare a Recreation Resources Monitoring and Evaluation Program. Every 6 years, Chelan PUD, in consultation with the RR Recreation Forum, would review and evaluate information with respect to existing and potential recreational use within the project boundary, including on BLM lands. Chelan PUD would submit a report to FERC consistent with FERC Form 80 requirements and simultaneously present the information to Chelan PUD's communication department for use in its ongoing comprehensive I&E programs. Following submittal of the FERC Form 80, Chelan PUD and the RR Recreation Forum would review and evaluate the information from the FERC Form 80 along with the findings contained in the most recent Washington State SCORP document. Chelan PUD

[32] We note the recommendation to contribute funds to the Entiat School District for ballfields is no longer part of the Chelan PUD proposal, pursuant to the Settlement Agreement.

and the RR Recreation Forum would also review the Recreation Plan for its adequacy in contributing to meeting the recreational needs within the project boundary and, if necessary, revise the plan to accommodate the updated recreation needs and priorities identified by these documents. The revised plan would be submitted to FERC for approval before implementation.

*Our Analysis*

A concern of the Social Sciences Working Group and other stakeholders expressed during workgroup meetings was how to address potential project-related recreational effects during the term of the license. The proposed monitoring and evaluation program is designed to be a flexible method for Chelan PUD and interested parties to address recreational resources within the project boundary. The proposal establishes a procedure for evaluating and updating the recreation plan. Consequently, the proposal would benefit recreational resources by addressing unforeseen recreational needs that may arise over the term of any new license issued.

The proposed and recommended recreation resources monitoring and evaluation program could provide an opportunity for interested parties to meet every 6 years and review recreational use data collected as part of the FERC Form 80 filing. Chelan PUD's proposal could allow the parties to consider the adequacy of public access and recreational facilities, address project-related recreation and other environmental resource issues; and provide the basis from which Chelan PUD could consider and prioritize new projects.

We acknowledge Chelan PUD's intent of creating the RR Recreation Forum to share information, coordinate efforts, and make recommendations and decisions on the Recreation Plan. Section 15 of the Settlement Agreement indicates that the signatory parties may elect to participate in the forum. Providing a means for the signatory parties to join the forum would help ensure that stakeholders have reasonable opportunities to comment on the recreation plan to meet changing recreational needs.

#### 3.8.2.4 Recreation Use Assessment and Recreation Needs Forecast

Chelan PUD proposes to conduct a study of project recreational use and needs, as well as an analysis of recreational effects on wildlife. Chelan PUD would begin the study in year 20 of the new license and complete it in year 23. See Settlement Agreement, Chapter 9 at Section 4.6.

*Our Analysis*

The proposed recreational use study, to be completed in year 23 of the new license, would provide useful estimates of total recreational use, recreational use by

activity, the effects of recreational use on wildlife, and recreational resource mapping. This information would complement the recreational use information collected at 6-year intervals for the FERC Form 80 filing and would provide data for assessing site capacity and adjusting recreational resource management practices to meet future recreational needs. As described in section 15.4 of the Settlement Agreement, Chelan PUD would consult with the signatory parties to the agreement, which would help ensure that the study concentrates on the areas most affected by project-related recreational use.

#### 3.8.2.5 Other Measures

As part of its October 28, 2005, section 10(a) recommendations, the Forest Service recommends that Chelan PUD address development, funding, and implementation of a comprehensive Information & Education package to be used to complement efforts underway locally. The Forest Service states that its interest is providing the public with wholistic recreation information about the entire area. In its April 27, 2005, response to agency and stakeholder recommendations, Chelan PUD points out that, although the implementation of a comprehensive information and education package is not included in its proposal, interpretive trails and signs in the project area are being considered for inclusion in the Recreation Plan. The Recreation Plan, filed with the Settlement Agreement, includes interpretive trails and signs in the project area.

*Our Analysis*

The Forest Service states that the recommended Information and Education package would integrate recreation interpretation and education needs of public recreation providers beyond National Forest System lands. However, the need for a program of this scope is unclear, since the Forest Service does not manage any formal public access sites at the Project. Currently, the existing public recreational sites at the project include educational signage, such as acceptable and prohibited uses. In addition, many of the existing sites, including the Rocky Reach dam site, include educational and interpretive signs and trails. As part of the proposed Recreation Plan, pursuant to the Settlement Agreement, Chelan PUD proposals for interpretation and education would complement the existing signs at the project. Furthermore, interpretation and education would be a component of the Cultural Plan.

### 3.8.3 Unavoidable Adverse Impacts

None.

## 3.9 LAND MANAGEMENT AND AESTHETIC RESOURCES

### 3.9.1 Affected Environment

#### 3.9.1.1 Land Ownership and Use

The project is located in the Columbia River Basin, an important agricultural area and regional transportation hub providing rail service and a water route for barges carrying agricultural and other products to Pacific ports. The Wenatchee National Forest includes more than 2 million acres of public lands in Chelan, Kittitas, and Yakima counties west of the project. Approximately 40 percent of the forest is designated as wilderness, with the remaining 60 percent managed by Forest Service for multiple use, including timber harvest, livestock grazing, and road construction. Recreational opportunities include fishing, rafting, climbing, and skiing.

Other public lands west of the project include the Swakane, Entiat, and Chelan Butte WAs managed by WDFW. The Swakane and Entiat WAs cover approximately 19,200 acres of land and encompass valley bottoms and numerous steep drainages with both perennial and intermittent streams. Primary habitat types include sage steppe, ponderosa pine, and several riparian draws. The higher elevations and north slopes of these units have some heavy thickets of Douglas fir.

The Chelan Butte WA covers approximately 8,200 acres located just outside of Chelan on south-facing slopes of Chelan Butte. The WA is primarily dry grassland and provides habitat for upland birds including chukar, quail, grouse, and mourning doves. In 1963, Chelan PUD provided funds for purchasing 20,397 acres of lands in the Swakane, Entiat, and Chelan Butte areas as mitigation for the development of the project. WDFW manages these areas for hunting, as well as for deer and upland game bird habitat.

Ownership of lands outside and/or adjacent to the project boundary is held by WDNR, Washington Parks and Recreation Commission, the Forest Service, BLM, Chelan PUD, railroad companies, WDOT, City of Entiat, WDFW, and private landowners. Land use adjacent to the project reservoir is primarily agricultural and recreational, and development along the reservoir is low-intensity and rural in nature. Approximately half the development along the reservoir consists of orchards, pasture lands, and residential development associated with Entiat and Orondo. There are two wastewater outfalls that service the cities of Chelan and Entiat.

Seven parks that are part of Chelan PUD's existing Recreation Resources Plan are also located along the reservoir. These include almost 400 acres of land that provide public access to the river and adjacent lands for swimming, boating, personal water-craft use, fishing, camping, picnicking, water-skiing, and other recreational uses.

The remaining lands surrounding the reservoir are undeveloped. These lands can be characterized as dry lands, made up of shrub steppe and grasslands with areas of exposed rock. Much of the undeveloped shoreline lies in areas where the reservoir is very close to transportation rights-of-way, including a small, private railroad and State Route 97A on the west side of the project reservoir and State Route 97 on the east side. Narrow strips of riparian vegetation, including wetland areas, are present along those areas of the reservoir where the shoreline slopes are relatively gentle.

#### 3.9.1.2 Project Lands

The project boundary encompasses approximately 1,500 acres. The majority of the project boundary runs along the 43-mile-long project reservoir. Federal lands within the project boundary include 150.64 acres of BLM land and 1.5 acres of Forest Service land. All of the Forest Service land is in WDOT and railroad right-of-way status. Chelan PUD has flowage rights easements for the remainder of the land within the project boundary.

The midline of the project reservoir forms the boundary between Douglas County to the east and Chelan County to the west. Land use activities within and adjacent to the project boundary on non-federal lands in each county are subject to the relevant county comprehensive plans (developed in accordance with the Washington State Growth Management Act of 1990) and the municipal zoning ordinances that guide specific land use activities under these plans. The Growth Management Act requires that specific planning elements be addressed by each jurisdiction and that implementing regulations (for example, zoning) be consistent and concurrent with the plan.

#### 3.9.1.3 Shoreline Permitting System

Chelan PUD is responsible for reviewing permit applications for certain types of use and occupancy of project lands and waters, in cooperation with local and state agencies, to assure compatibility with FERC license terms and conditions and other appropriate regulations. Chelan PUD's role in the permitting process is to ensure consistency with project purposes, including safety, environmental concerns, and aesthetics. Chelan PUD also encourages consistency with local and county management plans and zoning. Chelan PUD administers a Shoreline Development Tracking System as a means of ensuring that structures built within project lands and waters have minimal environmental or visual effects.

Under the 1971 Washington State Shoreline Management Act, the Columbia River, including the entire shoreline within the project boundary, is designated as a shoreline of statewide significance. Both Douglas and Chelan counties have developed shoreline master programs consistent with the goals of the 1971 Washington State Shoreline Management Act to regulate land use of shorelines up to 200 feet inland from

the ordinary high water mark. The programs have eight goals: economic development, public access, circulation, recreation, shoreline use, conservation, historical/cultural, and restoration. Federal lands within the project boundary have very little shoreline development.

Chelan and Douglas counties and area municipalities participate in the Joint Aquatic Resource Permit Application Program (Joint Permit Program) to reduce the number of forms needed to comply with environmental laws that have a redundant purpose and authority. The project Lands Management Study (DES, 2001c) contains a summary of the Joint Permit Program and an example of the Joint Permit application form. One form can now be used to process any and all permits for:

1. Shoreline Substantial Development, Variance, or Conditional Use Permit issued by local government;
2. Temporary Modification of Water Quality Criteria issued by WDOE;
3. Hydraulic Project Approval issued by WDFW;
4. Section 401 Water Quality Certification issued by WDOE; and
5. Corps section 404 and section 10 Permits.

#### 3.9.1.4 Project Setting and Aesthetic Features

The immediate project area includes about 60 river miles and is dominated by large tracts of natural-appearing landscapes, with agricultural lands and roads along the river and plateaus. The overall character of the landscape is rural, with some development associated with the Rocky Reach dam, Entiat, and Orondo. River terraces contained by high plateaus that are cut by canyons characterize the landscape around the reservoir.

Generally, long-range views from the project reservoir include natural and agricultural landscapes with visual variety created by variations in topography, geology, vegetation, and the relationship of the reservoir to the landscape. Distant views of the eastern slope and the high peaks of the Cascade Mountains are available from project-area roads and other points in the project area.

From Route 2 and Route 97A, the Columbia River and plateaus generally dominate the mid-range viewshed. Project developments, private residences, recreational sites, roads, and transmission lines provide visual contrast to the views of the river valley. In most cases, architectural design and site engineering for project facilities used local materials, so the facilities generally blend with the color and form of the river valley. With some exceptions discussed below, most project developments blend well with the surrounding area and the visual effects are marginal.

Project features, including the reservoir and dam, dominate the close-range views as seen by boaters from the reservoirs, by travelers on Route 2 and Route 97A, and by visitors at the public view points at the dam and on the southern end of the reservoir. Because the river terraces are relatively level and only sparse vegetation is present, there is little or no visual screening of the dam facility. However, where views of the project dam are available, the viewpoints are generally from a height that contains the visual elements of the development in the larger Columbia River Basin. Other components of the development are more prominent than the dam, including the fish passage facilities and fish rearing facilities, located upstream and downstream, respectively, of the project dam's left abutment; the switchyard; the five sets of 230-kV transmission lines that convey power from the powerhouse to the switchyard; and the high-voltage transmission lines, which are outside the project boundary.

The reservoir is the dominant visual element throughout most of the project area. It is well established, with areas of mature riparian habitats, sandbars, cobble and other elements that allow the reservoir to blend with adjacent natural, agricultural, and developed lands. Chelan PUD typically operates the reservoir at a fairly constant level throughout the primary recreational season, which reduces visual contrasts associated with reservoir drawdown, such as shoreline scouring and erosion.

### 3.9.2 Environmental Effects

#### 3.9.2.1 Land Use Mitigation, Protection and Enhancement Measures

In its license application, Chelan PUD indicated an intent to continue administering the Shoreline Development Tracking System. Although the tracking system is not mentioned in the Settlement Agreement, we assume that Chelan PUD has not changed its stated intent to continue administering the system during the term of any new license.

*Our Analysis*

Chelan PUD does not propose to implement any specific measures that would affect land use or visual resources within the project area. However, new projects implemented by private or public entities could affect these resources during the term of the new license. The Chelan PUD-proposed measure to continue to administer the Shoreline Development Tracking System would continue to provide a mechanism for controlling shoreline development and ensuring that structures built within project lands and waters have minimal environmental or visual effects.

### 3.9.3 Unavoidable Adverse Impacts

None.

## 3.10 SOCIOECONOMIC RESOURCES

### 3.10.1 Affected Environment

#### 3.10.1.1 Regional Population and Economy

In 2001, the population of Chelan County was approximately 67,100 people and the population of Douglas County was approximately 32,800 people. Overall, the region is sparsely populated, with most of the population concentrated along the Columbia and Wenatchee rivers. The city of Entiat is the largest community on the project reservoir with a population of about 975. The cities of Wenatchee and East Wenatchee, located 7 miles south of the project dam, are the largest in the region and have approximately 27,930 and 5,430 people respectively. Chelan County's population grew 11.8 percent and Douglas County's population grew by 10.8 percent from 1995 to 2001, a rate that is consistent with averages for rural Washington counties.

The economy of the north-central Washington region encompassing Chelan and Douglas counties is based in tourism, agriculture, government, and education. Chelan County provides 80 percent of the jobs in the two-county area and contains 65 percent of the total number of employers. Apples, pears, cherries, and other fruits are important crops in the Columbia River Basin. Other types of agriculture (vineyards, wheat, hay, and potatoes), retail trade, services, manufacturing, recreation, and tourism also support the regional economy.

Table 16 indicates that in Chelan County, the service industry (i.e., hotels, lodging, healthcare, professional services, recreation) is the largest sector in terms of employment and wages paid. Health care is the leading industry and accounts for almost half of the sector's employment and a significant portion of this sector's wages. Hotels and lodging are also important in the service sector, in part because recreational opportunities attract a large number of tourists and recreational visitors from coastal cities such as Seattle. The tourist industry supports a substantial portion of the retail sector in Chelan County.

Table 16. Employee and wages by industry, 1998. (Source: Chelan PUD, 2004a)

| | **Chelan County** | | **Douglas County** | |
|---|---|---|---|---|
| | **Employment** | **Wages** | **Employment** | **Wages** |
| **Total by county**: | 36,021 | $860,009,112 | 8,910 | $187,016,602 |
| **Top three business sectors**: | | | | |
| Service industry | 7,472 | $182,070,758 | 1,223 | $21,758,936 |
| Agriculture | 7,281 | $107,768,316 | 2,716 | 37,142.025 |
| Government | 6,151 | $203,175,772 | 1,877 | 60,953,160 |

The fruit industry (agriculture) is the second largest employment sector in Chelan County, and apples are the largest crop. The primary fruit-growing areas are located along the Columbia and Wenatchee River valleys, where water is available for irrigation.

Government is the third largest employment sector in Chelan County, with education accounting for half of the sector employment. State government employment includes employees of the local school districts, a community college, and the WDOT. Federal employment is primarily associated with the Wenatchee National Forest.

Alcoa Inc. owns and operates an aluminum smelter (Wenatchee Works) in Chelan County, Washington. Aluminum smelting is electricity-intensive and, at full operation, Wenatchee Work's electric demand is approximately 334 MW. In its March 14, 2005, filing with the Commission, Alcoa Inc. states that it has a long-term power supply contract with Chelan PUD to purchase power for consumption at Wenatchee Works.

In Douglas County, agriculture is the largest employment sector, with apples and other fruit as the primary crops. Most of the orchards in the county are located along the Columbia River. The county also has large areas on the Columbia plateau in dry land and irrigated wheat production.

Government is the largest non-agricultural sector in Douglas County, with 87 percent of employment in local government, most of which is devoted to education.

In Douglas County, as in Chelan County, most service-sector employment is in health care. Other service-sector and retail employment supports local businesses and residents and is less dependent on tourism than Chelan County.

Because of the predominance of agriculture in Chelan and Douglas counties, their unemployment rates tend to vary with the agricultural seasons. For example, Washington Employment Security Department (2002) data indicate that Chelan County's unemployment rate in January 2001 was 11.9 percent, rose slightly in February, and decreased to 6.0 percent in July during the peak cherry harvest and remained at 6.0 percent through October due to the apple harvest. Douglas County's unemployment rate showed a similar trend.

Washington Employment Security Department (2002) data also indicate that in 2001 9.5 percent of the population of Chelan County was unemployed, and 8.8 percent of the county population was determined to be below the poverty level. In Douglas County, 7.6 percent of the population was unemployed, and 11.2 percent was determined to be below the poverty level.

#### 3.10.1.2 Project Relationship to Socioeconomic Resources

Chelan PUD and the Social Science Working Group developed a study plan to document current and recent historical economic conditions, as well as the relationship of the project to the economies of Chelan and Douglas counties. The Socioeconomic Study Report (McHugh and Associates, 2000) focuses on the influence of the project on specific industrial and agricultural sectors, as well as communities, within the two counties.

The study indicates that the agriculture sector, which receives water from the project reservoir for irrigation, contributed total (direct, indirect, and induced) output in 1999 amounting to $166.3 million to the two counties. Total employment and earnings associated with agriculture amounted to 2,550 jobs and $47.9 million in earnings, with average annual earnings of $18,803.

Alcoa Inc., a metals manufacturing employer, generated total output of approximately $254.9 million in 1999. The associated employment and earnings amounted to 1,365 jobs and $53.5 million, respectively, with average earnings of $39,198. Alcoa Inc.'s Wenatchee Works employs about 381 people. In its March 14, 2005, filing, Alcoa Inc. states that renewal of Chelan PUD's license for the Rocky Reach Project is critical to sustaining this employment. Alcoa Inc. states that, without continuing access to cost-based power from the project, the company would be forced to seek a power supply in the market place, and that the price would be too high for the company to sustain operations at Wenatchee Works.

Public utilities and electric services providers in the two-county region contributed a total of 307 jobs (including direct, indirect, and induced employment components) and $11.4 million in earnings. These jobs and earnings are associated with power distributed to other industrial customers from direct allocations (approximately 15 percent of power generated is allocated to Chelan PUD and Douglas PUD) of electricity generated at the project.

The study estimated that the tourism and recreation industries, which depend in part on facilities at the project dam and along the project reservoir, generated total (direct, indirect and induced) output of $42.9 million in 1999. The associated employment and earnings amounted to 1,108 jobs and $15.3 million, respectively, with average earnings of $13,802.

The economy of Orondo, a small rural center located on the east side of the project reservoir in the unincorporated portion of Douglas County, depends on agriculture, tourism, and recreation and was affected by reservoir inundation associated with project construction. Chelan PUD compensated Orondo landowners with a total payment of $61,500 at the time of construction.

The downtown area of the city of Entiat, located on the west side of the project reservoir in Chelan County, was relocated to accommodate the initial development and inundation of the project. When the project began operations, Chelan PUD compensated landowners that were affected by dam construction and subsequent reservoir inundation. In addition, Chelan PUD provided infrastructure in upland areas of the town site. Chelan PUD paid a total of approximately $3.1 million from 1956–1961 in compensation to property owners and provided planning assistance to the city of Entiat during this period. In addition, Chelan PUD made payments for legal assistance and infrastructure development totaling approximately $426,000.

Relocation of the downtown core of Entiat changed the character and the economic welfare of the community during subsequent decades. The community experienced modest improvements in economic conditions, particularly in the real estate market, during the 1990s. A detailed analysis of the relationship of the project to the city of Entiat and Entiat School District No. 127 is provided in the appendix of the Socioeconomic Study Report (McHugh and Associates, 2000).

*Environmental Justice*

On February 11, 1994, President Bill Clinton signed Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." In the memorandum that accompanied Executive Order 12898, the memorandum stated that each federal agency shall analyze environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by NEPA.

When considering environmental justice under NEPA, the Council on Environmental Quality (1997) provides guidelines to assist federal agencies so that environmental justice concerns are identified and addressed. For the Rocky Reach Project, we assess potential environmental effects of the proposed project on minority and low-income communities, including Indian tribes.

For Chelan and Douglas Counties, the Hispanic community comprises 19.3 percent (12,831) and 19.7 percent (6,433) of the counties' population, respectively, compared to the state average of 7.5 percent and the national average of 12.5 percent. American Indian and Alaska Native comprise of 1.8 percent (1,187) and 1.9 percent (622) for Chelan and Douglas Counties, respectively (U.S. Bureau of the Census, 2000).

### 3.10.2 Environmental Effects

Chelan PUD made no proposals that pertain directly to socioeconomic resources within the project boundary.

In their comments on the PDEA, CRITFC recommends that Chelan PUD conduct an analysis on the effects of relicensing alternatives on tribal socioeconomics. CRITFC indicates that construction and operation of the project transferred wealth from tribal people to non-tribal peoples due to the loss of salmon resources.

*Our Analysis*

The project is operated to optimize use of the water resource to produce electric energy while taking into account the irrigation, recreation, fish and wildlife, flood control, and other beneficial uses of the resource. The project provides low-cost power to its customers, which provides a benefit to residents of Chelan and Douglas counties. The project has had a positive socioeconomic effect on the agricultural, basic metals (aluminum) manufacturing, tourism, and recreation industries and on the region. The city of Entiat and some lands in the area of Orondo were affected by the initial development of the project. However, during the period from 1958 through 1961 when the project began operations, Chelan PUD compensated affected property owners monetarily and provided funding for planning assistance.

Project operations under a new license would not change substantially from existing conditions, although there would be increased costs associated with fish mitigation, implementation of other environmental measures, and plant operations. Energy generation would continue at current levels. As such, the proposed project would not have adverse effects on the cost structure associated with dam operations or create adverse effects on socioeconomic resources in the region. In contrast, proposed measures, such as HCP implementation and implementation of management plans for anadromous and resident fish, could increase the quality of the existing fishery and enhance the recreational resource. These measures could attract new visitors to the area, and, in this way, contribute positively to the socioeconomic resources of Chelan and Douglas counties.

CRITFC's recommendation for further analysis of tribal economics does not appear to provide new information in our consideration of the environmental effects of proposed measures. Insofar as proposed environmental measures protect and enhance anadromous fish that reach project waters, Chelan PUD's proposal would have some positive effect on tribal socioeconomic conditions.

Based on available information including the Settlement Agreement, we find that the proposed project would have no adverse socioeconomic impact on minority and low-income communities within the project area.

### 3.10.3 Unavoidable Adverse Impacts

None.

## 3.11 EFFECTS OF NO-ACTION ALTERNATIVE

Under the No-Action Alternative as defined by the staff, the project would continue to operate as it is currently, with no further implementation of the HCP. There would be no significant change to the existing environmental setting or project operation. No new environmental measures, including those contained in the Settlement Agreement, would be implemented.

## 3.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Our recommended action alternative to relicense this existing project would not irreversibly or irretrievably commit any significant developmental or nondevelopmental resources in the basin. At any point in the future, project facilities could be modified or removed and any operational effects altered. There is no major new capacity or construction proposed or recommended that would commit lands or resources in an irreversible manner.

## 3.13 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Our recommended operating alternative for the project is expected to provide an average of 6,043,800 kWh of energy each year to the region. This long-term energy productivity would extend for at least as long as the duration of the new license. Our recommendations are designed to minimize or avoid long-term decreases in biological productivity of the system, as well as enhance aquatic habitat and local and regional recreational opportunities.

If the project were operated solely to maximize hydroelectric generation, there could be a loss of long-term productivity of the river fisheries due to decreases in fish passage. Moreover, many efforts to enhance recreational opportunities at the project would be foregone.

With the proposed operating mode, as well as with proposed and recommended enhancement and protection measures, the project would continue to provide a low-cost, environmentally sound source of power. The project, with our recommended measures, would further many of the goals and objectives identified by agencies, tribes, and other interested parties.

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